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Terms in an Aircraft Mechanic's Professional Life

Abstract

The aim of the paper is to analyse a terminological mechanism applied in choosing English words and phrases which are the basis for professional communication between airport aircraft mechanics of various nationalities. Correctly applied terminology facilitates successful communication and can contribute to reducing incidents arising from errors made during aircraft pre-flight preparation. Aircraft mechanics communicate not only by means of specialised terms and acronyms, but also by AECMA/ASD[1] standardised *Simplified Technical English* for technical documentation purposes. Due to frequent text comprehension problems, common specific words have been selected according to the rule "one word – one meaning." Furthermore, English grammar has been simplified for successful international communication between aircraft mechanics. Thus, a specific communication tool has been created and is currently in global use, which indirectly contributes to flight safety. The author presents common trends applied in the process of terms selection in the working environment. She also emphasises the necessity of using clear and concise terminology in aviation communication. The author's observations can support aircraft mechanics' language training, and terminological as well as translation work. The article familiarises the reader with some key concepts of aircraft maintenance terminology.

Keywords: Simplified Technical English, aircraft maintenance terminology, technical documentation, Aviation English, aircraft mechanics' communication, pre-flight preparation, specialised language

Introduction

Air transport is a dynamic global industry. Every type of aircraft undergoes a pre-flight inspection by qualified personnel who are responsible for line maintenance, so accordingly they service aircraft, perform any small repairs and make entries in the aircraft technical logbook. Due to the fact that airports are now international places of work, aircraft mechanics need to understand and prepare the technical documen-

1 AECMA – European Association of Aerospace Manufacturers, ASD – Aerospace and Defence Industries Association of Europe

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tation as well as communicate with flight and cabin crews, all in English. Therefore, AECMA/ASD[2] has prescribed a rule 'one word – one meaning' that can support those with lower levels of English. In this way, successful aviation communication contributes to aviation safety and often reduces the potential communication problems when the crew is pressed for time.

The materials for the presented terminological research consisted of a variety of written texts such as AECMA/ASD recommendations, aircraft producer's manuals and daily maintenance documentation. All such writings are currently used at international airports. The texts were collected, read and examined. The analysis of many terms and syntactic structures selected in randomized order shows clear tendencies in forming utterances as well as term type selection. These occurrences were categorised following the most common usage. Consequently, the study suggests the most regular terminological combinations, taking into account all the above.

1. An aircraft mechanic's profile

An aircraft mechanic is a broad common term that is replaced by *an aircraft maintenance technician* or *an aircraft maintenance engineer* in various aviation regulations and specialised references. Aircraft maintenance personnel work around the globe in a number of "highly technical specialty occupations such as airframe and powerplants, maintenance, avionics (*e.g.*, navigation, communication, and other electronic-based or depended systems), and instrument repair (*e.g.*, navigation, flight, and engine)" (U.S. Department of Transportation, 2020) and their primary responsibilities include:

> inspect and test aircraft systems to ensure they are in proper working order; diagnose malfunctions or other problems in the aircraft or in mechanical components or systems including engines, hydraulic systems, flight control systems and fuel systems, as per technical manuals, drawings or blueprints; disassemble aircraft systems and remove defective components; assemble and/or install replacement parts, components and structures, as per technical manuals, drawings or blueprints; record problems and the action taken to rectify them, maintaining an accurate record of the maintenance history of the aircraft.
>
> (CCAA[3] 2020)

All types of aircraft maintenance must be performed and accepted only by authorised personnel. Moreover, according to European regulations, the repairs and inspections in question should be further double-checked and accepted by another colleague. In the European Union, all maintenance technicians must therefore be holders of a licence called *Aircraft Maintenance Licence (AML)*. It is issued by every European Union country's competent authority based on specific exams. The certificate also indicates the aircraft category for which a maintenance technician is recognised in order to perform maintenance (it is divided further into a base or line type). There are the following categories:

2 AECMA – European Association of Aerospace Manufacturers, ASD – Aerospace and Defence Industries Association of Europe

3 Canadian Council for Aviation and Aerospace

66.A.3 Licence categories

(a) Aircraft maintenance licences include the following categories:

