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Needs Analysis of Aircraft Mechanics' English Language Skills

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Abstract: English is used in all parts of aviation, especially in aircraft maintenance, where all documentation and various manuals are written in this language. However, there are no formal requirements for aircraft mechanics to have a certain level of English. Nevertheless, aircraft mechanics must master their English language skills, since they are needed for managing their work tasks. This study deals with the issue of insufficiency of standardized English courses, and determines the English language needs of aircraft maintenance in the Slovak Republic, using a triangular approach. The gathered data from 80 respondents for this paper were subjected to descriptive and inferential statistics, which were calculated by the means of Jamovi statistical software. The results revealed that aircraft mechanics engage most often in communication situations that require their knowledge of the reading skill. The importance of all language skills (reading, writing, listening, speaking) is proven by the determination of the most-common communication activities of aircraft mechanics, which should be included in specialized English courses. The results of this study are useful in the creation of language courses which increase the level of English in aircraft maintenance, thus, increasing safety in aviation.

Keywords: aircraft maintenance; aircraft mechanic; communication; English; language needs; needs analysis; language skills; reading skill; technical documentation

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1. Introduction

The English language is a well-established language of aviation, whether it is communication between pilots, air traffic controllers, flight crew, or aircraft mechanics. The need for a common language among aviation personnel led to acknowledging English as the working language. The importance of effective communication strengthened the demand for certified English-speaking pilots and air traffic controllers [1].

Communication can be divided into synchronous (occurring in real time) and asynchronous (occurring with a time delay). The former is, for example, face-to-face communication, and the latter is non-verbal communication that lacks communication cues (e.g., body language) such as e-mail, reports, written text, etc. [2]. Both these communications are present in the communications of aviation personnel; however, the frequency of each differs, based on the profession. In the case of aircraft mechanics, asynchronous communication tends to be more common, as reading aircraft manuals and other technical documentation in English constitutes a significant part of their job duties [3,4].

Even though 80% of aircraft mechanics worldwide are non-native speakers of English, there is no formal requirement for aircraft mechanics to have a certain level of English, as opposed to pilots and air-traffic controllers, who have to obtain an ICAO English certificate in order to participate in international travel [3,5]. In some countries, for example in Malaysia, its Civil Aviation Authority viewed the missing requirements on English

proficiency skills for aircraft mechanics as crucial in ensuring safety, and therefore they adopted the ICAO language proficiency requirements, with appropriate alternations for aircraft maintenance [6–8].

Despite the lack of requirements from ICAO, the EASA member states follow regulation No 1321/2014 on the continuing airworthiness of aircraft and aeronautical products, parts, and appliances, and on the approval of organizations and personnel involved in these tasks [8]. According to this regulation, the holder of an aircraft maintenance license may not exercise its privileges unless they are able to read, write and communicate to an understandable level in the language(s) in which the technical documentation and procedures necessary to support the issue of the certificate of release to service are written. Even though this requirement exists, there is no official regulation that describes rating needs for maintenance personnel in order to demonstrate their ability to speak and understand the English language, which is the most common language of technical documentation. According to the research carried out by EASA surveying maintenance and repair organizations in 2018 [9], most respondents consider developing a system for determining the level of English for aircraft maintenance as urgently needed. They recommend that similar provisions to those that are now in place for pilots and air traffic controllers should be developed and implemented, and propose that the national aviation authorities should check the level of English of aircraft mechanics before delivering a license. This document points out the need for an update of the Part-66 syllabus, which should also integrate the examination of English language proficiency.

The lack of legal requirements on the English level of aircraft mechanics results in the lack of specialized language courses for aircraft mechanics. The available courses on aviation English are focused on pilots and air traffic controllers, whose communication vastly differs from the one occurring in aircraft maintenance [10]. A language-training center in Argentina started providing English courses for pilots and air traffic controllers when encountered interest in specialized courses for aircraft mechanics. While developing such a course, the missing guidelines became desired, and the limitations of Doc 9835 language proficiency requirements became evident [11].

The one-size-fits-all approach in teaching languages has been discredited by findings of various research based on the specificity of the tasks or discourse practices that the learner encounters in different domains [12]. The developments in educational psychology revealed that learners have different needs and interests regarding their learning [13]. The course that addresses these needs and interests consequently influences the motivation to learn and therefore the effectiveness of learning. These realizations led to the creation of English for specific purposes, which pays attention to the relevance of the course in relation to learners' needs (e.g., using materials from the specialized area) [14].

English for specific purposes (ESP) is a subcategory of the English language, and it contrasts with general English. ESP focuses on the needs of a specialized group of learners, and it can be divided into English for occupational purposes (EOP) and English for academic purposes (EAP). The former pays attention to the language needs posed by a certain profession (e.g., English for nurses, English for waiters), and the latter concentrates on the needs of learners in the academic environment (e.g., college students) [15].

Language courses in aviation English can be categorized under either EAP or EOP, depending on the content and focus of the specific course in aviation English. The scope of language-training programs for aircraft mechanic students would likely differ from English-language training for aircraft mechanics that are already employed. Language training evolves and changes in similar ways as the students gain knowledge and enter the workforce. The ab initio training programs should focus more on obtaining the necessary academic language skills needed in training. On the other hand, training programs for employees should concentrate on tasks present during their job (e.g., application of information from manuals). A course in aviation English may combine the properties of both EAP and EOP [10].

Even though the ICAO document *Guidelines for aviation English training programs* (Circular 323-AN/185) addresses especially the designers of curricula for pilots and air traffic controllers, not those designing curricula for maintenance or cabin crew [10], in developing courses for other aviation personnel the same guidelines should be followed. The curriculum has to simulate as closely as possible the communicative needs used in their jobs and aim at achieving necessary skills and operational proficiency [16].

In the case of aircraft maintenance courses, according to a language center providing training in aviation English, many aircraft mechanics did not participate in any specialized course for their profession [11]. The general lack of specialized courses inspired the current research. Since ESP is viewed as an approach to learning which is based on the needs of learners [14], therefore, the first step in developing an ESP course is to access the needs of the learner through needs analysis.

Therefore, the main aim of this research is to determine the basic needs of aircraft mechanics and provide recommendations for course designers of aviation English for aircraft mechanics. According to the findings of this research, the most used language skill by aircraft mechanics is the reading skill, then writing, listening and, lastly, the speaking skill. However, upon more detailed inspections of the individual communication activities, it was discovered that some communication activities that fall under the skills of listening or speaking are among the most important ones. Consequently, the English courses for aircraft mechanics should include exercises that focus on all four language skills (reading, writing, listening, speaking) and develop the key knowledge necessary for effective participation in the most common communication activities.

