ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

FAKULTA DOPRAVNÍ

DAMIR KUCHKAROV

DEVELOPMENT OF OJTI TRAINING METHODOLOGY IN THE COUNTRIES OF THE THIRD WORLD

Bakalářská práce

Praha 2021

CZECH TECHNICAL UNIVERSITY IN PRAGUE
Faculty of Transportation Sciences
Dean's office
Konviktská 20, 110 00 Prague 1, Czech Republic

K621 ..... **Department of Air Transport**

BACHELOR'S THESIS ASSIGNMENT

(PROJECT, WORK OF ART)

Student's name and surname (including degrees):

Damir Kuchkarov

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

B 3710 – PIL – Professional Pilot

Theme title (in Czech): **Návrh metodiky výcviku OJTI v zemích 3. světa**

Theme title (in English): Development of OJTI Training Methodology in the Countries of the Third World

Guides for elaboration

During the elaboration of the bachelor's thesis follow the outline below:

- The goal of the thesis is to compare the methodology of ICAO and EASA in the development of requirements for the training of Air Traffic Services personnel, namely for the OJTI group and on the example of Kazaeronavigacia, design procedures for OJTI training for the countries of the Third World.
- Further requirements on the theses elaboration are as follows:
- Conclude an analyses of ICAO and EASA methods setting training requirements for air traffic control personel. Determine best practice of above mentioned organizations in their approach to Air Traffic Services personell training.
- Based on the results of the analysis and the requirements of the National Kazakhstan Regulator propose an OJTI training methodology for Kazaeronavigacia.
- Compare the proposal with training organizations within EASA region and validate the proposal, deliver an economic analyses of the proposed methodology and in conclusion, recommend the operationally and economically most suitable OJTI training method.

Graphical work range: Acoording to the instructions of the supervisor

Accompanying report length: Minum 35 text pages (including figures, graphs and sheets which are a part of the main text)

Bibliography: ICAO, Annex 1, Procedures For Air Navigation Services - Training - (Doc 9868)

Commission Regulation (EU) 2015/340

Bachelor's thesis supervisor: **Ing. Terézia Pilmannová, MBA**

Date of bachelor's thesis assignment: **October 09, 2020**
(date of the first assignment of this work, that has be minimum of 10 months before the deadline of the theses submission based on the standard duration of the study)

Date of bachelor's thesis submission: **August 9, 2021**
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

L. S.

doc. Ing. Jakub Kraus, Ph.D.
head of the Department of

doc. Ing. Pavel Hrubeš, Ph.D.
dean of the faculty

I confirm assumption of bachelor's thesis assignment.

Damir Kuchkarov
Student's name and signature

Prague ..... October 09, 2020

Abstract

The subject of the bachelor thesis „Development of OJTI training methodology in the countries of the third world“ is the proposal of the methodology for preparing a training course for the third countries. The thesis analysis differences between the traditional ICAO approach in course creation and the standardized Eurocontrols approach. The proposed methodology will combine the step-by-step ICAO approach with the target population analysis and apply Eurocontrol's best practices. The result of the work is a proposed methodology for an exampled third country, with the possibility of further development of a training course.

Keywords: ATC, OJTI, Methodology, Competency.

Abstrakt

Předmětem bakalářské práce „Návrh metodiky výcviku OJTI v zemích třetího světa“ je návrh metodiky pro přípravu vzdělávacího kurzu ATC-OJTI pro třetí země. Práce analyzuje rozdíly mezi tradičním přístupem ICAO při tvorbě kurzu a standardizovaným přístupem Eurocontrolu. Navrhovaná metodika bude kombinovat step-by-step ICAO metodu, včetně analýzu cílové populace a bude uplatňovat osvědčené postupy Eurocontrolu. Výsledkem práce je návrh metodiky pro třetí zemi s možností dalšího rozvoje vzdělávacího kurzu.

Klíčová slova: ATC, OJTI, Metodologie, Competence

Acknowledgement

At this point, I would like to thank my family, who supported me throughout my studies. Furthermore, I would like to express my gratitude to my thesis supervisor for her patience and help with the topic elaboration. I would also like to thank all the subject matter experts from Latvia and Kazakhstan for providing me valuable information from their long-standing experience.

Declaration

I hereby declare that the presented thesis is my own work and that I have cited all sources of information in accordance with the Guideline for adhering to ethical principles when elaborating an academic final thesis.

I acknowledge that my thesis is subject to the rights and obligations stipulated by the Act No. 121/2000 Coll., the Copyright Act, as amended, in particular that the Czech Technical University in Prague has the right to conclude a license agreement on the utilization of this thesis as a schoolwork under the provisions of Article 60 (1) of the Act.

In Prague, 3d of August 2021 . . . . . .

Signature

Contents

List of Abbreviations

ANSP	Air navigation service provider
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATS	Air Traffic Service
CATC	Civil aviation training centre
CCC	Common Core Content
EASA	European Union Aviation Safety Agency
ECAC	European Civil Aviation Conference
EUROCONTROL	European Organisation for the Safety of Air Navigation
ICAO	International Civil Aviation Organization
KSA	Knowledge, Skills, Attitudes
LoA	Level of Accomplishment
OJTI	On-the-Job Training Instructor
OJT	On-the-Job Training
STDI	Synthetic training device instructor
TF-CCC	Task Force Common Core Content

1.Introduction

There is no doubt that the pilot largely depends on how skillfully the air traffic controller performs his functions during the flight. When a pilot does not hesitate in the reliability of air traffic services, he will not be distracted from performing his tasks when flying over any country in the world. Since the instructor is the main participant in the practical training of any civil aviation specialist, the compliance of his qualifications with the established requirements and best operating practices is the key factor that ultimately lays the foundation for the safe operation of an aircraft flight. Recent changes in ICAO documents, based on the good operating practices of EASA and Eurocontrol, have been the main impetus for the analysis and development of proposals for improving the methodology for the training of controller-instructors (OJTI).

For the global safety and simplification of work, it is thought, that it is important to create a single standardized training system for aviation experts. ICAO offered a world general view on the creation of training courses; it was aimed at demanding knowledge only needed to gain the license. It should also be borne in mind that every nation has its own mentality and preferred ways of learning, which were built on their cultural habits for centuries. Implementation of the best European practices into the ICAO`s course creation methodology will offer third countries to skip years of “trials and errors” and will start a path to the single standardized worldwide course creation methodology.

This thesis aims to propose the training methodology for ATC-OJTI by the implementation of Eurocontrol`s methodology into ICAO`s competencies frameworks while taking into account local legislation and their requirements. There will be taken one third country on an example of Kazakhstan, without an ATC-OJTI training course. This thesis deals with the methodology part of course creation. This study neither deals with training project planning nor with the creation of a study schedule.

This Thesis is focused only on one selected group of ATCO – it is ATC-OJTI. ATC-OJTI - Air traffic controller On-the-Job Training Instructor, these instructors have the skills and competency necessary to help student controllers and trainees to progress toward a successful conclusion of on-the-job training.

2. Comparison of the ICAO and EASA methodologies for ATS personnel.

2.1 Background

In this part, there is an approach of ICAO and EASA (Eurocontrol) explained in course creating methodology, including single parts of the ATC training. The beginning of this part describes why Kazakhstan had been chosen as a model country.

It is necessary to consider the difference in approaches of two organizations in the development of courses, as countries following EASA use the methodology of Eurocontrol CCC (Common Core Content), while third world countries such as Kazakhstan since not regulated by EASA, use the ICAO competencies frameworks, which require the development of initial stages of the training course.

The need to change the principles of training in third countries and integrate them into the regular comprehensive training programs for ATCOs who will be undertaking OJTI duties, arose as a result of the global introduction of a qualification system of training and evaluation for air traffic controllers and OJTIs taking into account the introduction of adoption of Amendment 176 to Annex 1 — Personnel Licensing and Amendment 7 to the Procedures for Air Navigation Services — Training (PANS-TRG, Doc 9868)[1][30], in this documents air traffic control on-the-job training instructors provisions have been introduced.

Such a training course must have a focus on operational practices, using national regulations and procedures, industry requirements, referencing ICAO Standards and Recommended Practices (SARPs) and guidance materials, as well as EASA (Eurocontrol) practices in this area.

Kazakhstan is a good example for proposing an OJTI training methodology since there was a state reform referred to as “100 steps” launched, wherein paragraph number 68 an intention to improve the efficiency of public regulation of air transport has been stated, in order to increase the attractiveness of air transit through Kazakhstan. According to the mentioned reform, the activities of the Civil aviation authority of Kazakhstan shall be oriented on the British national Civil Aviation Agency and Eurocontrol.[33]

The ANSP of the Republic of Kazakhstan still doesn’t have an OJTI Training course in the training curriculum and the main cause of the problem is that there was no competency framework for ATC OJTIs to be used for a course’s development so far.

The ICAO competency framework identifies the competencies required for a specific aviation discipline with the associated description and observable behaviors for performing the

professional tasks. [22]

The following should be considered as causes of the problem:

– applying the traditional approach to ATC training, which is based on the local requirements for the issue of the license and ATC ratings.

– the shortage of experts qualified for competency-based training and assessment principles application in unit training of student ATCOs.

– limited sharing of the experience accumulated by OJTIs in the different regions of Kazakhstan.

A competency-based training program for Air Traffic Controller Officers (ATCOs) shall include on-the-job training (OJT), under the supervision of a qualified on-the-job training instructor (OJTI), to ensure that the competencies appropriate to the duties are consistently achieved. Given OJTI duty is related to licensing of operational safety and personnel, it is essential to provide training for such specialists in accordance with objectives aligned with the ICAO competency framework for ATC OJTIs. Such training ensures that sufficient qualified and current aviation professionals manage and support the international air transport system. Moreover, ATCOs managing and operating ATS systems must have a shared understanding of what is expected from them in terms of performance, wherever they may work, in order to support a globally interoperable system and to achieve optimum capacity within acceptable safety limits.