- Category A
- Category B1
- Category B2
- Category B3
- Category C

(b) Categories A and B1 are subdivided into subcategories relative to combinations of aeroplanes, helicopters, turbine and piston engines. These subcategories are:

- A1 and B1.1 Aeroplanes Turbine
- A2 and B1.2 Aeroplanes Piston
- A3 and B1.3 Helicopters Turbine
- A4 and B1.4 Helicopters Piston

(c) Category B3 is applicable to piston-engine non-pressurized aeroplanes of 2000 Kg MTOM and below.

(Consolidated version of Part-66
of the Commission Regulation EC No. 2042/2003)

Clear detailed requirements for every category are provided by European regulations in *EASA*[4] *Part-66*, as in the following example:

> AMC 66.A.30(e) Basic experience requirements 1. For category A the additional experience of civil aircraft maintenance should be a minimum of 6 months. For category B1, B2 or B3 the additional experience of civil aircraft maintenance should be a minimum of 12 months. 2. Aircraft maintenance experience gained outside a civil aircraft maintenance environment may include aircraft maintenance experience gained in armed forces, coast guards, police *etc*. or in aircraft manufacturing.
>
> (Annex III (Part-66) to Regulation (EU) No. 1321/2014)

It is possible to hold different categories and type ratings on one AML. Depending on the category, an applicant must demonstrate an established level of knowledge on related topics specified in *EASA Part-66, Appendix I to Annex III*. Aircraft mechanics' career path is thus strictly regulated.

However, there is one aspect of their work that is not standardised. Although aircraft mechanics often work in an intercultural and international environment, they are not required to prove their knowledge of English by any formal means in contrast to pilots and air traffic controllers. Currently, there are no regulated English language tests in order to assess maintenance mechanics' level of English. Nevertheless, according to EASA regulations "holders of a Part-66 aircraft maintenance licence may not exercise certification privileges unless they have a general knowledge of the language used within the maintenance environment including knowledge of common aeronautical terms in the language" (EASA 2015, Part-66, GM 66.A.20(b)4). This ability is only assessed at the professional licence exam based on the applicants' answers to exam questions: "Questions may be prepared in the national language but the use of aviation English is recommended wherever possible" (EASA 2015, GM 66.B.200) and "(j) The answer should show the candidate's ability to express himself in technical language. This includes readability of the language, basic grammar and use of terminology" (EASA 2015, Part-66, GM 66.A.20(b).

4 EASA – European Aviation Safety Agency

Therefore, everyone who applies for the position of an aircraft mechanic is supposed to demonstrate their ability "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" (Annex III, Part-66, 66.A.(b)4, 2014) while performing their tasks. In its *Guidance Material* (2015), European Aviation Safety Agency (EASA) further explains:

> The level of knowledge should be such that the licence holder is able to:
> — read and understand the instructions and technical manuals used for the performance of maintenance;
> — make written technical entries and any maintenance documentation entries, which can be understood by those with whom they are normally required to communicate;
> — read and understand the maintenance organisation procedures;
> — communicate at such a level as to prevent any misunderstanding when exercising certification privileges.

2. Simplified Technical English (STE)

EASA language requirements for aircraft maintenance personnel, presented in *Guidance Material* (see above) are very general. In a real working environment, there are, additionally, specific rules of technical aviation English use in order to reduce the misunderstanding of technical texts. Such principles were created in the 1980s by the *European Association of Aerospace Manufacturers* (AECMA). Operational and maintenance manuals are generated by manufacturers, however, operators and technicians, who may be neither scientists nor engineers, have to understand information that the design community is trying to communicate to them (Borowska 2017: 85, after Chiarello & Knezevic 2013). Since the readers of technical documentation may still have limited knowledge of English and may be easily confused by complex syntax and synonyms, the AECMA's work is followed by the *Aerospace and Defence Industries Association of Europe* (ASD), which regularly issues international specifications for the preparation of technical documentation in a controlled language called ASD Simplified Technical English (STE)[5].