The whole paper is organized into separate sections that form a compact outcome. Firstly, in Section 2, available literature sources demonstrate some preceding research regarding the role of the English language in aircraft maintenance and also the use of needs analysis for determining the language needs of aircraft mechanics. Section 3 discusses the research framework, including the explanation of the purpose of needs analysis. Furthermore, the results obtained from the triangular approach comprising informal interviews, document analysis and questionnaire are presented in Section 4. The discussion of the main issues is in Section 5. Finally, Section 6 summarizes the conclusions of the study.

2. Related Work

This research follows the concept of needs analysis, which has been at the center of focus for many years among scholars working in the field of English language teaching for specific purposes. A needs analysis was denoted as an important step in developing a specialized curriculum, as it discovers the needs of a specific profession and therefore it permits addressing them in the course. Nowadays, needs analysis comprises several approaches that were developed over the years. Each approach complemented the previous ones that existed, in order to make the needs analysis more efficient.

According to Brown [15], the purpose of needs analysis is to gather information about the language needs of a particular group. Needs analysis consists of systematic collection and further analysis of all objective, subjective and other types of information that are appropriate for creating a satisfactory course. The denoted needs are translated into learning objectives, which are the basis for the preparation of study materials, tests, or evaluation strategies. However, the definition of needs analysis has come a long way since its beginning.

Firstly, the evaluation of needs was based on the intuitions of teachers or some informal analysis of students' needs. Further on, needs analysis became a key instrument in developing an ESP course [17]. The concept of needs analysis in ESP course development began to rise in popularity in the 70s and 80s [18]. The communicative syllabus design was introduced in 1978 by Munby [19], whose work was further followed by Chambers, who introduced target situation analysis in 1980 [20]. This analysis focuses on the expectations of learners after the completion of the language course. Hutchinson and Waters [14] provide a series of questions that the course developer needs to find the answers to in

their comprehensive target-situation-analysis framework. In the following years, several scholars provided different approaches to needs analysis, each bringing new aspects to the evaluation of language needs.

The present situation analysis was developed with the goal to complement the target situation analysis. Dudley-Evans and St. John [21] claim that if the target destination is determined, it is equally important to evaluate the starting point. The present situation analysis can be performed by the establishment of placement tests, and according to the various types of information about the learners (years of learning English, education, etc.), it is possible to predict, to a certain extent, the present situation.

The further-developed deficiency analysis concentrates on the discovery of the gap [22] in knowledge also called the lack [14] or learners' present needs and wants [23]. The deficiency analysis can form the basis of the syllabus as it focuses on the knowledge that is desired but lacking in the present knowledge of the learner. Another approach to needs analysis is strategy analysis, which focuses on the preferred strategy of learning. According to Allwright [23] there are needs (skills that are relevant for the learner), wants (needs of the highest priority), and lacks (differences between the present and desired competence of learners). These ideas were later adopted by Hutchinson and Waters [14], who developed a learning needs analysis, that establishes what the learners need to do in order to attain their goals in learning. A successful language course has to be susceptible to the environment in which it is to be taught, as one course that works well in one situation may not work the same way in a different one. Therefore, Dudley-Evans and St. John [21] suggest performing a means analysis that gathers information about the environment in which the course is going to take place.

In evaluating the language needs for courses of English for specific purposes (ESP), the register analysis is appropriate. Even though grammar used in scientific or technical English does not differ from general English, certain grammatical or lexical forms tend to be used more often than others [21]. The purpose of performing a register analysis is to make the course as relevant as possible for future course learners. This analysis is focused on the level of words and sentences, and therefore discourse analysis was introduced. This analysis pays attention to how sentences form discourse [14]. The criticism of register and discourse approaches resulted in genre analysis, which may overlap in certain aspects with discourse analysis. This analysis focuses on learning specific language from specialist contexts and not in isolation.

The above-mentioned scholars among others, propose certain steps in the execution of needs analysis. The analyses represented in Figure 1 can be also viewed as types of needs analysis. However, each of these approaches would not be a reliable indicator of language needs on its own. It is believed that a combination of these types would be the best procedure for gathering all necessary information in developing a language course for specialized purposes that sufficiently reflects the needs of its learners. It is in the competence of the researcher to decide on the types of needs analysis that will be performed in their research, as each situation is specific and requests a specialized approach. In the present study, the current authors focused mainly on the target-situation analysis. This paper examines the language needs of aircraft mechanics; therefore, it studies the target situation in which the prospective holders of aircraft-mechanic certification could find themselves after employment in a company providing aircraft maintenance.

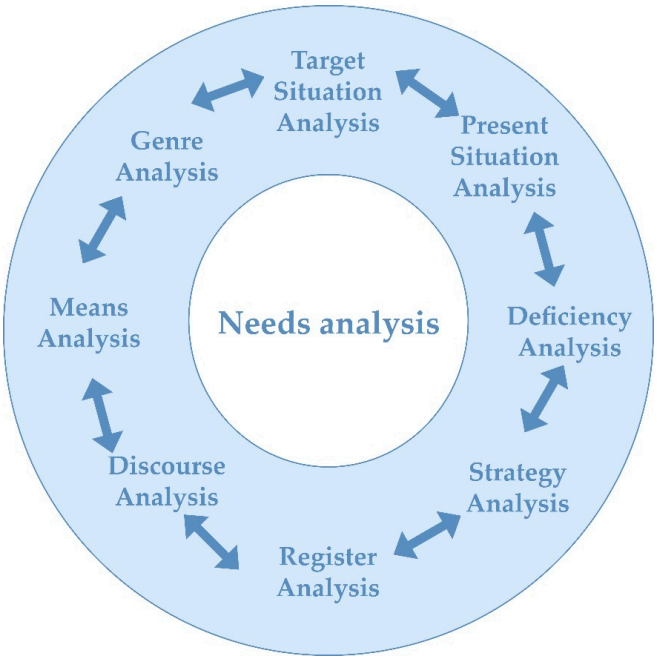

Figure 1. Approaches to needs analysis.

Figure 1 shows the different types of needs analysis. According to Brown [15], a certain combination of these types would be the most reliable way of conducting a needs analysis. Every type of needs analysis concentrates on different aspects that have to be considered during the development of a language course for specialized purposes. These types are:

- Target situation analysis, which includes objective product-oriented needs. This analysis pays attention to the needs of learners after the completion of the course. It constitutes asking questions about the target situation and the attitudes towards that situation [14].
- Present situation analysis, which considers strengths and weaknesses in the language, skills, and learning experience of the learners at present.
- Deficiency analysis, which estimates learners' present needs and wants. It studies the gap between the present situation and the target situation of the learners.
- Strategy analysis, which includes subjective- and process-oriented needs. These refer to the learners 'preferred strategies of learning.
- Means analysis, which focuses on the environment of the course and its feasibility; it accesses the possible constraints that can arise during the course.
- Register analysis, which investigates vocabulary and grammar used in the target situation.
- Discourse analysis, which focuses on combinations of sentences which together form discourse; it focuses on the analysis of the level of words, sentences and overall discourse.
- Genre analysis, which studies regularities of structure that make one text different from another; it focuses on studying the language from specialized texts, and not in isolation.

