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Characterizing aviation maintenance manuals written in the controlled language ASD-STE100 as a genre: a corpus analysis

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Abstract. The texts associated with aircraft maintenance are fundamental in the maintenance process and in aircraft security. Aviation maintenance manuals –the core of this documentation– have to comply with regulations concerning content, format and expression. To ensure uniformity, manuals abide by a specification which regulates writing practices accommodating them to the controlled natural language ASD-STE100, a simplified version of English used as a standard in the industry. Through the qualitative analysis of a corpus of maintenance texts, this paper characterizes aviation instructions manuals as a genre by (i) illustrating the most relevant restrictions imposed by the specification and their implementation at the surface levels glossed in the specification and (ii) providing a description of the rhetorical macrostructure of instructional texts. The analysis reveals discrepancies between actual use and the rules which concern lexical, phrasal or sentential units; compliance with the rhetorical macrostructure seems to be the norm, however. As an explanation, it is hypothesized that deviations occur in areas where the specification clashes with standard technical writing practice, supporting thus the view that genres are mediated by social practices. Although further quantitative analysis is pending, this description of the use of ASD-STE100 might prove of interest both to scholars and practitioners.
Keywords: controlled natural language ASD-STE100; instructional genres; technical genres; maintenance manuals; rhetorical structure.

[es] Caracterización como género de los manuales de mantenimiento para aviación escritos en el lenguaje controlado ASD-STE100: un análisis de corpus

Resumen. La documentación relativa al mantenimiento de las aeronaves es crucial en las operaciones de mantenimiento y en la seguridad aérea. Los manuales de mantenimiento –elemento central de tal documentación– deben ajustarse a regulaciones que conciernen a su formato, contenido y expresión. Respecto la última, los textos deben seguir a las normas del lenguaje controlado ASD-STE100, una versión simplificada del inglés cuyas reglas de escritura se detallan en una especificación. En este artículo se pretende caracterizar a estos manuales como género. Para ello, (i) se detallan las restricciones lingüísticas más relevantes de la especificación y se analiza cualitativamente su implementación en un corpus, y (ii) se ofrece una descripción de la organización retórica de los textos instruccionales. El análisis revela discrepancias entre las reglas y su implementación en los niveles léxico, sintagmático y oracional, pero no así en lo referente a la organización macro-estructural. Aunque un análisis cuantitativo del corpus debe confirmar los resultados, como explicación se sugiere que las desviaciones aparecen cuando las reglas suponen un conflicto para los escritores/editores por diferir de las de la escritura técnica general, lo que confirmaría la hipótesis de que los géneros están mediados por las prácticas sociales.
Palabras clave: lenguaje controlado natural ASD-STE100; géneros instruccionales; géneros técnicos; manuales de mantenimiento; estructura retórica.

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1. Introduction

1.1. Background

On July 24th, at the busiest point of the summer season of 2019, the year before a pandemic sent the world into lockdown, the tracking service Flightradar detected 225.296 flights worldwide; the report for 2019 by the Airports Council International was of 9.1 billion passengers and 102.3 billion aircraft movements; this association forecasts a 2% annual growth of operations until 2040, that is, nearly 150 billion air operations a year. Every time the engine of a plane starts before taking off and shuts down after landing, it completes a flight cycle; it is the number of such cycles together with the flight hours of the aircraft that determines the type and scope of the maintenance operations needed to keep it serviceable (Mofoken, Mativenga, and Marnewik 2020). When set in the context of the figures of air traffic, it is easy to appreciate that the hours of labour and the cost required by aircraft maintenance are a major expense for airline companies, for whom "maintenance is required to keep the aircraft in a serviceable and reliable condition to generate revenue, to minimize its physical deterioration to reduce operating cost due to failure, and to abide by the regulatory authorities' requirements" (Mofoken, Mativenga, and Marnewik 2020: 467-468). The focus of the authorities is, rather, on the security of the aircrafts, as maintenance has been proved to be a triggering factor in the chain of errors leading to accidents or serious in-flight incidents (Hackworth, Holcomb, Dennis, Goldman, Bates, Schroeder, and Johnson 2007; Guo-Feng, Hwang, Min-yang Wang, and Patterson 2010). Research on the assessment and remediation of maintenance errors has shown human malpractice to be a key element in half of the incidents (Hackworth et. al. 2007), and, among the many reasons that may elicit human error, Hackworth et. al. specifically point at "mechanics not reading or following the maintenance manual, mechanics overlooking required inspections items, and mechanics making logbook errors" (2007:1); in the same line, Guo-Feng Liang et al. (2020) single out task instructions as an external factor that determines task performance. The texts associated with maintenance play an important role in the maintenance process, and, to avoid mishaps, personnel around the world need to be competent readers (and to a lesser extent, writers) of a considerable volume of technical documentation written in English, the lingua franca of aviation since 1944. The core element of that documentation is the maintenance manual, an aircraft-specific guide supplied by the manufacturer that has to comply with regulations (Hinsch 2019: 63) which establish the format and the organization of the documents[2] and prescribe the use of simplified English.