2.2 ATC Training

Training of air traffic controllers is divided into a number of defined phases [3][10][14]:

- ***Initial training*** is provided in an establishment designed or designated specifically for training and staffed for that purpose, divided into Basic and Rating.
    - **Basic training** – the main goal is to build fundamental knowledge and skills to enable the student to progress to specialized ATC training.
    - **Rating training** – specialized ATC training that provides the knowledge and skills related to a job category (e.g. Area or Approach control). [3]
- ***Unit training*** is delivered in an operational work environment and is following institutional training. It is divided into 'transition training', 'pre-OJT training', and 'OJT training'.
    - **Transition Training** - phase following the rating training during which site-specific theoretical knowledge and understanding will be transferred to the trainees using a variety of methods and during which skills will be developed through the use of site-specific simulations.

- **Pre-On-the-Job Training (Pre-OJT)** is a phase of locally-based training with extensive use of simulation with site-specific facilities. This enhances the evolution of previously acquired routines and abilities to an exceptionally high level of achievement.
- **On-the-Job Training (OJT)** is 'Live training' where previously acquired skills and routines are further developed and consolidated in a live situation under the supervision of an OJTI. [3]

- ***Continuation training*** is a part of training to enable operational ATCOs to maintain the validity of their license and enhance their existing competencies.
  - **Refresher training** – it is designed to review, reinforce and/or enhance the existing competencies of ATCOs to provide a safe flow of air traffic.
  - **Conversion training** - designed to provide knowledge, skills, and attitudes appropriate to a change in the operational environment. Conversion training may be provided for changes to operational procedures and/or systems. [3]
- ***Development training*** – This kind of training provides additional knowledge and skills demanded by a change in the job profile. Development training stands for OJTI (on-the-job Training instructor), Assessor, Supervisor, etc.

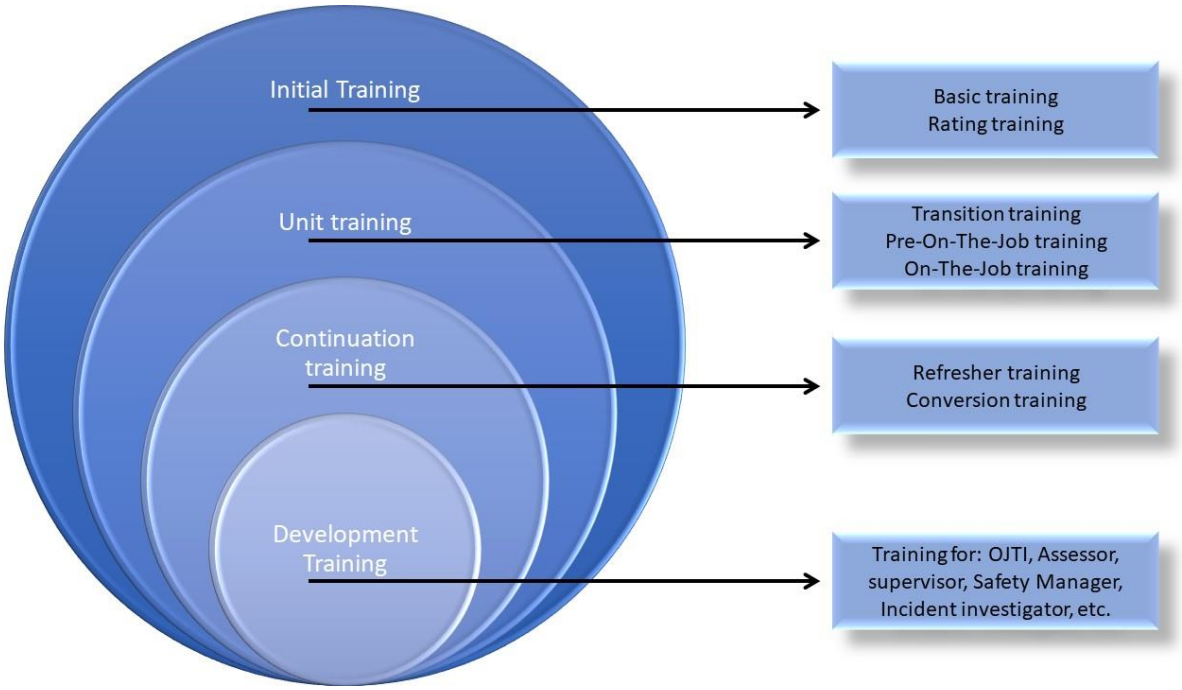

Figure 1: Phases of ATC training [14]

2.3 ICAO and EASA Requirements

The International Civil Aviation Organization points out the minimum requirements, but the actual content of any training program and the time spent on each individual subject vary greatly, depending on the requirements of the Air Traffic Services (ATS) Organization of any particular country.

In Europe, the European Air Traffic Control Harmonization and Integration Program (EATCHIP) (later the European Air Traffic Management Program-EATMP) Task Force on Common Core Content (TFCCC) formulated "Eurocontrol's' ATCO Common Core Content Initial Training Specification's" with the detailed description of The topics, subtopics, and subjects to be dealt with in a basic controller training. [2]

ICAO	EASA
1. Annex 1, 2. Doc 9868 PANS-TRG, 3. Doc 10056.	1. Regulation (EU) 2015/340, 2. ED Decision 2015/010/R (AMC&GM), 3. Eurocontrol Guidelines for ATCO Development Training OJTI Course Syllabus.

Table 1: ICAO and EASA documents, from which are requirements for the Instructors generated

2.4 ICAO competency-based methodology

ICAO`s official definition of Competency-based training and assessment is that they are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards. [30]

ICAO's modern methodology of competency-based training and assessment consists of several stages, each of which addresses specific tasks that are required for curriculum development, material development, practical and test assignments. Competency-based training and assessment are characterized by a performance orientation, emphasis on standards of performance and their measurement, and the development of training to the specified performance standards. (from doc. 9868 PANS-TRG)

When developing a training course methodology, it is very important to correctly define knowledge, skills, and attitudes (KSA). KSAs are what a performer requires to perform, their underlying knowledge, underlying cognitive, psycho-motor skills, and attitudes.

2.5 Knowledge, skills and attitudes (KSA)

2.5.1 Knowledge is an outcome of the learning process, whether learning occurs in formal or informal settings. There are different types of knowledge: declarative (e.g. facts and raw data),

procedural (e.g. categorized/ contextualized and application of conditional if-then rules), strategic (e.g. synthesis, inference to guide resource allocation for decision making, problem-solving, and behavioral action), and adaptive (e.g. generalization, innovation, and invention).

2.5.2 Skill is the ability to perform an activity or action. It is often divided into three types: motor (an intentional movement, involving a motor or muscular component, that must be learned), cognitive (any mental skill used in the process of acquiring knowledge), and metacognitive skills (the ability of learners to monitor and direct their own learning processes).

2.5.3 Attitude is a persistent 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. Attitudes have affective components, cognitive aspects, and behavioral consequences. To demonstrate the "right" attitude. [30]

2.6 Training development methodology stages:

The ICAO course development methodology uses a systematic approach to training development. It has three main categories – Analysis, Design and Production, and Evaluation. The categories are subdivided into nine steps. All the names of each step are provided in the table below:

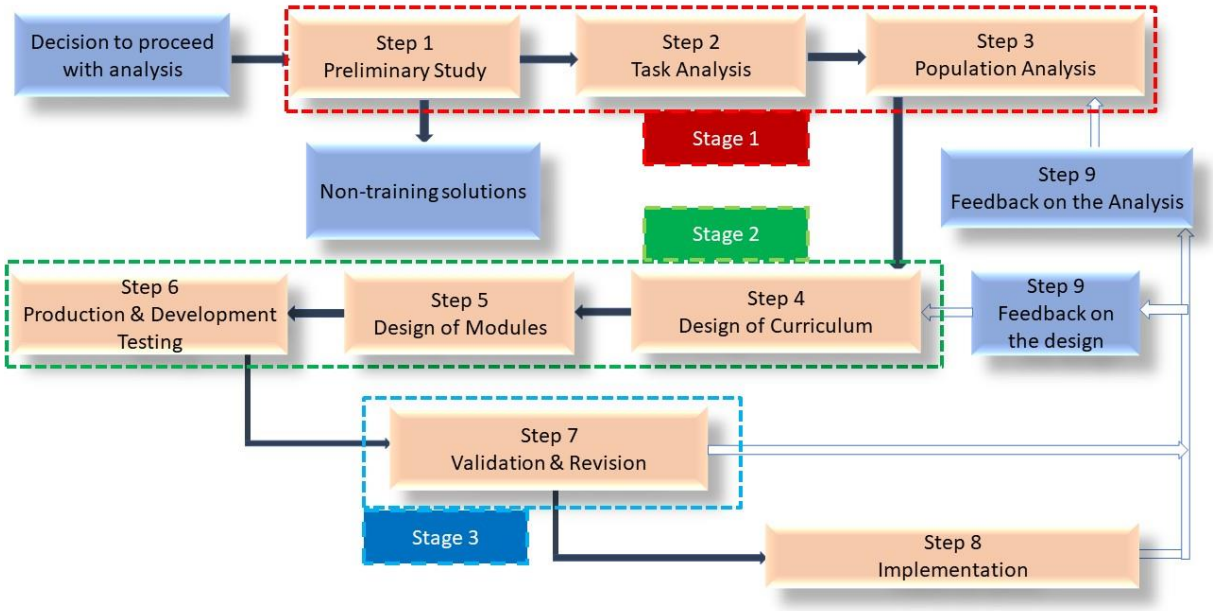

Figure 2: Training development stages by ICAO [29][30]

2.6.1 Stage 1 – Analysis

Step 1 – Preliminary Study.

The purpose of this stage is to provide management with the information needed to decide, it

there is any need for training, and if so, what training strategy to use. It consists of two sets of related activities: problem analysis and training need analysis. Work performance issues are usually detected. To accurately define problems, a system approach method is used to identify symptoms, system and affected systems, and their causes.

This step is designed to provide answers to the following questions:

- what exactly is the problem that training is expected to solve?
- what causes it?

Step 2 – Task Analysis.

In this step, the job is analyzed systematically in order to determine the performance requirements of each task and, from these, define the knowledge, skills, and attitudes (K/S/A) required by employees to perform tasks at acceptable levels of competence. These "standards" of job performance are defined during Job Analysis. The focus of the training program is on enabling employees to perform tasks competently and not only to "learn about" or "understand" the subject matter.

Step 3 - Population Analysis

In this step, information is gathered about the target population of future trainees. It is needed to identify how much knowledge and skill future trainees already have as well as their educational background, their preferred learning styles, and their social and linguistic environments, given that such factors can have an impact on designing the training modules (Step 5).