The use of needs analysis for determining the language needs of a certain profession is widespread in various fields, such as the business English of managers [24], English for pharmacy students [25] or for agriculture [26]. The results of these needs analyses reflect the needs of the current profession under study. Each profession has its own preferences when it comes to language needs, and therefore there should be a separate needs analysis performed for individual professions. The role of needs analysis is to denote the needs and therefore help curriculum developers to design an appropriate syllabus, as these designers often do not have the necessary time or resources to perform a needs analysis on their own [27]. The possibilities for performing needs analyses are various, for example [28]

explored the results based on interviews and observations; however, a very common way is to use questionnaires [24].

There is some previous research focusing on the importance of the English language in aircraft maintenance or on the needs of aircraft mechanics. The study carried out by Drury et al. in 2005 focused on the reading-level evaluation of aircraft mechanics around the world. They selected one representative country for each continent. This study was performed at the demand of the Federal Aviation Administration, in order to establish whether language errors may compromise safety. The results showed that the reading level of aircraft mechanics varies from level 5 on the LEXILE scale [29]. However, the reading level of aircraft maintenance manuals was established at level 8 on the LEXILE scale [10] which was exceeded only in the United States, by level 14 [29]. This country is one of the few that established the requirement of specific English knowledge for the certification of aircraft mechanics. Despite English being the native language of the country, many non-native speakers that were employed in aircraft maintenance did not demonstrate an adequate level of English, which forced the Federal Aviation Administration to introduce the knowledge of the English language as a requirement for obtaining certification [30].

Another study was aimed at determining the needs of aircraft heavy maintenance mechanics at a Malaysian airport. The data were collected via a questionnaire, which promoted the findings that the listening skill was perceived as the most needed, followed by speaking, reading, and writing. Speaking was determined as the most problematic area. The research states that English courses should be focused on all four language skills equally, and should contain class activities [31].

Research exploring the English language skills used by aircraft maintenance engineers in their workplace was carried out with the goal of developing an aviation-English module for aircraft maintenance engineers. This Malaysian study collected data from aircraft maintenance engineers, pilots and flight-crew members, and written documents. A needs analysis was performed in the form of an interview and oral-communication analysis and document analysis. Findings demonstrate that despite expected knowledge of all four language skills, they are expected to master the skill of technical writing. Aircraft mechanics must have good reading-comprehension skills, to minimize the possible misunderstanding and misinterpreting of important information. They should be able to infer the meaning of written texts accurately, as they use short and straightforward language. Listening and speaking skills are equally important, as aircraft technicians communicate with foreign pilots or cabin-crew members [32].

Another research focused on the English language needs analysis for mechanical engineering at a university in Indonesia. The researchers collected data by the means of a questionnaire, interviews and observation of classroom activities. This study concentrated on English for academic purposes, and evaluated the topics that should be discussed in class. The topics were aircraft maintenance, manufacture and materials, energy conversion, and job hunting. It also performed a strategy analysis, discovering that the preferred presentation of materials is through discussion or group work. The paper proposes a semester learning plan based on the findings [33].

All previous research focus on the issue of the English language in aircraft maintenance. Some of it provides essential information in the creation of the present study, which focuses on the language needs of aircraft technicians in the Slovak Republic. While some of the previously carried-out research used the needs analysis, each decided to use a different approach. Each situation may require a different approach to best reflect the needs of learners. However, it can be observed that the view of the most-needed language skill varies according to different studies. On the other hand, all researchers agreed that knowledge of all language skills is needed. The present authors believe that the reading skill is the most important, and at the same time agree that the knowledge of all skills is needed and that this knowledge should reflect the skills needed for the most used communication activities for aircraft mechanics.

3. Methodology

This research aims at exploring the most used types of communication by aircraft mechanics and determining the most important language skills that are required to be mastered by aircraft mechanics in order to perform their job duties effectively. Based on the results of the present study, it is possible to determine the communication activities that should be included in the language training of aircraft mechanics. According to the information gained from this research, the authors were able to make a list of the most common types of communication activities. Course designers can, therefore, determine specific language skills that are needed to participate in these activities. Based on the literary research, the authors formulated the following hypotheses:

Hypothesis 1 (H1). *The reading skill is significantly more used, in comparison with other language skills.*

Hypothesis 2 (H2). *All language skills (reading, writing, listening, speaking) are crucial for the profession of aircraft mechanic.*

The authors believe that the reading skill is of salient importance, since aircraft mechanics have to work with various types of technical English documentation. In order to prove or disprove the hypotheses, the results from a questionnaire are evaluated by means of inferential and descriptive statistics.

In order to easily understand the findings of this research, it is necessary to define the key terminology used in the results section. Firstly, the research addresses the four language skills (listening, writing, reading, speaking) and a general skill, which is focused on the relationship between aircraft mechanics and travelling abroad and cooperating with foreign colleagues. The general skill was created as these aspects of their work were considered important, and could not have been included in any other language skill. Each skill is composed of specific communication activities. Communication activities are various tasks that have to be performed by aircraft mechanics with the use of the English language, such as listening to instructions, reading aircraft manuals, writing reports or asking questions about work to be done. These communication activities combine with each other, and together they are used in various communication situations.

Overall, the authors estimated that the knowledge of all language skills is important, and importance should be paid to all of them during the language training of aircraft mechanics. Even though this study focuses only on aircraft mechanics working in the Slovak Republic, the tasks of aircraft mechanics depend on their job position, not on the country in which they are working. The differences may be in the training procedures and also in the attitudes of the workers. The purpose of this needs analysis is to determine which are the most common tasks that require knowledge of English in the target situation of aircraft mechanics in the Slovak Republic. This paper constitutes qualitative research and a quantitative research approach which allows for the employment of statistical methods resulting in generalizations.

In order to fulfill the aim of the research, the authors decided to perform an analysis of the target situation, which is one of the steps of needs analysis. The evaluation of the target situation is carried out through a triangular approach [34]. It aims to determine which are the language needs of aircraft mechanics. The steps of the research are shown in Figure 2. Starting with literary research, the identification of the issue is followed by the preparation of a questionnaire and the gathering of information for the informal interviews, contacting the maintenance and repair organizations (MROs), visiting the maintenance and repair organizations, the gathering of data and lastly, the interpretation of results and their evaluation.

