Overcoming Challenges in English for Aviation Maintenance: Technical Publications Selection for the Construction of a Corpus and Its Use to Teach Language Aspects Considering Learners Needs

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Abstract

Aviation English and Corpus Linguistics have been put together and focused by some investigations especially those regarding Aeronautical English (the language used between pilots and air traffic controllers in international radiotelephony communications). However, English used in aviation maintenance, specifically in written documents, has not been as much researched. This paper briefly explains the main concepts considering Aviation English and presents—based on previous researches—aircraft maintenance professionals' needs and regulatory agencies' requirements related to language proficiency. Afterwards, it summarizes information about the most important technical publications for aircraft maintenance and describes the compilation of the Corpus of documents related to aviation maintenance (CoDoRAM). At the end, some ways the corpus can be used to teach vocabulary and grammar in English are pointed out. Although corpus compilation and analysis have been proved to be valuable for research and instructional purposes, most of publications encompass English for academic purposes teaching context. For that reason, this is a way to inspire new projects related to English used in aviation maintenance and the use of corpora in English for specific purposes classes.

Keywords

English for Specific Purposes, Aviation Maintenance, Technical Publications, Corpus Compilation and Analysis, Teaching Challenges

1. Introduction

English is officially the "language of the skies" considering it is the most globalized sector of industry and professionals of this area such as pilots, mechanics, engineers and air traffic controllers (ATCs) not only need but are also demanded to use English to communicate in oral and written situations [1] [2] [3] [4].

Although it may seem English for aviation is a single package for the whole field, that is not the reality and even the use of some terms can be confusing. Aviation English is a broad term, but it is usually adopted to refer to the language used between pilots and air traffic controllers in international radiotelephony communications and this specific usage definitely does not encompass all the language varieties used by the different professionals of the area. Like in Tosqui-Lucks and Silva [5], throughout this paper, aviation English is used as the "umbrella term" while aeronautical English determines the language for communications that take place during a flight in an international context.

Taking aviation field and language into consideration, it is important to keep in mind other two concepts, phraseology and plain English. Tosqui-Lucks and Silva [6], as a translation of Scaramucci, Tosqui-Lucks and Damião [1] definitions, defined the first one as "a code used by pilots and air traffic controllers [...] characterized by short phrases and reduced vocabulary" (p.14) used for transmitting information related to the flight. Also according to them, plain English is the use of the language "in radiotelephony communication that exceeds the use of standard Phraseology, when it is not sufficient, but that should mirror phraseology, keeping its characteristics and specificities" (p.14) without jeopardizing intelligibility, non-ambiguity and concision.

Aeronautical English, standard phraseology and plain English have been focused by aviation organizations, regulatory agencies, researchers and teaching material developers for decades but there is a totally different scenario considering communication among maintenance professionals such as technicians and mechanics. There are still few standards and rules related to language proficiency, tests, studies and teaching materials whose priority is English for aviation maintenance.

These are some of the challenges pre- and in-service professionals, language teachers and Maintenance Repair and Operations/Overhaul (MRO) companies have faced over the years. Although compiling a corpus for a specific purpose and using the results of its analysis in teaching environment is not a recent enterprise, the number of researches and the use of their outcomes in real scenarios in the field of aviation English is not satisfactory yet. Some studies, as those presented in Bocorny [7] and Tosqui-Lucks [8], have proven the combination of corpus linguistics and aviation English is beneficial to understand language aspects and to help teachers and learners. However, the great majority of the investigations has focused on aeronautical English, what shows there is still a huge gap regarding English used in aviation maintenance.

The aim of this article is to describe the most important technical documents

in aviation maintenance which were chosen to be part of the corpus. Besides that, it is presented how different types of analysis might point out solutions to challenges of understanding, choosing and teaching specific language aspects. It is based on the experience of compiling a corpus considering maintainers' needs, lacks and wants [9] and demands of regulatory agencies from The United States of America and Brazil.

In the following, Section 2 presents aircraft maintenance professionals' needs and regulatory agencies' requirements based on studies and regulations and, then, in Section 3 the main challenges considering English for aviation maintenance are pointed out. Afterwards, in Section 4, the relation between aviation English and corpus linguistics is shown considering some researches that have been done specially in Brazil. Aviation maintenance technical documents and the corpus compilation are explained in Section 5 and that precedes the ideas of how the CoDoRAM might be helpful to teach English vocabulary and grammar aspects presented in Section 6. The paper is closed, in Section 7, with a conclusion and references are presented after it.