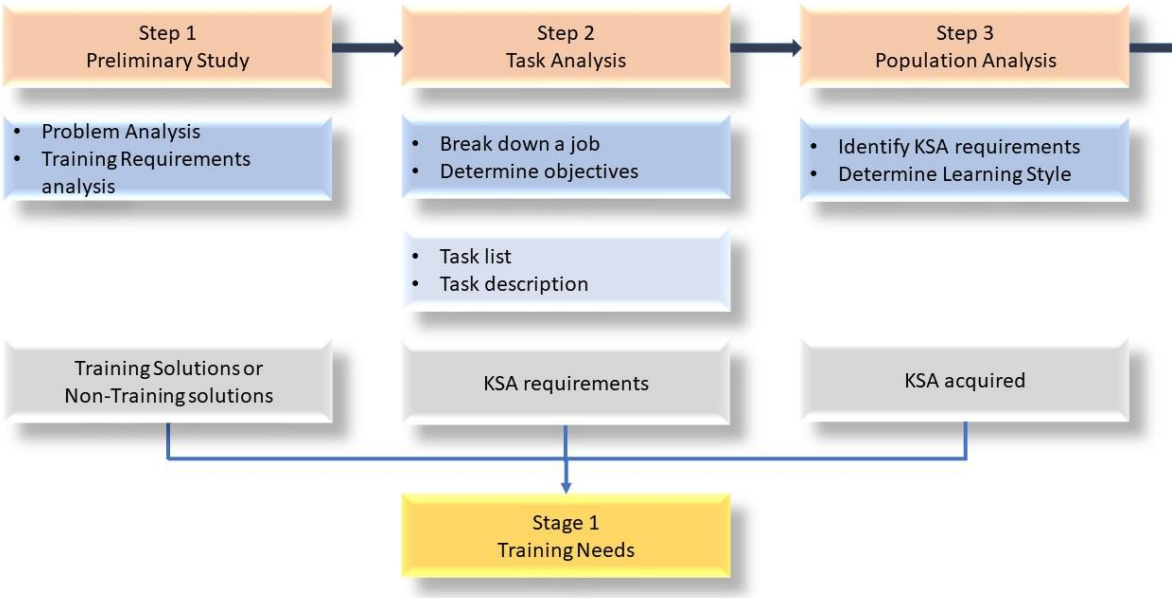

Figure 3: Stage 1 steps and their short description [29][30]

2.6.2 Stage 2 - Design and Production

Step 4 – Design of Curriculum.

With the information obtained during the Analysis stage, phase of the design of the curriculum of the future training course will be initiated. This is done through a process called sequencing, whereby subtasks from the Job Analysis, written in the form of intermediate (performance) objectives, are grouped into training modules which are in turn put into a logical training sequence.

Objectives describing the performance to be achieved at the end of each module, known as end-of-module objectives, are then prepared.

The creation of the training methodology part ends here, that is why the content of this Thesis covers Step 1 – Step 4, whereas Step 5 – Step 7 represents the creation of exercises, tests, and feedback.

Step 5 – Design of Modules.

In this step, a detailed plan of the training activities for each module is designed. The plan must ensure that trainees will be capable of performing the end-of-module objective to the standard (level of competency) required.

For the first time in the course development process, the detailed contents of each of the teaching points will now be prepared. Only content relevant to achieving the required performance of the end-of-module objective should be included, thus substantially cutting down on training time and resources used, compared with the traditional method of considering the detailed syllabus first. Draft copies of all printed and audio-visual training material are also prepared in this step.

Mastery and progress tests corresponding to the end-of-module objective and to intermediate objectives respectively should be finalized during this step.

Step 6 – Production and Developmental Testing.

When the design parameters of each module have been determined, the production of training material in its final format may begin. To ensure that training material is suitable and effective, it is recommended to organize trying out such items as mastery tests using both skilled and unskilled performers, testing audiovisual programs for clarity and relevance, and ensuring that printed material can be understood by the target population. Any corrections required must be completed before the validation delivery.

2.6.3 Stage 3 – Evaluation

Step 7 – Validation and Revision.

The first delivery of the complete training course must be carefully monitored to determine whether, during the training, the trainees react as they are expected to react and achieve the

end-of-module performance objectives. Results of the mastery tests for each module must be carefully recorded and checked against the standard of performance required. Trainee and Instructor opinions are also gathered and analyzed.

2.7 EUROCONTROL Common Core

EASA and EUROCONTROL have agreed to work more closely to provide EUROCONTROL technical standards to support the implementation of EU regulatory requirements. EUROCONTROL has been providing standards that support a single European sky initiative for many years, but as the EASA regulatory framework evolves toward airports and air traffic management (including oversight), it is crucial to establish a closer relationship with EASA.

The TF-CCC (the Task Force Common Core Content) created a guideline standard, designed, and set of common core contents for Air Traffic Controller training. [4]

The guideline standard included syllabi and training objectives that were common to all ECAC Member States.

A designed phase of training also known as Initial Training – includes Basic and Rating training.

The document became known as the Guidelines for ATCO Common Core Content Initial Training. This document required that Initial Training of ATCOs satisfy, as a minimum, the contents of the Guidelines for Common Core Content Training.

It shall be used as a reference to ensure that all the relevant objectives have been included in the appropriate courses for training providers, who are responsible for creating and developing courses. [14]

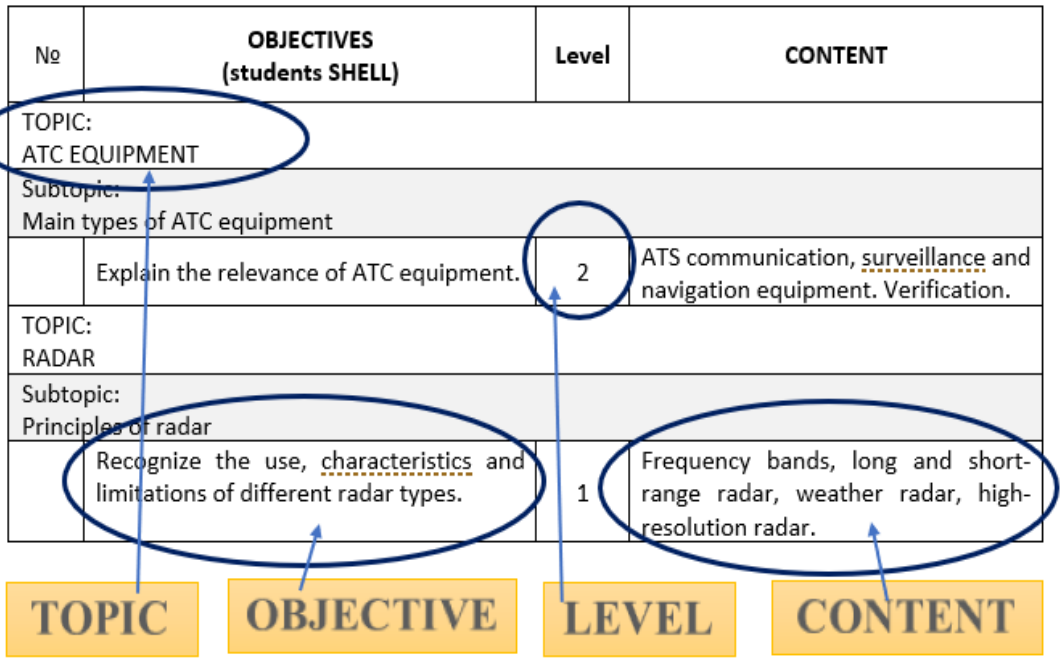

Figure 4: CCC example of topics, use of Levels of Accomplishment [9]

It is important to separately mention **LEVEL** as a list of applied verbs to prepare training objectives and definition for each level of accomplishment (LoA), it will be described in a further chapter of this thesis.

The following aspects should be carefully considered in order to prepare the training course: Training Plans, Training Event, Performance objective, and Competence. [3]

- **Training plans.**

  For Training plans it`s important to set training requirements such as type of training event, schedule, objectives and provide all the educational materials needed, methods, and the way to deliver training plans acting as lectures, lessons, exercises, etc.
- **Training Event**

  It is an element of the training course (lectures, lessons, exercises, etc.), where we interact with students to achieve all the necessary knowledge.
- **Performance objective**

  Is a set of standards of minimum acceptable performance in terms of quality, quantity conditions, and time given for completion of work.
- **Competence**

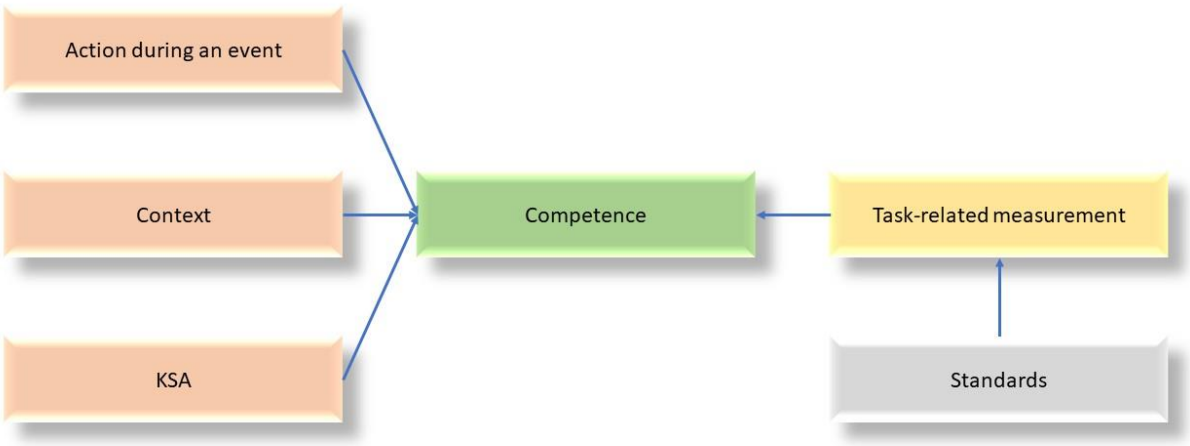

Figure 5: Constituent components of Competence [3]

Competence - required level of knowledge, skills, attitudes, experience, and proficiency in languages in order to maintain the safe and efficient provision of aviation services. [3]