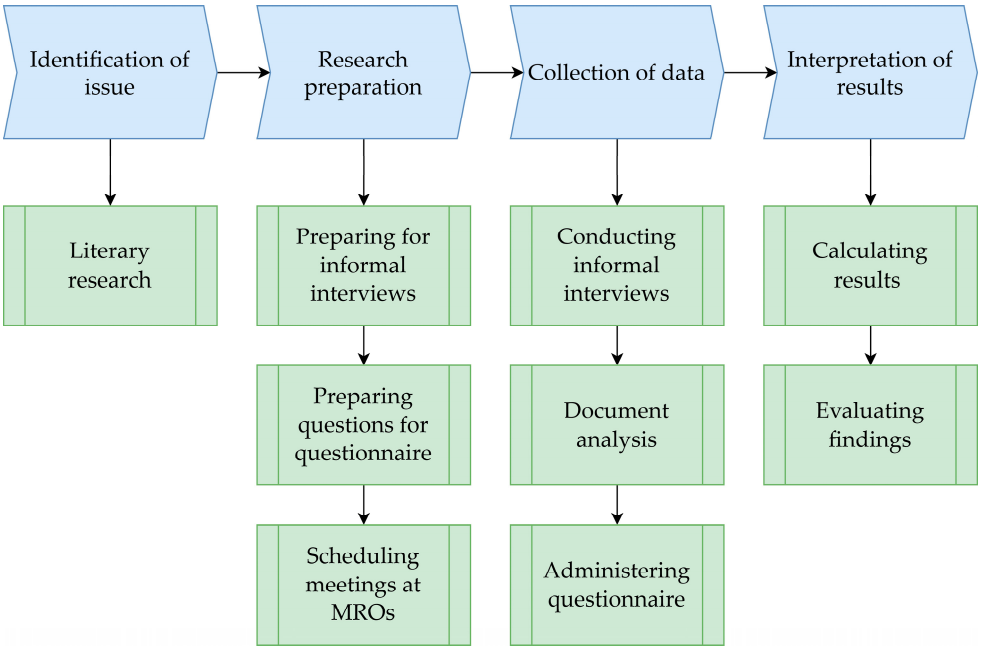

Figure 2. Research framework.

There are several options for how to perform a needs analysis, each having its advantages and disadvantages. While interviews provide useful in-depth information, they are significantly more time-consuming than questionnaires and permit addressing far fewer people. On the other hand, using questionnaires as a fundamental data-collection method has many advantages, in the form of greater anonymity for respondents and the gathering of information from a larger sample. Questionnaires are economical, consolidated, fast, comfortable, and easily accessible for respondents. However, questionnaires might pose certain disadvantages in the form of respondents' low attention to question texts, limited space to express respondents´ additional thoughts, absence of question understanding, and a high number of non-responded questions.

These are the reasons why the authors decided to adopt a triangular approach, composed of administering a questionnaire, an informal interview with some of the respondents, and an analysis of manuals and technical documentation. The information gathered from these three sources permits us to approach the issue of the English language in aircraft maintenance from different perspectives, which can together paint a more complex picture of the issue.

3.1. Method of Informal Interviews

According to the triangular approach, it is important to assess the situation of aircraft mechanics from three different points of view, one of them being informal interviews. The main objective of informal interviews was to gain important insight in the four aspects including the training of aircraft mechanics, their work with written documentation, language needs and work with foreign colleagues. The informal interviews were conducted upon visiting the companies, and the respondents were managers, heads of maintenance and also aircraft mechanics, who shared their views on the importance of English in aircraft maintenance and their attitudes towards the needs of this language. The managers at the companies showed the authors the premises of their companies and explained how the companies operate.

3.2. Method of Document Analysis

When the authors visited the maintenance and repair organizations, they had the opportunity to examine the documentation that the aircraft mechanics work with. The

examined documentation was in English and included task cards, worksheets, training aircraft manuals, various aircraft manuals, component manuals, troubleshooting manuals or internal directives. This documentation was observed, and notes were taken on the used grammatical structures, tenses, sentence structures, vocabulary, and content of the documentation, in order to gain information about the difficulty of the language used. The aim was to evaluate the language skills needed to effectively understand such documentation.

3.3. Method of Questionnaire

The main objective of a questionnaire in research is to obtain relevant information in the most reliable and valid manner [35]. Our questionnaire complies with the description of an ideal questionnaire, in that it is composed of simple and specific language, demands one answer only, it is truthful and accurate, and minimizes social desirability. The data were collected in two ways. Firstly, a questionnaire in paper form was self-administered at five aircraft maintenance companies. Secondly, an online form of the questionnaire was conducted through Qualtrics, and it was sent via email to aircraft mechanics at two other maintenance and repair companies. The respondents were introduced to the aim of the research at the beginning of the questionnaire, and the estimated time of filling out the questionnaire was determined as 15 min. The research was targeted at aircraft mechanics working at maintenance and repair organizations in the Slovak Republic. The gathering of data took place from 7 October to 7 November 2022.

The questionnaire consisted of two parts; the first was devoted to the gathering of demographical data (age, years of experience in the field, years of learning English, job position), and the second contained questions about the most common communication types and language skills. The questionnaire featured various types of questions which were close-ended, open-ended or in the form of a Likert scale.

The research featured 80 male respondents, since the job position of an aircraft mechanic is a highly male-dominated profession. The researchers consider that the number of responders is sufficient, since the study performed specialized in aircraft mechanics working in the Slovak Republic. In order to draw conclusions that would be true for the Slovak working environment it was necessary to focus on aircraft mechanics working in the Slovak Republic. In this way, the findings of this research can give appropriate recommendations for language courses which are specialized for Slovak aircraft mechanics.

The data gathered by questionnaires focused on needs analysis. These data were analyzed by descriptive and inferential statistics by the means of the statistical program Jamovi. These calculations were used to determine the significant differences between the language skills. According to these calculations, it is possible to establish which are the most commonly used in aircraft maintenance. Descriptive statistics was used to evaluate the most-used communication activities, which permitted the authors to give recommendations for the contents of the English language courses specialized for aircraft mechanics. Since the sample did not meet the criteria for parametric approaches, the authors employed the Friedman test with the proper corrections in a non-parametric ANOVA for repeated measures, to identify the differences that were statistically significant in the most prevalent style of communication.

4. Results

This section presents the results of the triangular approach of this research. Initially, it presents the findings that resulted from the informal interviews, addressing the training of aircraft mechanics, work with written documentation, language needs and work with foreign colleagues. In addition, the nature of the technical documentation used is presented. Moreover, the results from the questionnaire are shown, presenting the calculations of inferential statistics together with the descriptive statistics providing information about the most common communication activities of aircraft mechanics.

4.1. Informal Interviews

The informal interview focused on several aspects of the work of aircraft mechanics; namely, the questions were aimed at gaining more insight into the form of training of aircraft mechanics, either continuous or initial training, then their work with aircraft manuals, including work with written documentation in the form of aircraft manuals, component manuals, task cards or work orders, then their views on the language needs of the aircraft mechanics at their company, including opportunities for travelling abroad, and, lastly, their work with foreign colleagues, focusing on the frequency of such collaborations and whether they have a non-native Slovak speaker in their team of aircraft mechanics.