2. Aircraft Maintenance Professionals' Needs and Regulatory Agencies' Requirements

As far as we are aware, there are only three studies which aimed at analyzing aircraft maintenance professionals' needs, Terenzi [10], whose results are also presented in Terenzi and Augusto-Navarro [11], Niamsuwan [12] and Embryany and Ratmanida [13]. All the authors emphasize workers from different areas in aviation have particular demands when it comes to language use as stated by Embryany and Ratmanida [13]: "English needs for the aircraft maintenance are different from other divisions, such as pilots, ATCs, or flight attendants, which are based on the performed tasks" (p. 35).

It is known the main jobs of the maintenance are maintaining and repairing the aircraft, and "to perform the tasks the workers must follow certain task card or job card that are in English" [13] (p. 36). However, cards are not the only type of document engineers, mechanics and technicians are supposed to deal with on a daily basis. Terenzi and Pizzi [3] mentioned some of those documents and the ones used in our corpus will be described later in this paper.

The most important skill for maintenance workers is reading [10] [11] [12] [13] and it is used to understand technical manuals, instructions, reports, statistic data, and many other documents. The second most required skill in aviation maintenance is writing since all tasks must be recorded and, although they are not essential in this scenario, listening and speaking are also relevant skills as they favors better career opportunities and remuneration, possibilities of traveling abroad and of reaching higher career levels [10].

Even though the researchers pointed out the most common needs and wants for aviation maintenance professionals, studies have discussed language and safety issues [14] [15] and it is common sense English is vital in all fields of aviation, aeronautical authorities have not yet prescribed procedures for both training and

testing of English for maintainers.

According to the Electronic Code of Federal Regulations (eCFR), written by the Federal Aviation Administration [16] in which there is information about the Eligibility Requirements for United States mechanics (Title 14 Aeronautics and Space → Part 65 Certification: airmen other than flight crewmembers → Subpart D—Mechanics → §65.71 Eligibility requirements: General), "to be eligible for a mechanic certificate and associated ratings, a person must—[…] (2) Be able to read, write, speak, and understand the English language". In the same document, "a certificated repair station must ensure its supervisors [inspectors] understand, read, and write English. (Part 145 Repair station → Subpart D—Personnel → §145.153/§145.155).

The American aviation agency, as cited above, requires personnel to know English but there is no specification on mandatory language aspects such as vocabulary or grammar professionals should be able to understand/use and no obligation of a test which would assess their language proficiency, not to mention there is no information on criteria to evaluate if the employee is able to understand, read, and write English as required.

In Brazil, the National Civil Aviation Agency (*Agência Nacional de Aviação Civil*—ANAC) stablishes the contents for a certified aviation maintenance mechanic program and it is mandatory for the students to have English classes during their training. The instruction—IS 141-002A [17]—is the document that specifies course goals, content and learning outcomes. According to it, knowing basic grammar aspects, specific vocabulary and how to understand technical publications are objectives to be achieved by students. Although Brazilian instructions are a little more specific than FAA requirements, it is still a challenge for teachers to determine what will be covered during a course.

3. Challenges Considering English for Aviation Maintenance

The International Civil Aviation Organization (ICAO) has stablished Standards and Recommended Practices (SARPs) concerning language proficiency requirements since 2010. However, the focus of ICAO language proficiency requirements is on improving aeronautical radiotelephony communications and there are no such guidelines considering other uses of aviation English.

That probably is the greatest challenge considering English for aviation maintenance since SARPs are used worldwide as a guide for material development, teaching and testing and they only include directions for communication over the radio among fight crew members and air traffic controllers.

In this scenario, it is not difficult to find course books focusing on English for aviation, but the truth is all of them are about aeronautical English as in English for Aviation: for pilots and Traffic Controllers [18], Aviation English: for ICAO compliance [19] and Flightpath: Aviation English for Pilots and ATCOs [20].

Although these materials offer activities that aim at giving students opportunities to practice authentic communication situations based on the requirements previously stablished by the ICAO, language teachers, students and even profes-

sionals cannot rely on these materials to study and teach English specifically used in aviation maintenance field [3]. The referred materials are not suitable for maintainers not only because of the difference in language use among the professionals but also due to the fact the functions, structures, qualifications and levels considering English have not been determined for maintenance area.