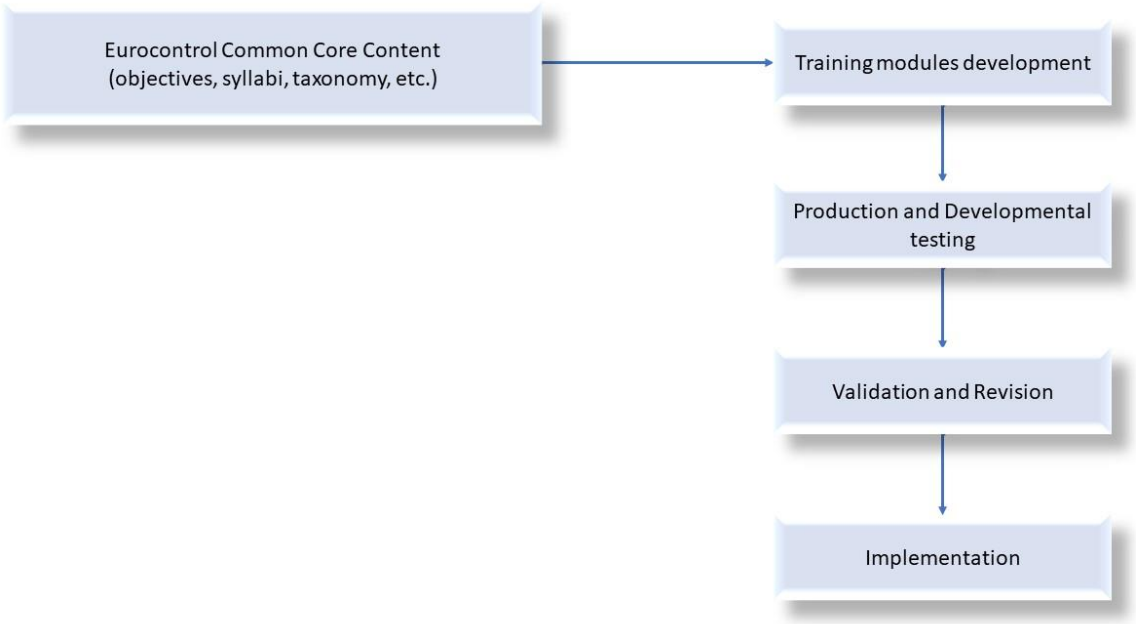

Figure 6: Training development stages by Eurocontrol CCC *[9]*

This approach has ensured versatility of training, achievement of training objectives based on established standards, implementation of national specificities without compromising global requirements, and detailed documentation for training instructors.

3. Conclusion of analysis of ICAO and EASA methods in setting requirements for ATS personnel.

During the analysis of the six main documents (ICAO doc.9868 PANS-TRG, ICAO doc. 10056, Annex 1, Regulation (EU) 2015/340, ED Decision 2015/010/R (AMC&GM), Eurocontrol Guidelines for ATCO Development Training OJTI Course Syllabus), related to the training course creation for ATC`s group, the following differences in a single field were identified:

Subject	ICAO	EASA	Differences
Training syllabus	Competency frameworks for ATC OJTIs provided in Appendix 2 to this chapter shall be used as the basis for the development [30]	This syllabus should be applied by training providers in European Civil Aviation Conference (ECAC) Member States for the development of OJTI Courses in order to meet ESARR 5 requirements in a harmonized way. [7]	ICAO – more autonomous on the side of ANSPs to develop/ revise the syllabus EASA – for the purposes of harmonization requires

Subject	ICAO	EASA	Differences
			common standards applied across ECAC.
Approval of the syllabus by the state authority	Appendix 2 of Annex 1 to the Chicago Convention establishes the need for aviation authorities to approve training curricula (syllabuses) for licensed personnel. [23]	The competent authority shall approve training courses and training plans developed in accordance with the requirements laid down in ATCO.OR.D.001 (Reg (EU) 2015/340). [6]	No differences.
Minimum requirements on the OJTI candidates	Shall hold or have held ATCO license with ratings and be trained in a program based on a competency framework for ATCO OJTI.[23]	Shall hold ATCO license with a valid unit endorsement for at least two years and successfully completed a practical instructional techniques course.[6]	ICAO – establishes the general criteria, defines as the ATCO qualification. EASA – for the purposes of harmonization requires common standards applied across ECAC.
Practical training in the context and environment within which OJTI will provide training required?	The training and assessment plans are relevant to the work of ATC OJTIs in the specific context and environment within which they will provide training.[29]	The training program must include all practical elements that the OJTI performs at the unit.[6]	ICAO – establishes the general criteria for endorsement. EASA – for the purposes of harmonization requires common standards applied across ECAC.
Computer-based training required?	Undefined	Undefined	
Contents of the training specified?	Defined a competency framework for curriculum development [29]	Established competence areas and OJTI Course Syllabus [6]	ICAO – establishes the general criteria for training centers. EASA – establishes requires common standards for training course development across ECAC (common core content).
Number of training hours/	Not specified	Not specified	ICAO and EASA – determined by the

Subject	ICAO	EASA	Differences
days specified?			capabilities of the training organization's program to achieve the training objectives
Final assessment required?	The need for a final exam during training is determined.[30]	Specifies that the training course must include all elements of control over the development of the curriculum and the final exam [6]	ICAO and EASA – defines the need for final assessment.
Continuous assessment applied when holding the OJTI license	Designates that all instructors should receive periodic training at least once every three years [29]	Establishes OJTI endorsement validity for a period of three years and requirements the successfully passing a practical instructor competence assessment within the year preceding the application for renewal. [6]	ICAO – defines General compliance requirements. EASA – for the purposes of harmonization requires common standards applied across ECAC.

Table 2: Differences between ICAO and EASA course development methodologies

A notable difference in almost every comparison point is that ICAO establishes a "general" concept, while EASA has standardized points in different aspects of course creation. The only point described in the table, where ICAO and EASA have identical views is the approval of the syllabus by the state authority.

4. Proposed OJTI training methodology for Kazaeronavigacia

4.1 Procedures for OJTI training for the Third countries (Kazakhstan)

Due to the analysis of documents and consultations with subject matter experts, there were defined several points regarding the training course proposed for Kazakhstan, that were combined into a table below. All the aspects below are created according to the local legislation and national features, together with the EASA and ICAO requirements:

Subject	Description
Who trains.	ATS controllers, who showed their propensity to educative-methodological work, have working experience as ATS Controller not less than 3 years.

Subject	Description
Process of a training	For every trainee, there is a fixed instructor who determines, date of start/end (number of hours) and the goal of the training. Changing the instructor without registration of a special request is prohibited.
The end of a course.	Planning of an intermediate test is not fixed, the controller-instructor should evaluate the progress of a trainee and when according to the controller-instructors opinion his trainee may accomplish more than 50% of a program. The end of a course will decide if a trainee may go for individual work and ready to pass practical exams.
Revalidation and upkeep of a current proficiency level:	It's necessary to revalidate proficiency level if: -Pause in work from 6 to 12 months - going through a simulator and check of the practical skills in a workplace. -Pause longer than 12 months – going through a course of upkeeping of a proficiency level, practical part, theoretical knowledge check. In case, when trainees' level is high, the course may be reduced, but no more than by 70%. -More than 7 years – going through a course of elementary training for rating training
Theoretical and practical knowledge checks:	Theoretical knowledge in the following special areas: -Regulation in the Republic of Kazakhstan -Air traffic service -Rules of radiocommunication and phraseology -Meteorological flight support -Basics of aerodynamics and flight-technical characteristics of airplanes -Navigation flight support -Radiotechnical flight support
Local legislation and features	- Combined Metric and Imperial systems - Region is not using CPDLC. Training and familiarization with CPDLC will not be provided - Regulations in the Republic of Kazakhstan - Local languages: Russian and Kazakh - Languages used during training: English and Russian
Assessment:	Final result – 5 – passed (maximum 2 marks "4", all other "5") Final result – 4 – passed ("3" are not allowed, only "4" and "5") Final result – 3 – not passed + recommendations (there are no "2", but at least one "3")

Subject	Description
	Final result – 2 -not passed (at least one “2”) The course will use the five-point Russian grading system, as it is familiar to the locals since school.
Course Length	According to already existing European practices in OJTI courses, the predicted course duration is 10-12 days.

Table 3: Independent points of course creation and their components

4.2 Stage One of OJTI methodology Development for Kazakhstan

4.2.1 Stage One Step One – Preliminary Study

Based on the results of the analysis, the requirements of the national regulations of the Republic of Kazakhstan, and taking into account that OJTI duty is related to licensing personnel and safety, it is essential to provide training for such specialists in accordance with objectives aligned with the ICAO competency framework for ATC OJTIs. Moreover, as simulation training is part and parcel of OJT and relevant training techniques are necessary to be acquired by OJTI’s, according to the best world practices in the OJTI training course, it has been decided to consider STDI’s (synthetic training device instructors) performance in the course.

Such training can ensure that there will be enough qualified aviation professionals to manage and support the international air transport system. Training should be effective and focused to cultivate only the necessary knowledge, job-related skills, and attitudes in a unit training environment, and eliminate unnecessary training activities.

In order to provide a detailed analysis of the performance requirements, they are broken down into functions, tasks, subtasks, and task elements.

Functions are major subdivisions or “areas” of a job. A function is made up of a series of tasks and the result of the function is the combined result of the tasks that constitute it. Subtasks are specific single actions required to complete the task. Subtasks are also intermediate objectives of training. Because tasks and subtasks are of the measurable or observable outcome, they are defined by means of action verbs.

Action verbs

Action verbs are verbs, that are subdivided according to levels of Accomplishment (LoA) and relate directly to a defined taxonomy for classifying training objectives (highlights numerically the taxonomy level of the action verb). There are five levels defined as follows:

Level 1: A basic knowledge of the subject. It is the ability to remember essential points, to memorize data, and retrieve it.

Level 2: The ability to understand and discuss the subject matter intelligently in order to represent and act upon certain objects and events.

Level 3: A thorough knowledge of the subject and the ability to apply it with accuracy. The ability to make use of the repertoire of knowledge to develop plans and activate them.

Level 4: The ability to establish a line of action within a unit of known applications following the correct chronology and the adequate method to resolve a problem situation. This involves the integration of known applications in a familiar situation.