The purpose of STE is to provide technical editors and readers of maintenance documents with clear and easy to follow rules for documentation that include prescribed vocabulary. The specifications consist of two parts: 1) a set of writing rules that covers aspects of grammar and style, and 2) a controlled dictionary that gives the general words that a writer can use (ASD STE 2017: i). The main idea of the presented sets of words is that they are not only simple and easy to recognise, but each word has only one meaning and functions as only one part of speech: "When there are several words in English for the same thing (synonyms), STE permits one of these synonyms to the exclusion of the others. For example, STE uses 'start' instead of 'begin', 'commence', 'initiate', or 'originate'" (ASD STE 2017: ii). Thus, STE rules prescribe exactly which word should be used. The same applies to the function of a given word as, in general, only one part of speech is permitted for each word, *e.g.* the verb *cover* is not approved here, but only the noun a *cover*. Therefore, *to cover* is replaced by a synonym *to include* or by a phrase *to put the cover on* (*Ibid.*)[6]. Additionally, the STE dictionary includes some unapproved words that can be technical names

5 Also called Simplified Aviation English – SAE (see Borowska 2017).

6 See more on STE in Borowska (2017: 2.5.3) as this paper does not aim at presenting syntactic structures in detail.

if you can put them in the applicable technical name category, as shown in the following example (*Ibid.* 1-1-7):

Examples:

"Base" is an unapproved word in the dictionary. But you can use this word as a technical name.

STE: The base of the triangle is 5 cm.
("Base" is a technical name, category 7, mathematical, scientific, and engineering terms.)

Non-STE: *Make sure that the two spigots at the base of the unit engage.*
("Base" is an unapproved word that is related to a surface.)

STE: Make sure that the two spigots at the bottom of the unit engage.

The same word "base" can go into different technical name categories when it is used with different meanings in different contexts.

Example:

STE: Access to the base is permitted between 9 a.m. and 6 p.m.
("Base" is a technical name, category 5, names of facilities, infrastructure, their parts, and locations.)

Figure 1. Examples in *ASD STE* (2017)

Furthermore, STE specification supports technical translation: "If the vocabulary, meanings of words, and the types of sentence constructions in a text are controlled, the variation between texts will be minimal. Thus, it is easier for translators or translation machines to translate text written in STE into the target language" (ASD STE 2017: iii). Currently, STE seems to be a useful element of aircraft mechanics' international communication. Because they are familiar with it, AMTs are more prone to follow its rules in their every day speech and technical documentation. It is highly probable that when in doubt, *e.g.* whilst preparing a report, they will turn to well-known expressions and structures instead of seeking new ones.

3. Terminology at aircraft mechanic's work

For the purposes of this paper, the definition of terminology presented by *Cambridge Dictionary* (2020) is applied: "special words or expressions used in relation to a particular subject or activity". Aircraft maintenance as a technical domain has its rich terminology that enters the technical language domain at the moment when a new flying machine is launched on the market. All the documentation and manuals for mechanics are prepared beforehand and are ready to be used at the same time. In this way, the new terminology is promoted. However, it does not mean it is uniform as manufacturers may still use different terms.

Every aircraft mechanic works primarily with terms of the aircraft category they are qualified for. Therefore, they are supposed to demonstrate all four language skills of English while performing their duties, including the knowledge of the required technical terms defined by the occupational context: 1) *reading* that is necessary for the comprehension of technical manuals, reports, work cards and oth-

er documentation, 2) *writing* for preparing reports, completing forms (*e.g.* description of work accomplished) as mechanics are required to make appropriate entries of maintenance actions or inspection results in the aircraft maintenance record on a daily basis, 3) *listening* for the comprehension of dialogues between maintenance personnel, but also among flight crew, dispatchers, airport managers and other operations personnel, and 4) *speaking* mainly for troubleshooting, clarifying information, reporting and giving instructions. According to research on aircraft mechanics' level of English, poor communication skills are still listed as one of the human factors that affect maintenance performance (*Aviation Maintenance Technician Handbook–General* 2018):