1. Training of aircraft mechanics

Aircraft mechanics pass the on-the-job training work with training manuals, which provide definitions of parts of the aircraft, explain the construction and state the nature of maintenance that has to be carried out on a certain part of the aircraft. These training manuals contain many technical descriptions, with appropriate terminology. The language used in these manuals features the use of the present tense, passive voice, conditional clauses, imperatives, listings, and relative clauses. Before enrolling in such training, at least a basic previous knowledge of English has to be achieved.

However, the training that is performed by the companies is carried out in the native language of the country. The certification process is in the native language of the Slovak Republic, even though the certification permit is valid in all EASA member states. In order to work on specific types of aircraft, it is necessary for aircraft mechanics to participate in a type of training, which is mostly in the Czech Republic, depending on the type of aircraft. This training is usually in the Czech language, which does not pose significant difficulties to Slovak aircraft mechanics, as most of the Slovaks understand the Czech language. It is common for Slovaks to understand the Czech language because of the similarities between these two languages and also because of the long common history of the Slovak and the Czech Republic. While these aircraft mechanics undergo this training in a language other than English, the materials and final tests are in English. The use of both languages in training is not ideal; however, it ensures that all participants in the training understand everything that is stated.

2. Work with written documentation

Aircraft mechanics usually work with various documents which are in the English language, such as aircraft manuals, task cards, work orders, components manuals, troubleshooting manuals and many others. The aircraft manual is accessible to the aircraft mechanics during their work, and it does not contain very detailed technical descriptions. The informal interview revealed that some aircraft mechanics noticed inconsistencies in the use of terminology in the aircraft manuals. They considered that manuals from some smaller producers could be revised in order to bring about unification in the use of terminology. A better knowledge of English can help aircraft mechanics during their work with the manuals, in cases where the manuals do not comply with the standards for clear, unambiguous manuals. In the case of inconsistencies or unknown vocabulary that might be present in the aircraft manual, aircraft mechanics stated that better knowledge of English can help them with finding the correct meaning. A more detailed description of the written texts that the aircraft mechanics come into contact with is described in the section Document Analysis.

3. Language needs

Aircraft mechanics demonstrated a need for general English in their job, as it is needed for maintaining continuous communication in English with foreign speakers. As mentioned by some aircraft mechanics, it is beneficial to have a broad knowledge of general English. It can ease the understanding of aircraft manuals in the case of complicated sentence structures or inconsistent vocabulary, which may occur in aircraft manuals for older aircraft. The ability to communicate freely and fluently may be needed when aircraft mechanics have

the opportunity to go on training in a foreign country. Based on the informal interviews, there is an excessive need for understanding of the written text in English. However, other language skills are also required. To determine which skill is the most often used, this study addressed the frequency of occurrence of various types of communication. This permits determining which communications are the most commonly used, and thus which skills are needed to be mastered by the aircraft mechanics, in order to participate in these communications effectively.

4. Work with foreign colleagues

In the case of branches that belong to an international-company group, communication with foreign colleagues is inevitable. According to the informal interviews, this communication occurs mostly via email or telephone. Naturally, not all aircraft mechanics have to communicate with foreign colleagues. This task depends on the working position of the individual. At certain maintenance and repair organizations, there are international teams of aircraft mechanics, meaning that they are employing people from other countries than the Slovak Republic, mostly from Croatia or Serbia. It also happens that there is a need for a repair that can be carried out only by specialized aircraft mechanics that may be from other countries than the Slovak Republic. In this case, these aircraft mechanics arrive at the maintenance and repair organization and have to cooperate on a specific problem with the local crew of aircraft mechanics. This cooperation is not possible without maintaining effective communication that has to be in a common language to all aircraft mechanics, which is in most cases the English language.

4.2. Document Analysis

Aircraft mechanics work with a variety of documents, namely, task cards or work orders, and especially with manuals such as aircraft maintenance manuals, component manuals or troubleshooting manuals. Manufacturers of aircraft parts and equipment issue these documents in English that should be understandable to the target audience, in this case, the aircraft mechanics. However, the level of English knowledge of aviation personnel differs widely across countries. This, together with the fact that around 80% of all aircraft mechanics are not native speakers of English, promoted the development of Simplified Technical English (STE) [3,36].

Therefore, the goal of maintenance manuals is to reduce the reading difficulty of these documents by shortening the length of the sentences and using limited vocabulary. According to the rules of STE, the sentences used in aircraft manuals should not be longer than twenty-five words [10]. It is important to keep in mind that these texts are highly technical and thus, in general, not easily understood. Simplified Technical English, known also as ASD-STE100 was developed by the Aerospace and Defense Industries Association of Europe, and was first introduced in the late 1970s. The rules of STE state that each word should have one meaning aiming at limiting the ambiguity of sentences. Further, it promotes the use of simple syntactic structures and short sentences, with the use of restricted, unambiguous vocabulary [37]. However, STE rules are not fully standardized and implemented in all aviation texts [10].

A standard aircraft manual from aircraft manufacturers contains an introduction to the specific sections and compartments of the aircraft, together with descriptions and procedures. The manuals feature a table of contents, a list of abbreviations, and a list of tables, figures and illustrations. The length of a manual varies according to the aircraft manufacturers, and some manuals from big companies such as Boeing may contain over 200,000 words [10]. These manuals are mostly accessible to aircraft mechanics in electronic form, which they can access through a computer, which makes searching for a specific chapter easier.

Generally, aircraft manuals are composed of two main sections or genres, descriptive and procedural sections, while each part has its own language attributes. The descriptive section features a narrative where a certain piece of equipment, item, or part is introduced and described in detail, and is usually followed by a procedural section which provides

step-by-step instructions that are required for a certain procedure. These sections may follow the rules of STE, in which case the descriptive sections would be more lengthy and grammatically complex than the procedural sections [10].

Even though STE addresses the readability of manuals, it is still unable to address all issues posed by non-native English speakers regarding their reading ability. In general, shorter sentences and words should be more understandable, but the complexity of the vocabulary is only one component of the overall difficulty of understanding written text. The English language that is taught at schools is mostly academic English, which does not copy the standards of STE and the technical language used in manuals. In relation to course development, this should reflect the way in which manuals connect ideas and study texts, with similar reading-difficulty levels [10].

According to the study of the documents accessible at the MRO companies, which were made available to the authors for inspection, the following language features were observed: longer descriptions at the beginnings of the chapter, which used more complex syntactic structures, modal verbs, tenses (past simple, present simple, simple future), conditional clauses (zero and first conditional), and passive constructions. The procedural sections featured different steps required in the maintenance procedure, which were in present simple imperative and followed a simple syntactic structure. Based on the aircraft manufacturer, the manuals contained various illustrations that showed the desired maintenance procedure.