For teachers, even though they are able to understand professionals' needs, lacks and wants, another difficulty is to select genres and language aspects to be focused during classes. At the same time, they are also challenged to deal with terms and concepts from an area that is not their expertise [21].

Just to give an idea about that challenge, there are almost 100 chapters and about 34,000 pages in only one aircraft maintenance manual. Each chapter is about a different part of the aircraft, such as landing gears, windows, doors, etc. Moreover, maintenance manuals are not the only documents professional are supposed to use daily, they are supposed to understand accident reports, advisory circulars, job cards and many others.

Therefore, without guidance, it is a tough task for language teachers to select what to teach in this type of course, especially if she has never had contact with such documents and might not be used to mechanics' job routine. As it has been done in other areas, corpus linguistics has proven to be a way to overcome some language issues considering aeronautical English, as we are going to present in the next section, but its use in aviation maintenance is still incipient.

4. Aviation English and Corpus Linguistics

The jargon used in aviation contains thousands of technical terms in English [22] [23] and due to the low number of investigations about them, the study of terminology also becomes a challenge. Researches in Brazil have focused on understanding aviation specific vocabulary based on corpus [24] [25] [26].

Brazilian researchers have conducted other corpus-based investigations related to aviation, such as Prado [27] [28] [29] who addressed aspects of the oral language used by pilots in abnormal situations, with a focus on lexico-grammatical and pragmatic patterns. The results of Santos [30]' research also contribute to understand lexical terms used in emergency situations, as well as offer "a broader idea for the purposes of teaching material, pilot training and other purposes" (p. 190).

Also in Brazil, other studies were developed in the aeronautical area and based on corpus, such as those by Gabrielatos and Sarmento [31] and by Sarmento [32], which aimed to quantify and analyze the modal verbs used in manuals. Also based on a corpus of manuals, Bocorny [33] [34] analysis helped to understand polylexical units in this type of document. In addition to these studies, those by Zuppardo [35] and Prado and Tosqui-Lucks [36] were also based on the theoretical-methodological assumptions of corpus linguistics.

Thus, the study of English in aviation context through corpus linguistics approach has significantly contributed to teaching and learning. This type of research is important for teachers to select and understand language aspects, but

just a few has effectively and directly applied corpus to teaching (Data-driven learning, for example) and assessment [8].

Considering this theoretical foundation, it is undeniable that a corpus of technical documentation used in aircraft maintenance might contribute to teachers and students in teaching and learning English for this specific purpose. Based on these arguments, most important documents, which were selected to be in the corpus, are presented hereafter.

5. Aviation Maintenance Technical Documents and the Corpus

Sarmento [37] states that in the case of a corpus with a very specific theme, such as in the aviation area, it is up to the researcher to compile the texts based on a specific research project in mind, such as the production of teaching material. There is no limit to the size of the corpus or degree of specialization involved, but the parameters for limiting the type of text, oral or written, must be very well established.

So, taking into consideration all the aspects related to English used in aviation maintenance field, the criteria for building the corpus were: 1) the most important skill for professionals, *i.e.*, reading; 2) the most important documents related to maintenance practice; 3) availability of the texts and 4) variety of genres. Before presenting the data about the corpus, a brief explanation on each type of selected document is given.

Zafiharimalala and Tricot [38] explain that aviation documents used in maintenance have three main functions, they provide support to professionals to perform tasks, they are legal documents for recording the actions performed and they are used for training. The most popular one is the Aircraft Maintenance Manual, known by its acronym AMM. It is provided by aircraft manufacturers to guide how to perform specific tasks and is usually used by technicians and mechanics. Predominantly, it is written in imperative form as it is a set of guidelines for maintenance duties such as inspection, cleaning, repair, and replacement of damaged or malfunctioning components.

Another very common type of manual is the Component Maintenance Manual (CMM). It is issued by the manufacturer of a specific component and defines the maintenance actions that must be performed. This manual is also used by mechanics with technical or technological training and its characteristics are similar to the AMM's. Aircraft Operating Manuals (AOM) are used by all aviation professionals and by students for training. It is a document in which each aircraft equipment or system is detailed, and its operation is explained. The text, in general, is written in the present tense, as it is descriptive and very objective, without the use of figures of speech and there are few occurrences of reference elements, such as pronouns, for example.