Level 5: The ability to analyze new situations in order to elaborate and apply one or another relevant strategy to solve a complex problem. The defining feature is that the situation is qualitatively different from those previously met, requiring judgment and evaluation of options. [14]

The use of action verbs for subtasks makes it possible to determine which ones relate to knowledge and which ones to skills or attitudes (K/S/A). This, in turn, helps to establish the types of training activities (lectures, practical exercises, self-study, simulator training, etc.). The summation of the K/S/A's on the different tasks represents all that a trainee must acquire in order to perform the job competently. Information about K/S/A's will serve in building the content of individual parts of the course modules. The identification of the required K/S/A's eliminates any item which is not essential in accomplishing tasks. It helps in determining the level of training required for each teaching point. It also assists in determining training sequences, going from elementary to complex.

A list of example verbs, that is presented below, its main goal is to prepare training objectives and definitions for each level of accomplishment. The following list is not complete, but a guideline only. The examples chosen are specific to the ATCO environment and are quoted from the ATCO CCC Initial Training Specification [14]:

Verb	Definition	Example
Level 1		
Define	State what it is and what its limits are; state the definition	Define the global performance for CVOR and DVOR
Draw	Produce a picture, pattern, or diagram	Draw the block diagram of the transmitter
Quote	A repeat of what is written or said to underline	Quote the ICAO definition of ATC service

Verb	Definition	Example
Recognize	To know what it is because you have seen it before	Recognize on a diagram all the elements of the ADS
State	Say or write in a formal or definite way	State who are the local telecom providers and the service characteristics
Level 2		
Characterize	To describe the quality of features in something	Characterize the consequences of an OS upgrade
Consider	To think carefully about it	Consider institutional issues and service provider responsibilities
Demonstrate	Describe and explain; logically or mathematically proves the truth of a statement	Demonstrate the possible use of GBAS for approach and landing
Describe	Say what it is like or what happened	Describe the architecture of the VOR/ILS working sequence
Explain	Give details about something or describe so that it can be understood	Explain the principles of SSR Pulses
Level 3		
Act	Carry out, execute	Act as a professional
Apply	Use something in a situation or activity	Apply the appropriate model to the analysis of a relevant aviation system
Check	Make sure the information is correct (satisfactory)	Check the operational status of the monitor system
Transfer	Hand over	Transfer information to another controller
Update	Refresh, makeup to date	Update traffic information
Verify	Establish truth of	Verify the impact of the requirements on the location and the type of the ground station
Level 4		
Acquire	Cain by oneself and for oneself; Obtain after research	Acquire relevant aeronautical information
Adjust	Change to a new position, value, or setting	Adjust the antenna system
Ensure	Make safe, make certain	Ensure the agreed course of action is carried out
Integrate	Combine into a whole, complete by the addition of parts	Integrate components adequately

Verb	Definition	Example
Justify	Show the rightness of a choice or of an option	Justify *charges by presenting evidence*
Level 5		
Assess	Estimate value or difficulty, evaluate	Assess flight inspection results
Balance	Weigh (a question, two arguments, etc, against each other)	Balance two control actions
Imagine	Form mental image of, conceive	Imagine possible actions to cope with unusual situations
Solve	Find answer to	Solve separation problems
Theorize	Extract general principles from a particular experience	Theorize principles of ILS
Troubleshoot	Trace and correct faults	Troubleshoot the wrong radial indications of a VOR

Table 4: Examples of action verbs, five for each Level of Accomplishment [14]

4.2.2 Stage One Step Two – Job Analysis

The aim of the job analysis is to determine the functions, tasks, sub-tasks, task elements of specialists performing unit training procedures, the corresponding knowledge, job-related skills, and attitudes required to perform the job. To analyze the OJTI`s job, the following activities were carried out:

- collecting and analysis of documentation relating to the performance of unit training procedures.
- questioning of ATCOs.
- interviewing of Civil Aviation Inspectors of Aviation Administration of Kazakhstan, Heads, and specialists of ATM departments, Heads of ATM Training Sections, as well as OJTIs;

To carry out the activities mentioned above, ICAO and national regulations of Kazakhstan were thoroughly analyzed, after which online meetings had been organized with the experts from the Aviation Administration of Kazakhstan and “Kazaeronavigatsia”. To study good practices of OJTI training procedures implementation in the EASA region, the online consultations were organized with subject matter experts from Latvijas Gaisa Satiksme (Latvia).

The following functions of the job were defined:

1. Organization of training.
2. Training delivery.
3. Evaluation.

Latvia's successful practices in the implementation of EASAs methodology plays a huge role, it shows the way how a post-Soviet Union country had done it.

The considered problem of OJTI job performance refers to three functions defined in the process of job analysis: function 1 - Organization of training, function 2 - Training delivery, function 3 – Evaluation [30].

Function 1 "Organization of training" includes 2 professional tasks:

1. Apply planning procedures for training.
2. Organize required training environment and conditions.

Function 2 "Training delivery" includes 4 professional tasks:

1. Manage the trainee during training.
2. Conduct a training session.
3. Ensure safety and efficiency of the operation during training.
4. Consider human factors principles during training.

Function 3 "Evaluation" includes 2 professional tasks:

1. Evaluate the trainee's performance.
2. Evaluate the efficiency of training.

As a result of the meetings with subject matter experts, the following inference can be drawn, that course should cover all the above-mentioned tasks.

For the convenience of subsequent determination of intermediate objectives, intermediate objectives are sequentially numbered.

4.3 Stage One Step Three – Population Analysis

4.3.1 Description of the target population

Personal data

Population Analysis is about gathering information on the target population (future trainees) in order to identify any KSAs that have already been acquired, determine preferred learning styles as well as the social and cultural environments of the prospective trainees since these can have a significant impact on the choice of training strategies [29].

16 ATCO`s from Kazakhstan were asked to answer 15 questions (Appendix 1). The results of this analysis are described in the following section. The following paragraphs describe the target population, which has been analyzed in terms of personal data, recent training, attitudes towards training, self-study attitude, and preferred ways of learning.

- Concerning age distribution, 31.5% of respondents are 20-29 and 31.5% of responders are 50 or more years old; 25% for 30-39 years old, and the remaining 12.5% are 40-49 years old.
- With regard to work experience in their present job, 56.25% of surveys indicated that they have been on the job for more than 10 years, 12.5% indicated 1-2 years; 25% for 2-5 years, and 6.25% have been on the job for 6-9 years
- Concerning high education, 81.25% of respondents have a university diploma, 12.5% have unfinished university or college studies and 6.25% have completed only a second school.

Recent training

- The survey revealed that 6.25% of the population has not attended any training courses in the last three years, while the 68.75% of the respondents indicated that they had attended 1-2 courses during this period. The remaining 25% indicated that they had attended 3-4 training courses.

Attitudes towards training

- 56.25% of the respondents indicated that all training, they had received, was needed to enable them to do their job. 31.25% answered that only a minor part of the training was irrelevant and most of it was useful. The remaining 12.5% believed that most of the training did not help them to do their job.
- 50% indicated that they knew what and how to do their job upon completion of training, while another 43.65% said that training enabled them to do only a part of their job. However, 6.35% admitted that training courses had not to cover their specialty and the courses were too theoretical.
- Regarding the time ‘on the job’ they needed to learn to perform all their tasks adequately, 43.75% indicated that they needed less than a week, 25% of the respondents needed one week to one month, 12.5% indicated that they needed from 1-3 months, while 6.25% of the respondents needed 3-6 months. It should be noted that the remaining 12.5% stated that they required more than six months to learn how to perform the job.
- When asked to point out some of the things that they did not like about past training, the responses were: lack of practice, a lot of theory and irrelevant information, training was short.
- When asked to point out some of the things that they liked about past training, the responses were: training environment, opportunities to share work experience, practical training on simulators, competent instructors, feedback from the instructors.

Self-study Attitude

- Concerning reading technical literature on their own, 37.5% of the respondents indicated that they do it regularly, while another 37.5% said that they read only sometimes. The remaining 25% seldom or never read technical literature.
- With regard to difficulties in reading handout literature, 37.5% reported very little difficulty, while the majority of the surveys (43.75%) felt that they could manage with some difficulties. The remaining 18.75% stated that they prefer somebody to explain the course material to them.
- The majority (87.5%) of the respondents are good at using computers on an average level, while 12.5% can use them on a high level.

Preferred ways of learning

- It was offered to respondents to assess the efficiency of various training methods and to specify how often each of these methods was used during their training. The results of the analysis are summarized in the table. The most effective is 1, the next most effective is 2, and so on.

	Rank	Frequently	Seldom	Never
Lecture	2	X		
Educational Film	3		X	
E-training	4		X	
Demonstrationnd practical exercises	1	X		

Table 5: Preferred ways of learning according to the survey

- Thus, regarding the effectiveness of different instructional methods, most of the respondents felt that demonstration and practical exercises along with lectures are the most effective method.
- When learning, 68.75% of the respondents prefer to learn the principles first and then the applications, while 31.25% prefer the opposite way. Nobody prefers to learn how to apply it in real life only.

Conclusion of the population analysis

Based on the above results of the questionnaires it is concluded that:

- The educational background and specialized training qualifications of the group are almost identical. In addition, a majority of the target population are between 20 to 49 years of age and have more than 5-10 years of experience.
- The analysis also shows that the group has been exposed equally to demonstration, practical exercises, and lectures, therefore this could be the preferred mode of instruction.
- Regarding the Population analysis questionnaire, it is obvious that the majority of the target population feel that training in their specialty is needed.
- Taking into account that the age category of the target audience varies quite widely - from 20 to 50 years of age or more when determining the teaching methods, the features of perception are necessary to be considered.

4.4 Stage 2

4.4.1 Criteria for evaluating OJTI's performance:

During the consultations with the subject matter experts, there are defined 4 main criteria [30] for each task:

- **Frequency (F).** The indication of how often the task is performed: D – daily, W – weekly, M – monthly.
- **Importance (I).** The indication of the relative importance of a task, which is defined by the seriousness of consequences if the tasks were performed poorly or not at all: NS – not serious, S – serious, VS – very serious.
- **Difficulty (D).** The indication of the difficulty of a task, which determines the probability of performance errors by trained employees: ND – not difficult, D – difficult, VD – very difficult.