4.3. Questionnaire

The sample of our research consisted of 80 male respondents. Table 1 provides detailed information about their background information. The respondents of this research were aged between 19 and 69 years, while the average age of the participants was 31. The majority of the respondents (45%) were aged from 31 to 45; 33% of respondents were aged 19–30, followed by 19% of respondents aged 46–60. Lastly, 3% of respondents were older than 60. The rather high number of young aircraft mechanics shows that this profession is attractive to young people. The augmented demand for aircraft mechanics in the future can be successfully achieved only with the involvement of the young generation, who have to be trained properly in terms of technical skills but also in knowledge of the English language.

Table 1. Demographical information.

Demographical Groups	*n*	%
Age		
19–30	27	33%
31–45	36	45%
46–60	15	19%
61+	2	3%
Years of experience		
0–5	27	33%
6–15	28	35%
16–25	14	18%
26+	11	14%
Years of studying English		
0–1	16	20%
2–5	19	24%
6–14	38	47%
15+	7	9%

The respondents' years of experience in the field of aircraft maintenance ranged from 0 to 47 years. The majority (35%) of respondents had been working in the field for 6 to 15 years, and the second-largest group, of 33%, was represented by aircraft mechanics just starting their professional carrier up to those who had five years of experience. There were

six aircraft mechanics that had been working in the field for more than 35 years, showing their dedication to the profession.

Considering the years of studying the English language, this varied from 0 to 30 years. The majority of respondents had studied the English language for 6 to 14 years, meaning that they dedicated appropriate time to mastering the language. Since English is inevitable in aircraft maintenance, it is surprising that 12.5% of respondents studied English for 0 years, which may mean that they never started to study the language, or that they started only recently. One way or the other, this profession requires a certain level of English, and it presumes that the working aircraft mechanics have participated in a certain form of English education, either at an institution or in the form of self-teaching. With the creation of specialized English courses for aircraft maintenance, it is possible to encourage aircraft mechanics to study English more.

The questions of our survey addressed each of the four language skills, together with an additional general skill, step by step. Firstly, the participants answered how often they participated in communication activities that were classified under the general skill. Similarly, they evaluated the frequency of occurrence of the communication activities that were classified under the other four language skills, namely listening, writing, reading and speaking. The participants had to evaluate the frequency by marking the corresponding number on the Likert scale, which presented options from 1 (not at all) to 5 (very often). Table 2 shows the mean, median and standard deviation of these responses. A median is a number which is situated in the middle of the dataset, and its advantage is that it gives a more realistic view on the majority of the responses when extreme values are present in the dataset. The standard deviation states how disperse the responses of individual respondents are. Table 2 portrays the standard deviation, which was the smallest for the reading skill. This means that the answers of the respondents were the closest to the mean in the case of the reading skill. From this, it can be concluded that the respondents mostly agreed on how often they use this particular skill. According to descriptive statistics, the most often used skill is the reading skill, then writing, listening, speaking, and the general skill. However, in order to determine whether the difference between these skills is significant, it is necessary to use inferential statistics.

Table 2. Descriptives of language skills.

	General	Listening	Writing	Reading	Speaking
N	80	80	80	80	80
Mean	2.87	3.16	3.33	4.26	2.96
Median	2.67	3.25	3.4	4.6	2.92
Standard deviation	1.13	1.18	1.27	0.974	1.2
Skewness	0.453	−0.173	−0.303	−1.51	0.157
Std. error skewness	0.269	0.269	0.269	0.269	0.269
Shapiro–Wilk W	0.931	0.955	0.928	0.774	0.949
Shapiro–Wilk p	<0.001	0.007	<0.001	<0.001	0.003

Our sample did not fulfill the requirements for the use of the parametric method, since the normal distribution was not achieved, as shown in Table 2. The histogram did not comply with the parametric requirements, and the skewness from −1 to 1 and the Shapiro–Wilk $p > 0.05$ were not achieved in all categories. Therefore, the non-parametric method was used to calculate the significant differences between the general and the language skills, in order to determine the most commonly used one.

The repeated measures ANOVA (Friedman) was used for calculations, with the appropriate post hoc test. Table 3 features $p < 0.001$, meaning that there are significant differences between the compared groups. In order to determine the significant differences more closely, it is necessary to observe Table 4, which features the results after the post hoc test.

Table 3. Repeated Measures ANOVA Friedman.

χ^2	*df*	*p*
121	4	<0.001

Table 4. Pairwise Comparisons (Durbin–Conover).

Compared Language Skills			Statistic	*p*
General	-	Listening	2.3707	0.018
General	-	Writing	3.3724	<0.001
General	-	Reading	11.8868	<0.001
General	-	Speaking	0.0668	0.947
Listening	-	Writing	1.0017	0.317
Listening	-	Reading	9.5161	<0.001
Listening	-	Speaking	2.3039	0.022
Writing	-	Reading	8.5144	<0.001
Writing	-	Speaking	3.3056	0.001
Reading	-	Speaking	11.82	<0.001

In Table 4, the comparisons of all skills can be seen. In order to denote significant difference between groups, it is necessary for *p* to be smaller than 0.05, which was achieved in eight out of ten comparisons. The comparison of the general skill with all other skills demonstrates a significant difference, except for the comparison with the speaking skill, which means that these two skills are comparable in terms of how often they are used by aircraft mechanics. Concerning the other skills, the general skill is used significantly less than the other language skills. When comparing the listening skill, this shows a significant difference with the reading, speaking and general skill, but the *p* is too high in the comparison with the writing skill. This means that the listening skill is used more often than the speaking and general skill; it is used in approximately the same amount as the writing skill, and it is used less often than the reading skill. Comparisons of the writing skill revealed significant differences with reading, speaking and general skill. Consequently, writing is used as much as listening, and it is used more often than speaking and the general skill, and less often than the reading skill. Lastly, the reading skill is significantly different from all other skills that were compared with it, namely listening, writing, speaking and general skill. This means that the reading skill is used significantly more often than any other skill.

According to the results presented in Table 4, it was possible to divide skills into three groups with respect to the frequency of use by aircraft mechanics. Table 5 shows three main groups, among which significant differences were observed. The most used skill is the reading skill, with a mean of frequency of 4.26. The second group features the writing and listening skills, which are comparable, even if one of the skills reports a slightly higher mean than the other. The last group consists of the speaking and general skills, which are similar in the terms of how often they are used by aircraft mechanics during their job. However, this division does not mean that the training of the English language for aircraft mechanics should focus solely on reading skills, even though it seems that it deserves the highest priority. All other skills should be present in the language training of aircraft mechanics, regardless of their scoring in Table 5. In order to determine what specific aspects of these skills should be taught in specialized language courses, it is necessary to observe Table 6, which features the top 15 communication activities that were evaluated as the most commonly used.