> Lack of communication is a key human factor that can result in suboptimal, incorrect, or faulty maintenance. Communication occurs between the AMT and many people (*i.e.*, management, pilots, parts suppliers, aircraft servicers). Each exchange holds the potential for misunderstanding or omission. But communication between AMTs may be the most important of all. Lack of communication between technicians could lead to a maintenance error and result in an aircraft accident. This is especially true during procedures where more than one technician performs the work on the aircraft. It is critical that accurate, complete information be exchanged to ensure that all work is completed without any step being omitted … In general, the technician must see his or her role as part of a greater system focused on safe aircraft operation and must communicate well with all those in that system to be effective.

Having analysed the entries in technical documentation made by aircraft mechanics, it can be observed that the general tendency of constructing entries is similar to the rules suggested by ASD (see above); namely: simple, clear and short, however, still including specialised terms. Complex sentences are not used in general, but phrases with conjunctions are common, *e.g. Fan Vibrations Higher than or Equal to 6 Units on Engine 1 or 2, Inspection of the Combustion Chamber and HPT Nozzle Following a Birdstrike / FOD*[7]. Moreover, instead of simple sentences, there are elliptical structures that are used to facilitate comprehension and utterance formation. For example, passive expressions are frequently used without the verb *to be,* but only with the past participle of the active verb. This fact does not interfere with meaning when used in context, *e.g. Oil pump replaced. / Replacement deferred. / No action required*. Nominal structures are also particularly common and useful in job cards, *e.g. Borescope Inspection of the Booster Rotor Blades, Stages 2,3,4 and 5 through the Booster Inlet and Borescope ports SO3 and SO5; Inspection / Check of the Spinner Cone, EIS Stop Procedure*[8].

Therefore, text cohesion is achieved mainly by the context. Aircraft maintenance personnel have to be able to comprehend and produce wording that is an appropriate combination of grammar and vocabulary. The question is about the best method of using proper terms and syntactic structures that would aim to facilitate written maintenance communication on a regular basis.

Due to the fact that there is an enormous repository of possible terms, aircraft mechanics are recommended to follow generally accepted rules when selecting the word to use. Firstly, according to the ASD-STE100 dictionary, there are twenty categories that must be applied to determine whether a word qualifies as a technical name and eleven categories of technical verbs. For instance, the word *interference* may not be used when it means "things knocking together" but it is permitted in describing electrical interference, which is "not an event but rather an environmental condition" (Werfelman 2007: 20). Ad-

7 Airbus Job Cards (2014)

8 Airbus Job Cards (2014, 2016)

ditionally, *EASA* has published its *Acceptable Means of Compliance and Guidance Material to Annex III (Part-66) to Regulation (EU) No 1321/2014* that contains basic terminology for practical experience and on-the-job-training (OJT) in the form of a list of tasks. For 'a landing gear' context, these are as follows:

Build up wheel.
Replace main wheel.
Replace nose wheel.
Replace steering actuator.
Replace truck tilt actuator.
Replace gear retraction actuator.
Replace uplock/downlock assembly.
Replace shimmy damper.
Rig nose wheel steering.
Functional test of the nose wheel steering system.
Replace shock strut seals.
Replace brake unit.
Replace brake control valve.
Bleed brakes.
Replace brake fan.
Test anti-skid unit. (*op. cit.*: 99)

Such lists are useful, especially for novice maintainers and mechanics with lower levels of English, because they clearly suggest verbs and nouns to be used in context. For example, the verb *to replace* instead of *to change* is recommended here, though the last one is used in collocations of different aspect, *e.g. Change magneto. / Change shroud assembly*.