  Priority (P). The criterion, which is used to determine the degree of urgency under which the task is required to be analyzed: LP – low priority, P – average priority, HP – high priority.

Task №	Task	Frequency (F)	Importance (I)	Difficulty (D)	Priority (P)
Function 1: Organization of training					
1.1	Apply planning procedures for training	D	S	ND	P
1.2	Organize required training	D	S	ND	P

Task №	Task	Frequency (F)	Importance (I)	Difficulty (D)	Priority (P)
	environment and conditions				
Function 2: Training delivery					
2.1	Manage the trainee during the training	D	S	D	P
2.2	Conduct a training session	D	VS	D	HP
2.3	Ensure safety and efficiency of the operation during training	D	VS	D	HP
2.4	Consider human factors principles during training	D	VS	D	HP
Function 3: Evaluation					
3.1	Evaluate the trainee's performance	D	VS	D	HP
3.2	Evaluate the efficiency of training	D	S	ND	HP

Table 6: Evaluation of tasks by Frequency, importance, Difficulty, and Priority

4.5 Tasks outline

Definition of subtasks and corresponding levels (LoA) is based on the competency framework for OJTI of ICAO Doc 9868 PANS-TRG, considering national regulations and EUROCONTROL Air Traffic Controller Training at Operational Units. It also uses data from the Population Analysis, which is carried out to gather information about the target population (future trainees) in order to identify any KSAs that have already been acquired, determines preferred learning styles as well as the social and cultural environments of the prospective trainees since these can have a significant impact on the choice of training strategies.

The sequence of training objectives in the course is determined as a result of interaction with Subject Matter Experts. Represented below Sub-Tasks are broken into the tables with the corresponding set of the pre-defined K/S/As with the assigned LoA to each. Every LoA in the table is a result of an interaction with the Subject Matter Experts. Different K/S/As are predefined in various documents. All the tables below will show an implementation of what has already been adopted and standardized in Eurocontrol documents and the requirements of the legislation of Kazakhstan into the methodology of creating a training course based on the

competence of ICAO.

Function 1: Organization of training

Task 1.1: Apply planning procedures for training

K/S/A – Knowledge/Skills/Attitudes LoA – Level of Accomplishment

Sub-Task 1: Apply unit training requirements [5][9][23][24][25][26][27][29][30]

K/S/A Requirements	LoA	K/S/A
Characterize regulatory requirements for ATCO	2	**K**
Explain regulatory requirements for OJTI	2	**K**
Determine requirements applicable for OJTI	3	**S**
Follow the requirements	1	**A**

Table 7: Sub-Task 1

Sub-Task 2: Use data on a trainee [9]

K/S/A Requirements	LoA	K/S/A
List types of data on a trainee and their sources	1	**K**
Characterize the procedure for data acquisition on a trainee	2	**K**
Collect relevant information in advance for the purpose of tailoring the training approach and maximizing the productivity of the training	3	**S**
Estimate the trainee's education, previous training, and experience	3	**S**
Demonstrate objectivity when using data on a trainee	2	**A**

Table 8: *Sub-Task 2*

Sub-Task 3: Establish personal contact with the trainee [9][20]

K/S/A Requirements	LoA	K/S/A
State general rules and steps in the establishment of personal contact with a trainee	1	**K**
State principles of interaction with the trainee	1	**K**
Characterize the trainee's qualities	2	**K**
Characterize the trainee's motivation	2	**K**
Act toward the trainee respectfully, fairly, and objectively regardless of differences	3	**S**
Apply techniques of establishing positive working relationships with the trainee	3	**S**

K/S/A Requirements	LoA	K/S/A
Answer questions truthfully without embellishment or attempt to cover up a lack of knowledge	3	**S**
Demonstrate principles of privacy and confidentiality when appropriate	2	**A**
Demonstrate integrity	2	**A**
Demonstrate a positive attitude to the trainee and training process	2	**A**

Table 9: Sub-Task 3

Sub-Task 4: Determine trainee's current level of knowledge, job-related skills, and attitudes [9]

K/S/A Requirements	LoA	K/S/A
Characterize the methods for determining trainee's level of knowledge, job-related skills, and attitudes	2	**K**
Apply the methods for determining trainee's level of knowledge, job-related skills, and attitudes	3	**S**
Demonstrate objectivity when determining trainee's level of knowledge, job-related skills, and attitudes	2	**A**

Table 10: Sub-Task 4

Sub-Task 5: Prepare training program for the trainee [9][29][30]

K/S/A Requirements	LoA	K/S/A
List the source data and limitations considered when developing a schedule for each training phase	1	**K**
Differentiate training objectives for existed ATC units	2	**K**
Characterize standards of performance	2	**K**
Characterize types of simulator exercises and their optimal sequencing	2	**K**
State requirements to the real character and relevance of simulation training	2	**K**
Determine the time period for each training phase	3	**S**
Use data on the instructor's roster for planning a training	3	**S**
Use data on simulator availability for planning a training	3	**S**
Prepare the training program in accordance with the unit training objectives	3	**S**
Demonstrate accuracy when planning	2	**A**
Demonstrate a desire for using the optimal training sessions sequencing	2	A

Table 11: Sub-Task 5

Task 1.2: Organize required training environment and conditions

Sub-Task 6: Take measures to provide an adequate environment and conditions for theoretical training [9][29][30]

K/S/A Requirements	LoA	K/S/A
List environment and conditions necessary for theoretical training	1	**K**
Make sure that the trainee has relevant documentation and training materials	3	**S**
Make sure that a place for training and self-tuition is available	3	**S**
Demonstrate a desire for providing an adequate environment and conditions for theoretical training	2	**A**

Table 12: Sub-Task 6

Sub-Task 7: Take measures to provide an adequate environment and conditions for simulation training [9][14][15][29][30]

K/S/A Requirements	LoA	K/S/A
State requirements to ensure appropriate environment and conditions for simulation training	1	**K**
Describe the operation of a synthetic training device system	2	**K**
Make sure adequate tools and equipment are available for simulation training	3	**S**
Demonstrate a desire for providing an adequate environment and conditions for simulation training	2	**A**

Table 13: Sub-Task 7

Sub-Task 8: Take measures to provide an adequate environment and conditions for operational training [9][15][29][30]

K/S/A Requirements	LoA	K/S/A
State requirements to ensure appropriate environment and conditions for operational training	1	**K**
Describe the operation of the ATS system	2	**K**
Make sure adequate tools and equipment are available for operational training	3	**S**
Demonstrate a desire for providing an adequate environment and conditions for operational training	2	**A**

Table 14: *Sub-Task 8*

Sub-Task 9: Prepare to deliver a tailored training session [9][29]

K/S/A Requirements	LoA	K/S/A
List elements of self-preparation for a training session	1	**K**
Characterize the ways to update knowledge of operational procedures	2	**K**
Use the training program for planning a training session and self-tuition of the trainee	3	**S**
Perform self-preparation for conducting a tailored training session	3	**S**
Make sure of own ability to use training tools and equipment	3	**S**
Demonstrate readiness to help the trainee by means of requesting supplementary resources, when required	2	**A**

Table 15: *Sub-Task 9*

Function 2: Training delivery

Task 2.1: Manage the trainee during the training

Sub-Task 10: Communicate effectively in verbal, non-verbal, and written form [9][12][20][26]

K/S/A Requirements	LoA	K/S/A
Characterize effective communication techniques	3	**S**
Explain complex situations clearly	3	**S**
Explain cognitive strategies clearly	3	**S**
Apply rules of active listening	3	**S**
Encourage constructive discussion about the trainee's performance	3	**S**
Speak clearly, accurately, and in a calm and measured manner	3	**S**
Adjust speech techniques to suit the	3	**S**
Choose the content of communication to the needs of the trainee	3	**S**
Determine the situation when explanations or questions might cause a distraction for the trainee	3	**S**
Ask questions to stimulate learning or to confirm correct understanding	3	**S**
Answer questions correctly and adequately	3	**S**
Demonstrate tact and sensitivity when delivering difficult messages	2	**A**
Demonstrate a positive attitude to a trainee	2	**A**

Table 16: *Sub-Task 10*

Sub-Task 11: Use the trainee management methods and techniques that facilitate learning

[9][13][15][20][29]

K/S/A Requirements	LoA	K/S/A
List methods and techniques that facilitate learning	1	**K**
Characterize effective methods and techniques that facilitate learning	2	**K**
Assist the trainee to build and maintain confidence through encouragement and motivation	3	**S**
Encourage a positive approach to learning	3	**S**
Assist the trainee in self-reflect to identify strengths and weaknesses and areas for improvement	3	**S**
Encourage the trainee to look for positive learning experiences from each training session, even those that did not go well	3	**S**
Encourage the trainee to extract maximum training value from any feedback, including negative points	3	**S**
Encourage the trainee to ask questions as part of the overall learning experience	3	**S**
Use techniques of sufficient repetition of learning activities	3	**S**
Maintain professional relationships with appropriate role boundaries	3	**S**
Take account of the trainee's individual features during training	2	**A**
Demonstrate a positive attitude to the trainee	2	**A**

Table 17: *Sub-Task 11*

Sub-Task 12: Manage fatigue and stress [9][17][18][26]

K/S/A Requirements	LoA	K/S/A
Characterize fatigue and its influence on training	2	**K**
Characterize the symptoms of stress and effects of stress in training	2	**K**
Explain the ways of preventing or reducing stress	2	**K**
Determine fatigue and stress	3	**S**
Respond as needed to deal with the demands of challenging training situation	3	**S**
Demonstrate self-control in challenging training situations	2	**A**

Table 18: *Sub-Task 12*

Task 2.2: Conduct a training session

Sub-Task 13: Apply learning techniques [9][11][13][15][17][19][20][26][29][30]