Other documents are published by regulatory agencies, such as ANAC and the FAA. Airworthiness Directives (AD), for example, are legally enforceable rules to correct an unsafe condition in a product. Advisory Circulars (AC) refer to a type

of publication made by the FAA to provide guidance on compliance with airworthiness regulations, pilot certification, operational standards, training standards and other rules.

Aviation Accident Reports provide date, time, location, people and aircraft involved, nature of the event and all pertinent details of an incident or accident. They are widely known documents used in aviation and are written as reports, including the sequence of facts and transcripts of conversations (between crew and air traffic controllers, for example) as well as the mainly verbal forms used are those to report facts that occurred (such as simple past and past perfect).

Forms, in which all types of information about an aircraft and its maintenance are provided, are also very important documents in aviation specially because all communication among the company's sectors is done though them. The Logbook is another well-known document as it is the official record of all data related to the aircraft. The information available in this book is used to determine the condition of the aircraft, date of inspections, etc.

In addition to these documents, there are others such as the Aircraft's Flight Manual (full of instructions, used mainly by pilots), the Airworthiness Certificate (which approves the aircraft to fly) and all the professionals' personal documentation, such as the certificates issued by ANAC and FAA. It is important to mention that most of the documents are free to be accessed and downloaded, especially those issued by national and international agencies, and some of them are restricted so to be part of this corpus they were provided by a MRO company as a collaborative action to our project. Information about documents availability will be provided along with corpus description.

Considering the corpus will be used for different purposes, such as researching and teaching language aspects related to specific vocabulary and frequent grammar structures and for Data Driven Learning (DDL), documents were selected based on their use and relevance in aviation maintenance. The selected materials, their availability/source, publication date and the number of tokens (the number of individual words in the text) and types (the number of unique word forms) are shown in Table 1.

It should be emphasized, as it was done by Prado and Tosqui-Lucks [39] about their corpus, that this corpus also focuses on a very specific area, the aircraft maintenance. Considering it is within a particular field, the aviation, it might not only enable linguistic investigations but also "offer the opportunity to bring authentic language to the classroom, supplying the language professional with adequate tools to teach from meaningful input" [39] (p. 125).

6. Uses of the CoDoRAM to Teach English Vocabulary and Grammar Aspects

Wang [40], who presented information on construction and application of an aircraft manufacturing engineering English corpus, points out "a large number of real language use examples in the corpus can provide scientific guidance for the design of syllabus […]" (p.294) and that is one of the applications we intend

Table 1. Corpus of documents related to aviation maintenance (CoDoRAM).

DOCUMENT	AVAILABILITY	PUBLISHED BY	PUBLICATION DATE	TOKENS	TYPES
Airworthiness Directives	https://www.faa.gov/regulations_policies/airworthiness_directives/	FAA	issued in last 60 days-on 01/11/2021	183,297	4460
Aircraft Maintenance Manual-A319	Restricted-provided by a MRO company (R-MRO)	Airbus	2012	13,250,428	24,599
Aircraft Maintenance Manual-A330	R-MRO	Airbus	2011	8,532,432	18,481
Aircraft Maintenance Manual-B737	R-MRO	The Boeing Company	2005	2,595,840	13,828
Aircraft Maintenance Manual-B767	R-MRO	The Boeing Company	2010	180,595	3320
Aircraft Maintenance Manual-Cessna	R-MRO	Cessna Aircraft Company	2002	131,613	5949
Aircraft Maintenance Manual-EMB190.195	R-MRO	Embraer S.A.	2017	221,227	4425
Aircraft Operating Manual-B737	R-MRO	The Boeing Company	2018	645,854	7099
Aircraft Operating Manual-EMB190.195	R-MRO	Embraer S.A.	2017	773,303	20,944
Reports (ASRM: Aviation Safety Reporting System)	https://asrs.arc.nasa.gov/search/database.html	NASA (National Aeronautics and Space Administration)	thirty (30) ASRS Database Report Sets on 01/11/2021	952,913	12,316
Magazine	https://www.avm-mag.com/	Aviation Maintenance Magazine	All issues: from 2010 to 2020	1,744,543	35,909
Accident Reports	http://sistema.cenipa.aer.mil.br/cenipa/paginas/relatorios/relatorios.php	CENIPA (Aeronautical Accidents Investigation and Prevention Center in Brazil)	From 1962 to 2020	55,135	3927
Airworthiness Directives	https://sistemas.anac.gov.br/certificacao/DA/DA.asp	ANAC	From 1915 to 2020	236,558	5067
Handbooks and Manuals	https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/	FAA	2000 and 2018	1,030,684	18,248
Engine Manuals	https://jabiru.net.au/service/manuals/	Jabiru Aircraft Pty Ltd (Australian aircraft manufacturer)	Different dates	1,219,589	8325
Accident Reports	https://www.ntsb.gov/investigations/AccidentReports/Pages/aviation.aspx	NSTB (National Transportation Safety Board-US)	Reports issued since 1996 up to 01/03/2021	2,186,525	24,239
Structure Repair Manual-A320	R-MRO	Airbus	2014	2,724,590	12,467
Structure Repair Manual-B737	R-MRO	The Boeing Company	2002	441,900	9229
Trouble Shooting Manual-A320	R-MRO	Airbus	2008	7,146,123	7031
Total				**44,253,149**	**239,863**