Secondly, aircraft mechanics follow the terms they find in all types of technical texts provided with a given machine, such as: the Aircraft Maintenance Manual (AMM), Illustrated Parts Catalog (IPC), Troubleshooting Manual (TSM), Service Bulletins (SB), Airworthiness Directives (AD), Service Information Letters (SIL), Structural Repair Manual (SRM) or Component Maintenance Manual (CMM) and Engine Shop Manual (ESM), *etc*. The terms in question consist of single word, two-word or multi-word constructions, *e.g. cantilever, stiffener, shimmy damper, gudgeon pin, blade lockpin pulllers, welded steel truss, outer dead centre*. Moreover, Shawcross (2020) notices that the last decade and a half has brought an increased reading load in the form of on-board computer interfaces used for system monitoring and troubleshooting. Airlines themselves have also generated computer systems designed to manage inventory, parts flow and maintenance performed.

Finally, all the above findings in studying the authentic maintenance materials for frequent terms reveal several terminological modules that are used on a daily basis by aircraft mechanics. They can be classified as follows:

- aircraft construction, *e.g. a flap actuator, a windshield cover, fan cowl doors, main landing gear tension strut*
- mechanical parts, *e.g. a cross-feed valve, an emergency ram air turbine, a combustion chamber, a thrust reverser, a trailing edge beam, high pressure compressor rotor assembly*
- faults and their causes, *e.g. blade wear, blade damage, cracks, gaps, holes, leaks*

- maintenance performance: *perform, check, test, replace, troubleshoot, inspect*
- chemical processing, *e.g. polymer processing, anodizing, passivation*
- other general technical terms such as material properties, processes, casting, *etc.*

Since frequently used acronyms in this context (*FOD, AMT, CAN, APU, GBAS, CFDS, OMS*, etc.) represent specific terms of a structure similar to the above, they are not given attention separately in this paper.

It is worth noting that long multi-word terms used to designate mechanical parts or parts of aircraft construction are in regular use in maintenance documentation. Therefore, particular attention should be drawn to their structure. The ability to understand and further create terms composed of three or four nouns, the so-called noun clusters, often preceded by an adjective or two seems to be crucial for aircraft mechanics, *e.g. main landing gear drag pin shim, oleo pressure valve, flight path angle selector.* The order of words is strict and a random change affects the meaning, *e.g.* location-function-object. Additionally, Burda and Maciejowski (2019) point to another important aspect of technical terms formation, namely the order of nouns in pure noun clusters where qualifiers precede a key-word, *e.g. bleed air* means 'air from engine compressor', whilst *air bleed* means 'a system that provides hot air'. Thus, aircraft mechanics have to carefully observe exceptionally long multi-word terms in all types of technical documentation in order to refer to them correctly. This task, however, is not as easy as it may seem because AMTs face the diversity of terminology used by various part, equipment and aircraft manufacturers.

Conclusions

This article highlights the aspect of terminology in the aircraft mechanics' daily professional routine. The high-risk environment imposes strict regulations on every aspect of aircraft maintenance personnel work, from the employment to the preparation of technical documentation at all levels. Increasingly, people work together across linguistic borders and the English required for this type of work is not always a native language. Therefore, they may make inaccurate terminological choices without necessarily being aware of it, even when they know which terms or forms are appropriate in a given instance.

The abovementioned examples show that aircraft mechanics work on a wide range of aircraft and equipment, and often it is not possible to follow uniform terminology. STE guidelines are to raise the awareness level of the language used at their work. In the terminology of technical documentation used by aircraft maintenance mechanics, the rule 'one word – one meaning' should still be followed. Together with a simplified grammar of English, it contributes to effective aviation technical communication all around the world. It is mandatory to understand maintenance documentation correctly so as to make sure that systems operate safely and correctly and to protect human lives (ASD STE 2017, i). Consequently, a vast majority of the utterances that have been looked at are not incidental. Although English grammar has been effectively simplified, we cannot say the same about technical terms. Unfortunately, multi-word terms from many sources do not make mechanics' life easier. Being familiar with the word-formation and the mechanism of presented terminological modules of a selected aircraft category may not only simplify the daily work, but also satisfy the needs of rapidly developing aviation technology. The data presented in the article may support the AMT language training process as well as any other work within the context of aircraft maintenance. It would therefore be useful to take a more discourse-analytic approach to the study of the ways in which AMT terminology is applied.

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