K/S/A Requirements	LoA	K/S/A
List knowledge and skills necessary for conduction of the training session	1	**K**
Characterize training session objectives and expected performance standards for the trainee	2	**K**
Describe different learning styles	2	**K**
Characterize questioning techniques	2	**K**
State principles of effective feedback	2	**K**
Explain principles of the trainee's error correction	2	**K**
Explain how to determine the strengths and weaknesses of the training session	2	**K**
Notify the goals for the training session, explaining clearly to the trainee the expected performance standards	3	**S**
Make sure training techniques and style meet the needs of the trainee	3	**S**
Maintain appropriate seating position and proximity to the trainee	3	**S**
Apply effectively questioning techniques appropriate to the given situation to ensure that the trainee understands what is required	3	**S**
Confirm understanding of the trainee's intended actions and plans	3	**S**
Monitor the trainee's ability to make decisions appropriate to their level of competence and experience	3	**S**
Respond appropriately to the trainee's behavior	3	**S**
Assist the targeted trainee to develop strategies to overcome any gaps in competencies	3	**S**
Monitor appropriate timing of teaching opportunities	3	**S**
Use training aids adequately	3	**S**
Assist the trainees by providing adequate explanations, recommendations, and other help when they experience difficulties	3	**S**
Give constructive and balanced feedback in a timely and appropriate manner	3	**S**
Determine corrective actions for the given situation	3	**S**
Determine the training session results emphasizing positive actions and areas to be improved	3	**S**
Maintain own situational awareness while instructing	3	**S**
Demonstrate a desire for achieving the training session objectives	2	**A**

K/S/A Requirements	LoA	K/S/A
Demonstrate constant readiness for taking corrective actions in a timely manner	2	**A**
Take into account that the process of training might influence situational awareness	2	**A**

Table 19: Sub-Task 13

Sub-Task 14: Brief the trainee [9]

K/S/A Requirements	LoA	K/S/A
State the importance of briefing	1	**K**
Characterize briefing structure	2	**K**
Inform the trainee about coaching and working conditions	3	**S**
Check if the trainee understands the operational situation prior to assuming control and what is required	3	**S**
Demonstrate a positive attitude to the trainee and training process	2	**A**

Table 20: Sub-Task 14

Sub-Task 15: Demonstrate [9]

K/S/A Requirements	LoA	K/S/A
Characterize demonstration procedures	2	**K**
Involve trainee into the demonstration	3	**S**
Take account of the importance of accuracy in demonstration procedures	2	**A**

Table 21: Sub-Task 15

Sub-Task 16: Debrief the trainee [9]

K/S/A Requirements	LoA	K/S/A
State the importance of debriefing	1	**K**
Characterize debriefing structure	2	**K**
Use records of monitoring and checklist to prepare for debriefing	3	**S**
Determine if the training session objectives have been met	3	**S**
Take account of the importance of following debriefing procedures	2	**A**

Table 22: Sub-Task 16

Sub-Task 17: Keep records [9]

K/S/A Requirements	LoA	K/S/A
List types of records	1	**K**
Explain how to keep records	2	**S**
Demonstrate accuracy when keeping records	1	**A**

Table 23: Sub-Task 17

Task 2.3: Ensure safety and efficiency of the operation during training

Sub-Task 18: Maintain safe and efficient ATS during operational training [9]

K/S/A Requirements	LoA	K/S/A
State principles that ensure safe and efficient ATS	1	**K**
Characterize the influence of operational training processes on safe and efficient ATS	2	**K**
Appreciate the priority of safety above teaching	3	**S**
Ensure traffic efficiency is maintained	4	**S**
Manage own and trainee's workload to ensure safe and efficient operations	5	**S**
Demonstrate a desire to ensure safety is never compromised	2	**A**

Table 24: Sub-Task 18

Sub-Task 19: Ensure intervention into the operational process when required for safety reasons [9]

K/S/A Requirements	LoA	K/S/A
State different methods of intervention	1	**K**
Explain possible reasons for intervention	2	**K**
Determine the need for intervention in a given situation	3	**S**
Act calm when taking control from the trainee in circumstances dictating the intervention	4	**S**
Demonstrate constant readiness for intervention in a timely manner into trainee's actions	2	**A**

Table 25: Sub-Task 19

Task 2.4: Consider human factors principles during training

Sub-Task 20: Appreciate human factors influence on training [24][26][27][29]

K/S/A Requirements	LoA	K/S/A
Characterize human factors principles taken into consideration during training	2	**K**
Identify human factors principles that influence training in a given situation	3	**S**
Take account of human factors principles	2	**A**

Table 26: Sub-Task 20

Sub-Task 21: Use effective methods of interaction within a team [9][17][18][26]

K/S/A Requirements	LoA	K/S/A
Explain factors defining teamwork efficiency	2	**K**
Explain the impact of individual coaching styles on the trainee	2	**K**
Explain principles of conflict resolution	2	**K**
Apply methods of interaction within a team efficiently	3	**S**
Use effective conflict resolution methods in a given situation	3	**S**
Follow effective methods and principles of interaction within a team	2	**A**
Demonstrate flexibility in choosing conflict resolution method	2	**A**

Table 27: Sub-Task 21

Function 3: Evaluation

Task 3.1: Evaluate the trainee's performance

Sub-Task 22: Apply evaluation procedures of the trainee performance [9][20][29][30]

K/S/A Requirements	LoA	K/S/A
Characterize evaluation principles of the trainee performance	2	**K**
Characterize assessment methods	2	**K**
Collect factual evidence of the trainee's performance against the objectives	3	**S**
Evaluate the trainee's performance in relation to the competencies and previously set goals and performance standards	3	**S**
Encourage the trainee to perform self-assessment of achieved results against training objectives	3	**S**
Analyze poor performance to determine root causes, when appropriate	3	**S**
Demonstrate use of standards when assessing performance	2	**A**

Table 28: Sub-Task 22

Sub-Task 23: Prepare a training report [9][29][30]

K/S/A Requirements	LoA	K/S/A
List the elements of a training report	2	**K**
Record information by writing an objective and comprehensive report on the trainee's performance	3	**S**
Take account of the importance of a clear and factual training report	2	**A**
Demonstrate accuracy when writing a report	2	**A**

Table 29: Sub-Task 23

Task 3.2: Evaluate the efficiency of training

Sub-Task 24: Perform self-evaluation of the effectiveness of actions to improve performance [9][20][29][30]

K/S/A Requirements	LoA	K/S/A
Characterize elements of the instructor's self-evaluation	2	**K**
Use accurate and balanced feedback to improve performance	3	**S**
Demonstrate open attitude to feedback	2	**A**

Table 30: Sub-Task 24

Sub-Task 25: Apply evaluation procedures of training efficiency [9][29][30]

K/S/A Requirements	LoA	K/S/A
State strengths and weaknesses of the training process	1	**K**
Determine the influence of strengths and weaknesses on training efficiency	3	**S**
Recommend measures to improve training	3	**S**
Follow training evaluation procedures for training improvement	2	**A**

Table 31: Sub-Task 25

During the creation of these tables, the following criteria were used: the logical sequence of OJTI tasks/sub-tasks performance, the specificity of the target population (for example, preference to study regulatory before procedures). Further description is provided below.

4.6 Course Description

Course Aim

The course will provide air traffic controllers with the necessary theoretical knowledge, practical skills, and attitudes to perform OJTI/STDI duties in a unit training environment. The expected length of training is 10-12 days.

Course Objectives

Upon successful completion of the course, the participants will be able to:

- apply planning procedures for training.
- organize required training environment and conditions.
- manage the trainee during training.
- conduct a training session.
- ensure safety and efficiency of the operation during training.
- consider human factors principles during training.
- evaluate the trainee's performance.
- evaluate the efficiency of training.

4.6 Course Content

According to the EUROCONTROL Specifications on Training Methods and Tools there were defined several training techniques that will be used during the training course [15]:

1. Lectures
2. Lesson/demonstration
3. Guided group discussion
4. Role play
5. Case studies
6. Games and simulations
7. Supervised practice
8. E-training
9. Independent study

4.7 Facilities and Equipment

According to the EUROCONTROL Simulations Facilities for Air Traffic Control Training there were defined specifications of Facilities and Equipment needed for the training course [13]:

Facilities and Equipment	Quantity
Classroom	1
ATC simulator	1
Smartboard	1
PC projector	1
Speakers	1
Screen	1
Whiteboard	1
PC/laptops	Per trainee

Table 32: Quantity of Facilities and equipment needed

5. Comparison of the proposal with training organizations within EASA region and economic analysis

5.1 Training organizations within EASA region

For the comparison of training course methodology proposed in this Thesis there had been chosen two organizations within EASA region: EUROCONTROL Training Zone and Entry Point North (Entry Point North is one of the largest ATS academies in the world, that delivers ATS training).

5.1.1 Content of EUROCONTROL Training Zone course

According to the official sources, the single objectives of the EUROCONTROL Training Zone [31] course are:

- Course introduction and Overview
- Coaching Video
- Learning Theory
- Communication with trainees
- Briefing
- Demonstration and Involvement
- Monitoring and note-taking
- Intervention
- Human behavior in Training
- Debriefing
- Stress management
- Report writing
- Practice and exercises
- Course critique
- Commission Regulation (EU) No 2015/340 regarding unit training and OJTI/STDI endorsements.

The course includes an examination and assessments in both theory and practical OJTI and STDI skills.

The price per course participant is 3200 EUR [31].

All the aspects of the above-mentioned training course are quite general and are most likely used to create a common view for customers, but still, it is possible to compare single objectives with this Thesis work.