Table 5. Relevance of language skills.

Rank	Language Skill	Mean
1	Reading	4.26
2	Writing	3.33
	Listening	3.16
3	Speaking	2.92
	General	2.67

Table 6. Most relevant communication activities.

No.	Type	Communication Activity	Mean
1	R	Reading and understanding of aircraft manuals	4.46
2	R	Reading and understanding of written instructions	4.39
3	R	Reading and understanding of task cards	4.24
4	R	Reading and understanding of detailed descriptions	4.21
5	R	Reading and understanding of emails	4.01
6	W	Writing task cards	3.67
7	G	Collaboration with foreign colleagues at Slovak maintenance organization	3.56
8	W	Writing reports	3.51
9	L	Listening to and understanding spoken instructions	3.38
10	W	Writing descriptions of work done	3.35
11	S	Talking with foreign aircraft mechanics	3.33
12	L	Listening to and understanding informal language	3.26
13	W	Writing emails	3.19
14	S	Talking about work-related topics	3.17
15	S	Spoken description of work done	3.14

During the working day of aircraft mechanics, they encounter many different communication situations. These situations are complex, and often combine several communication activities. In order to master any of the communication activities, it is necessary to have knowledge of multiple aspects of language. Some of these aspects which are included in communication activities appear together with other ones, and it is hard to draw a strict line between them. However, the current categorization is useful, for understanding which activities are used more than others. Even if some communication activities can occur together with other ones, it does not mean that they are required to the same extent, as some may be more needed than others.

Table 6 features the most relevant communication activities that occur the most during the job of aircraft mechanics. The reading skill that was denoted as the most often used consisted of five communication activities. All these communication activities are among the five most often used (all achieved a mean higher than 4), while *reading and understanding of aircraft manuals* occupies the first place, with a mean of 4.46. Similarly important are *reading and understanding of written instructions, task cards, detailed descriptions and emails*. All these communication activities require knowledge of slightly different aspects of language. The differences can be, for example, in the use of grammatical structures, which will be very likely different in, e.g., written instructions and emails. Aircraft manuals combine sections with written instructions and detailed descriptions; therefore, it is not possible rigidly separate one from another. The denomination of these communication activities serves for a better understanding of the crucial aspects of language that are needed. Based on these evaluations from the aircraft mechanics, it is possible to state that the reading skill, together with all communication activities, should be present in all specialized language courses for aircraft mechanics.

According to Table 5, the reading skill should be followed by communication activities using the writing and listening skills. However, some communication activities using the general and speaking skills received a higher mean than some using the writing and

listening ones. The sixth most-common communication activity belongs under the writing skill, and it is *writing task cards*. Task cards are an important part of the organizational structure of maintenance and repair organizations; therefore, it is a very common duty to write them out. By the means of task cards, the aircraft mechanics receive information about what job has to be done and in what way.

This is then followed by a communication activity from the general skill, *collaboration with foreign colleagues at the Slovak maintenance organization*. Based on this position, it can be concluded that Slovak aircraft mechanics come into contact with foreign colleagues fairly often. According to the informal interviews, the foreign colleagues are usually from the Balkan states or Austria. Successful collaboration has to be supported by effective communication, which cannot exist without proper knowledge of a shared language, which is, in most cases, English. It can be observed that even if the general skill was in the overall evaluation placed at the very bottom of the table, this particular communication activity seems to be more relevant than the others that were placed under the general skill.

Communication activities placed in eighth and tenth place fall under the category of the writing skill. Writing skills are needed after completion of the specified job described on the task card, as it is sometimes required to fill out a short description of the work that had been done. This relates to the communication activities of *writing reports* and *writing descriptions of work done*. *Writing of emails*, which was placed as number thirteen, also constitutes an important part of information transfer, for example, within the company or with suppliers, other maintenance and repair organizations, or foreign companies. This communication activity is in relation to *reading and understanding of emails*, as the aircraft mechanics have to give a response to the received email, also in the form of an email. However, it seems that reading and understanding of emails is more common and important than writing them. This could mean that not all aircraft mechanics are required to answer the emails, but they need to read and understand them.

Communication activities numbered nine, eleven and twelve can be all connected to the communication activity of the general skill, which was already mentioned: *collaboration with foreign colleagues at the Slovak maintenance organization*. This collaboration encompasses many communication situations, such as the verbal exchange of ideas. This means that the instructions are spoken and can be in an informal language, which is related to *listening and understanding of spoken instructions* and *listening and understanding of informal language*. There is a well-known tendency of using more informal language when talking rather than writing, which may cause some complications in understanding. Informal language may be harder to understand because of slightly different vocabulary or grammatical structures. *Talking with foreign aircraft mechanics*, which occupies the eleventh place, is closely related to the communication activities described in this section, since a verbal exchange of ideas cannot be carried out without talking. As it is illustrated here, even if the communication activities were classified under specific skills, it is not easy, and usually it is almost impossible to separate them from each other, as together they form a broader communication situation.

The last two positions in Table 6 belong to the communication activities of the speaking skill. *Talking about work-related topics* can be present in various communication situations, such as communication between colleagues about a specific job. *Spoken description of work done* may be needed, for example, during shift turnover, when one aircraft mechanic explains orally what job he performed so that the other aircraft mechanics can successfully continue the ongoing job. Both can be used as an additional transfer of information which accompanies written documentation, such as written reports, task cards or descriptions of work done.

The authors recommend that specialized English courses should address the communication activities in Table 6. They should pay sufficient attention to each of them in terms of explaining the aspects of language that are needed for the mastering of individual communication activities. To exemplify, in order to master reading and understanding of emails, it is necessary to know the commonly used phrases in emails, the structure

of emails, how the main body of emails is composed, etc. Each of the communication activities defined in Table 6 can be broken down into specific language aspects that the whole communication activity is based on.

5. Discussion

Aircraft maintenance plays an important role in a "safety-processes chain", where no mistakes are acceptable and, if present, they could lead to fatal consequences. Aircraft mechanics are responsible for providing the highest possible quality-level of maintenance. Their job is complex, and requires them to effectively participate in various communication situations, whether synchronous or asynchronous. Since English is the language of aviation, it is also present in aircraft maintenance. The global nature of the aviation industry strengthens the position of English and makes it a necessity when it comes to maintaining safety. It is not present only in face-to-face oral communication among aviation personnel from different countries. The English language is the language of the official documentation, which is inevitable in aircraft maintenance. Increased attention should be paid to the proper knowledge of English in the whole aviation sector, without the exception of aircraft maintenance.