to use the CoDoRAM for. Prado [41] had made the same point explicit saying the selection of the most common language chunks will show what content is to be taught.

Some studies [41] [42] [43] [44] have given ideas of how to use corpora for classroom applications. Some of them include turning concordance lines and other corpus data into activities, having a useful source of authentic language examples, enabling students to be researchers and form preliminary hypotheses about vocabulary and grammar uses. The cited authors defend that opportunity of inferring rules might lead to a more autonomous learning process. Examples to be presented are, therefore, related to the specific use of the CoDoRAM in an English for aviation maintenance teaching/learning context.

Considering the number of documents and their size, corpus analysis can be done in order to help teacher select the text, or an excerpt of it, to be used in a specific class. This selection can be guided by using concordance plot tool of Antconc [45], for instance. Because of their equal translation in Portuguese, students have problems in understanding the difference between some words such as "charge"/"load" (both are translated as "*carga*" in Portuguese), and "electric"/"electrical" ("*elétrico*") and the analysis of most common clusters with these terms helps them to discern the distinction, an adapted for classroom research activity similar to what was investigated by Costa and Camargo [25] regarding "safety" and "security" ("*segurança*").

The AMM and CMM are, in a simple way, sets of instructions and that is why verbs are so relevant for students and professionals to know in order to understand these publications. However, it would be hard to study many verbs based on a reading comprehension activity with an excerpt of them. Corpus analysis of these documents provides a list of the most frequent words—by using word/keyword list tool of Antconc [45], for example—and verbs can be highlighted by the teacher as well as their context of use (in concordance lines) aiming to offer students the opportunity to learn several verbs they will come across while following directions in the manuals.

Learners sometimes struggle with understanding noun strings, as it has been observed in classes, and when they are given guidance to explore the corpus using key words, such as system and valve, they might infer how to organize a cluster to give details/characteristics about its head noun (e.g. hydraulic system and shutoff valve). Another grammar aspect Brazilian English learners usually have problems with are the prepositions and it is helpful to use real examples from the corpus so they are able to study the most frequent co-texts and understand the differences of using each of them.

These are just some ideas of how the CoDoRAM can be explored and used for teaching and learning English for the specific purpose of reading and understand aviation maintenance technical publications. It is clear that the corpus analysis is not restricted to these mentioned points because there is a wide range of language aspects that can be investigated and there are many possibilities and dif-

ferent ways of using not only corpus analysis results but also the corpus exploration itself during classes.

7. Conclusions

This paper introduced the CoDoRAM and explained the most relevant technical publications in aviation maintenance field which were chosen to be part of the corpus. All the information presented can be used as a guide for English learners and teachers in order to understand the documentation of this area and as an inspiration to other language for specific purposes teachers considering corpora compilation, analysis and use inside their classrooms.

There is still much to be done considering corpus analysis in this specific area and their results in order to give teachers the opportunity to have a broader comprehension about linguistic features and to make informed decisions regarding classes and their contents. Besides that, there is a lack of studies regarding learners' performance and attitude when they are guided to explore corpora to learn English for a specific purpose.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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