Objectives	Thesis
Eurocontrol Training Zone	
Course introduction and Overview	Function 1: Organization of training
Coaching Video	Not a subject of this Thesis
Learning Theory	Task 2.2: Conduct a training session Sub-Task 13: Apply learning techniques
Communication with trainees	Sub-Task 10: Communicate effectively in verbal, non-verbal, and written form
Briefing	Sub-Task 14: Brief the trainee
Demonstration and Involvement	Sub-Task 15: Demonstrate Sub-Task 11: Use the trainee management methods and techniques that facilitate learning
Monitoring and note-taking	Sub-Task 17: Keep records Sub-Task 18: Maintain safe and efficient ATS during operational training Sub-Task 19: Ensure intervention into the operational process when required for safety reasons
Intervention	Sub-Task 18: Maintain safe and efficient ATS during operational training Sub-Task 19: Ensure intervention into the operational process when required for safety reasons
Human behavior in Training	Task 2.4: Consider human factors principles during training
Debriefing	Sub-Task 16: Debrief the trainee
Stress management	Task 2.4: Consider human factors principles during training Sub-Task 11: Use the trainee management methods and techniques that facilitate learning Sub-Task 12: Manage fatigue and stress Sub-Task 13: Apply learning techniques
Report writing	Task 3.1: Evaluate the trainee's performance

Objectives	Thesis
	Sub-Task 23: Prepare a training report
Practice and exercises	Not a subject of this Thesis
Course critique	Task 3.2: Evaluate the efficiency of training
Delivery of training	Function 2: Training delivery

Table 33: Comparison with training courses within EASA region [31]

5.1.2 Content of Entry Point North

Single objectives of Entry Point North course are [32]:

- Delivery of training.
- Human factors relating to teaching and learning, behavior, teamwork, communication, stress, and fatigue management.
- Challenges in the student's performance, how to help students to overcome challenges in the training.
- Appropriate OJTI/STDI techniques during co-operation agreements/briefing, training on the position, and debriefing.
- OJTI/STDI techniques on coaching, instructing, monitoring, and observing and their impact.
- The role of the OJTI when training colleagues in the operational environment.
- Assessment methods and report writing, which covers competency-based training and assessment models, dedicated and continuous assessment, and the importance of quality of report writing.
- Unit Training Plan (UTP) and Continuation Training.
- Practical training: applying the acquired knowledge and understanding through scenario-based exercises including role-play. The training is conducted on RST (Radar Skill Trainer).
- Stress and fatigue and awareness of the importance of developing resilience.
- A modern and positive approach to training and how to establish co-operation agreement.
- The importance of effective communication/interaction with students and ATCO colleagues.
- Commission Regulation (EU) No 2015/340 regarding unit training and OJTI/STDI endorsements.

Taking into account, that average cost for the course per trainee is about 1800-3500, a cost

of approximately 3000$ can be expected.

The same principle as with the previous course works here, aspects are general and are most likely used to create a common view for customers.

Objectives	Thesis
Entry Point North	
Human factors relating to teaching and learning, behavior, teamwork, communication, stress, and fatigue management	Task 2.4: Consider human factors principles during training
Challenges in the student's performance, how to help students to overcome challenges in the training	Sub-Task 13: Apply learning techniques
Appropriate OJTI/STDI techniques during co-operation agreements/briefing, training on the position, and debriefing.	Task 2.2: Conduct a training session Sub-Task 14: Brief the trainee Sub-Task 16: Debrief the trainee Sub-Task 21: Use effective methods of interaction within a team
OJTI/STDI techniques on coaching, instructing, monitoring, and observing and their impact.	Task 2.3: Ensure safety and efficiency of the operation during training Sub-Task 13: Apply learning techniques Sub-Task 15: Demonstrate
The role of the OJTI when training colleagues in the operational environment	Sub-Task 11: Use the trainee management methods and techniques that facilitate learning Sub-Task 15: Demonstrate
Assessment methods and report writing, which covers competency-based training and assessment models, dedicated and continuous assessment, and the importance of quality of report writing.	Function 3: Evaluation Task 3.1: Evaluate the trainee's performance Task 3.2: Evaluate the efficiency of training
Unit Training Plan (UTP) and Continuation Training.	Not applicable

Objectives	Thesis
Practical training: applying the acquired knowledge and understanding through scenario-based exercises including role-play. The training is conducted on RST (Radar Skill Trainer).	Not a subject of this Thesis, but role-play is supposed to be a part of a training course
Stress and fatigue and awareness of the importance of developing resilience.	Sub-Task 12: Manage fatigue and stress Sub-Task 13: Apply learning techniques
A modern and positive approach to training and how to establish co-operation agreement.	Sub-Task 13: Apply learning techniques Sub-Task 21: Use effective methods of interaction within a team
The importance of effective communication/interaction with students and ATCO colleagues.	Function 2: Training delivery Task 2.4: Consider human factors principles during training
Commission Regulation (EU) No 2015/340 regarding unit training and OJTI/STDI endorsements.	Commission Regulation (EU) No 2015/340 regarding OJTI/STDI endorsements.

Table 34: Comparison with training courses within EASA region [32]

Epitomizing comparison between proposed and already existing training courses, the following inference can be drawn – all three training courses have a lot in common, all the key points were almost similar.

5.3 Economic analysis of the proposed methodology

In the previous part of this Thesis, it was already defined what kind of facilities and equipment will be needed in order to provide training service. The most complex and expensive part of it will be the ATC simulator.

Instructors and pseudo-pilots

Instructors' salary is mostly confidential information, but from the open sources from the Central Asian region, salary in the amount from 2000-4000$ per month may be expected. One instructor may manage up to three trainees, also most of the instructors will be able to handle the theoretical part of the course. Up to 5 instructor workplaces may be expected for the final cost 3000$ per month will be counted

Pseudo-Pilots are special employees, whose job is to simulate pilots for ATC`s during simulator sessions, they create vectors for pseudo-aircrafts and maintain radiocommunication. One pseudo-pilot may simultaneously imitate up to about 3-5 pilots. Their salary is much less than instructors and may be expected from 300-600$ per month. Up to 5 pseudo-pilot workplaces may be expected. The final cost 450$ will be counted

Simulator

According to the EUROCONTROL Simulation Facilities for ATC Training Document, there are three main equipment lots [13]:

- Simulator (software, hardware)
- Image generator (number of channels)
- Infrastructure (room, furniture, consoles, and communication system)

More lots are added corresponding to services:

- Maintenance cost
- Exercises conception and maintenance

Main Factors Influencing cost of a simulator are Image generator, a number of channels, Infrastructure, Simulation Functions, Pseudo pilots Interfaces, and Real-time Functions, Environment data and Mobile Objects Creation, Exercises Creation, Operational Staff, Maintenance cost, Number of Students.

Estimate of Costs – Considering all the available information about price variation of simulators, its price may vary from 0.5 to 5 million euros. In fact, additional services might create a huge amount of additional cost. To this basic maintenance cost (up to 10% yearly), operational costs and costs for a simulation room with basic fittings have to be added to obtain real costs.

The following factors could also affect the cost and represent an additional cost in the final cost:

- any project-specific development/customization.
- Project testing and management.
- Insurance.
- Travel expenses.
- Warranty.
- Financial charges.
- Risk cover.
- Electricity

Expected final cost

The simulator is also used for other types of training, and in most cases will be already presented. That is why the only yearly cost of 2% from the simulator total cost will be counted.

Expences	Cost
Instructors (5)	5×12×3000$ = 180 000$
Pseudo-Pilots (5)	5×12×450$ = 27 000$
Simulator maintenance	3 000 000×2% = 60 000$
Additional	Incalculable
Final cost: 267 000$ per year + plus additional cost.	

Table 35: Calculations for the expected final cost

5.4 Recommended operationally and economically most suitable OJTI training method.

Taking into consideration all the above-mentioned factors, the following solutions can be recommended:

5.4.1 Training solutions

Training provided by other CATCs

The choice of third-party CATC to solve the problem is limited by the training courses' availability due to the high cost of simulation training, which makes up most of OJTI training. But used also for other types of training and therefore not fully valid as a parameter

Organization of training by ANSPs

To provide OJTI, the ANSP shall have the relevant Certificate of approved training organization, which demands to set up a training department. For some ANSPs this might be unpractical due to the lack of specialists and their high workload, as well as difficulties in providing the required training environment and conditions.

5.4.2 Non-training solutions

Participation of OJTIs in the international seminars, conferences, and other events

It is recommended for OJTIs to participate in international seminars, conferences, and other events for experience exchange to be aware of the good practices in ATCO training applied in different regions.

Adjust national regulations

To adjust national regulations to ICAO SARPs as much as possible in order to reduce efforts on studying and application of the rules during unit training. This problem often causes the

increase of cases of unit training prolongation for the trainees who had their initial ATCO training abroad.

5.4.3 Expected result

The proposed training-related solution will make OJTI training delivery in accordance with objectives aligned with the ICAO competency framework for ATC OJTIs.

Considering this course is directly associated with personnel licensing and safety, and such course, based on the ICAO competency framework for ATC OJTIs, it might be of interest to a wide audience of participants from various ICAO regions. In addition, this course might be economically attractive for the “Kazaeronavigatsia” itself due to the possibility to train its ATCOs on a high standard course.

6. Conclusion

A competency-based training program for Air Traffic Controller Officers (ATCOs) shall include on-the-job training (OJT), under the supervision of a qualified on-the-job training instructor (OJTI), to ensure that the competencies appropriate to the duties are consistently achieved.

OJTI activity is related to licensing personnel and safety, it is essential to provide training for such specialists in accordance with objectives aligned with the ICAO competency framework for ATC OJTIs. Such training ensures that sufficient qualified and current aviation professionals manage and support the international air transport system.

Purposed in this Thesis ATC-OJTI training methodology covers two main stages of the course development by ICAO. In the first stage, there were defined problems which the training course is expected to solve and what causes them. There were also determined performance requirements of each task and defined required K/S/A, which are required, so employees will be able to perform assigned tasks at an acceptable level of competence.

The main documents used for course creation are ICAO doc.9868, ICAO doc.10056 and EUROCONTROL, Air Traffic Controller Training at Operational Units. Proposed in this thesis training course methodology follows the main principle – implementation of Eurocontrol`s methodology into ICAO`s competencies frameworks and in the case of this thesis local legislation of the Republic of Kazakhstan. Local legislation is the variable, but on the example of the proposed methodology, it has been clearly seen, that local legislation takes a minor part in course creation and it won`t take long to adapt the methodology to another state's legislation for the course creation purpose. However, another variable – Population analysis, plays a huge role in a course creation process and results of it may vary significantly in different states, therefore further consultations with subject matter experts will be indispensable in order to edit affected parts of the purposed methodology.

The comparison between the proposed methodology and already existing training courses showed, that almost every aspect of the chosen training courses are covered by the proposed parts. Methodology in this Thesis has a lot in common with the existing training courses in Europe, which is not surprising since the goal of the work was to introduce the course methodology by implementing standardized aspects of course creation, proposed by EUROCONTROL into the ICAO competence framework.

Economic analysis showed that to fulfill the necessary requirements equipping the rooms and

organize a training course, a huge amount of cash investment will be. On order to solve the financial and organizational aspects of the course there were offered different training and non-training solutions.

This work can be continued in designing audio-visual training materials, mastery and progress tests corresponding to the end-of-module objectives, production of training materials.

List of Figures

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Appendix

1. Stage One Step Three – Population Analysis - Questionnaire for ATCOs

This questionnaire was used to gather information for Population Analysis.