The importance of English in aviation is supported by ICAO [3], which introduced the language proficiency requirements. However, these requirements are focused solely on pilots and air traffic controllers, not on other aviation personnel. The EASA and aircraft maintenance stakeholders recognize that similar requirements should be created for aircraft mechanics by incorporating them into their curricula [9]. In recent years, the content of maintenance training has been under modernization, whether it comes to the teaching of theoretical or practical knowledge [38]. In order to incorporate English into the education process, one of the first steps is to determine the minimal requirements for English, to find out what are the most commonly used and therefore the most needed language skills.

This research presents a triangular approach with the goal of determining the English language needs of aircraft mechanics. According to the informal interviews, it was found that training of aircraft mechanics is performed in the native language, which correlates with the findings in [29]. In such cases, aircraft mechanics are subjected to code-switching, which means that the language that they are speaking may be their native language, e.g., Slovak, but the vocabulary and terminology used is in English. The document analysis revealed that specific aspects of language have to be mastered, together with the proper terminology. Aircraft mechanics work extensively with a wide range of manuals that are written in English, which was also proven by the studies [10,30,33]. The aviation sector provides skilled aircraft mechanics with the possibility of career growth. However, it is conditional on a knowledge of English, which generally helps with the employability of individuals in industries with global activities.

The results section provides data in order to prove or disprove the first hypothesis formulated by the authors. Hypothesis 1: *Reading skill is significantly more used in comparison with other language skills* was proven. After the comparison of all language skills, it was determined that the reading skill is significantly different from all of them. According to the data, the reading skill is significantly more used than any other language skill. The reading skill is then followed by the writing and listening skill, and lastly by speaking and general skills. As the authors estimated, the reading skill was denoted as the most commonly used, and this is supported by the extensive work with written documentation (e.g., aircraft manuals, task cards, worksheets). This finding proves the results of [29], and at the same time disproves the fact that writing [32] or listening are the most important skills [31]. The reason for different results among the studies may be caused by different tasks that the aircraft mechanics have to perform.

While proving that the reading skill is the most important, a more detailed look into language skills was provided, in order to prove or disprove the second hypothesis. Hypothesis 2: *All language skills (reading, writing, listening, speaking) are crucial for the profession of aircraft mechanic*, was proved. The training of the English language for aircraft

mechanics should focus on all language skills, even though it seems that reading skills deserve the highest priority. The importance of all language skills is proven by the order of communication activities in Table 6. It features communication activities for all language skills, and also the general skill. Therefore, each of these skills should be present in language training, which is also recommended by other studies [30,32–34].

The determination of the most commonly used communication activities may serve as a guide for creators of specialized English language courses for aircraft maintenance. By consulting these results, it is easier to construct a syllabus for the course, and curricula designers can have a clearer understanding of situations in which aircraft mechanics have to use English. By preparing aircraft mechanics to master the top 15 communication activities, they are being prepared for the most common communication situations.

However, this study had some limitations, in the form of a homogenous sample in terms of gender. Our sample featured only male respondents, which the authors believe to be natural, as the profession of an aircraft mechanic is a highly male-dominated profession in the Slovak Republic. A limited number of works related to this topic of the English language in aircraft maintenance and a lack of similar works in the Slovak Republic may have influenced the participation of aircraft mechanics in the present research. The size of the sample was directly influenced by the willingness to cooperate of the maintenance and repair organizations and the aircraft mechanics themselves. Despite the limitations, the authors view the sample size of 80 respondents as sufficient, since the overall number of aircraft mechanics in the Slovak Republic is fairly low. Based on the prognosis of Boeing [39] about the future demand for aircraft personnel, the authors believe that the number of aircraft mechanics will greatly increase in the coming years in the whole world and also in the Slovak Republic. The Slovak Republic can be viewed as a country that has great potential for the outsourcing of maintenance.

The present study provides an analysis of language skills in aircraft maintenance which can be used for the development of specialized English language courses for aircraft mechanics. The authors recommend implementing the findings of this study into curricula development, and therefore address the most common communication activities of aircraft mechanics. By addressing the aspects of language which are needed for the mastery of these communication activities, it is possible to better prepare aircraft mechanics for their job and also increase efficiency and safety in aircraft maintenance. Further study could focus on the other aspects of needs analysis that were not addressed by the present study, and move one step closer toward the creation of a specialized English language course for aircraft mechanics. Other possible further research could focus on aircraft mechanics in other countries, examining a sufficiently large and heterogenous sample, and comparing the results with the present study. With such a comparison, it would be possible to determine whether aircraft mechanics' language needs vary according to the country they are working in.

6. Conclusions

This research performed a needs analysis focused on the target situation analysis. In the present research, a triangular approach was used, including informal interviews, document analysis and a questionnaire. According to the informal interviews, there is no sufficient training in the specialized English language, even when the application of English knowledge is wide-ranging. The aviation sector provides skilled aircraft mechanics with the possibility of career growth. However, in order to become a skilled aircraft mechanic, it is a requirement to master the English language, since it is needed for everyday tasks, such as working with manuals, writing reports or communicating with other aviation personnel. This research's document analysis revealed that knowledge of basic language structures and technical terminology is needed. The implication of this study is that there is a need for the development of specialized English language courses for aircraft mechanics, but there are no sufficient recommendations or guidelines for such courses. Therefore, this

research addresses the needs of aircraft mechanics that would help the course developers in preparing the contents of the specialized courses.

The first hypothesis was proven and, according to the questionnaire results, aircraft mechanics use their knowledge in the reading skill the most. The reading skill was found to be significantly more often used when compared to other skills. This means that the job tasks of an aircraft mechanic are most commonly connected to the knowledge of this skill. On the other hand, further analysis of the results focused on proving or disproving the second hypothesis. This hypothesis was also proven, and the data evaluation revealed that there is a need for all other language skills, beside reading, and that specialized language courses should not neglect them. Their frequency of occurrence is as follows: reading, writing, listening and speaking. The 15 most common communication activities contain activities from all language skills. Since reading skill was denoted as significantly the most often used, the first most-common communication activities are related to reading, namely reading and understanding of aircraft manuals, written instructions, task cards, detailed descriptions and emails, in this order. This gives the course and curricula developers information about the most common communication activities of the aircraft mechanics. They can address these needs by paying attention to those aspects of language that are needed for successful participation in these communication activities. Therefore, specialized English courses for aircraft mechanics should address all the above-mentioned skills, with a special focus on the mastery of the most common communication activities.

To conclude, the information presented in this research can be useful for course developers, academics, and aircraft mechanics, who wish to perfect their knowledge of English, or for students of aircraft maintenance who can obtain a clearer picture of the nature of the job and its link to the English language. It is important to keep in mind the fact that by achieving the appropriate knowledge to effectively participate in these communication activities, it is possible to maintain safety in aviation and increase effectiveness in aircraft maintenance.

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