The intent on the development of a simplified or controlled English to be used in maintenance documentation started in the 70s and crystallized in 1986 when the European Association of AeroSpace and Defense (ASD) Industries published a first guide to Simplified Technical English (STE) that would eventually become a standard in the industry: the ASD-STE100 specification. This writing manual, now in its 8th edition (AeroSpace and Defence Industries Association of Europe, ASD, 2021), contains the "approved" vocabulary and the writing rules to which the texts should conform. Although the specification tries to use a language as simple as possible and avoids linguistic terminology, it is usually the case that writers/editors need training –something which ASD also encourages– to ensure uniformity. Even so, when compared with a corpus of texts employed in the aviation industry, discrepancies between the rules stated in the specification and actual use can sometimes be observed, which suggests that the specification may prove insufficient or, at least, non-transparent to trainers, trainees, writers, editors, and readers alike. A description of the real use of the controlled language could improve the production and reception of the texts, facilitate the translation and teachability of the controlled language, and might, somewhat, well contribute to the ultimate aim of preventing human error. If we address aviation maintenance manuals written in STE not merely as "how to" (Harris 1983) or procedural (Longacre 1982) texts, but as a specialized technical instructional genre[3] (Bhatia 2004: 59, citing Lassen 1998), the description of the language, the structures, and their implementation would not be a mere list of rules with which writers/editors have to comply, but, rather, the means of acquiring the generic competence (Bhatia 2000) or the "genre knowledge" necessary to complement "professional knowledge and experience of professional practice" (Bhatia 2004: 20).

1.2. Manuals as a genre

Like other instances of procedural written discourses, manuals –be they intended for aircraft maintenance or to elucidate any type of standardized practices– can be approached from the point of view of genre as

[2] Aviation maintenance manuals have to follow the ATA (Air Transport Association) systematics, also known as ATA chapters. This systematics is a taxonomy that organizes as a numbered list in XML format the sections and subsections that appear in aircraft maintenance of instructions manuals in order to achieve consistency among the different aircraft companies (Hinsch 2019: 60). As an example, ATA section 32 is dedicated to the Landing Gear, within this section we will find numbered subsections, for instance: 00 General; 10 Main Gear and Doors; 20 Nose Gear /Tail Gear & Doors; 30 Extension and Retraction, etc.

[3] The terms *instructional* and *procedural* are sometimes not used as equivalent, and, thus, in some studies the concept *instructional* has a broader focus on *how to* discourses, which could, for instance, include textbooks or teaching manuals. Here we understand both terms as synonymous, as in this definition by Isani (2019, citing Aouladomar and Saint-Dizier 2005): "Procedural texts, an essentially written genre, are instructional texts which explain how to realize a certain goal by means of actions which are at least partially organized" (Isani 2019: 75).

traditionally understood in the field of English for Specific Purposes (ESP). This implies the combination of the complementary approaches to genre posited, first, by Swales (1990: 58) –for whom it is the shared communicative purposes of a genre, its rationale, that determines its content, its internal organization, and stylistic choices–, and, later, by Bathia, for whom:

> Genre essentially refers to language use in a conventionalized communicative setting in order to give expression to a specific set of communicative goals of a disciplinary or social institution, which give rise to stable structural forms by imposing constraints on the use of lexico-grammatical as well as discoursal resources (2004: 23).

In Bhatia's view (2004: 18-23) the analysis of discourse as a genre overlaps the traditional description of formal linguistic characteristics –an approach he labels "discourse as text"– and a more socially and contextually oriented approach in which discourse is understood as a social practice. For him, genre is the mediator between the two visions, and, thus, depending on the specific aims of the scholars, genre analysis may favour one or the other.

The genre description of procedural discourses is certainly not an uncharted territory. Swales (1997) highlights instructions for the preparation of poultices as one of the earliest technical texts. Procedural texts have also been frequently employed for pedagogical purposes; as an example, Eggins (2004: 66-67) presents cooking recipes as a prototypical genre exemplar to explain the differences between the "generic structure potential" and its realization in the "actual genre structure" as understood in the Systemic Functional Grammar (SFG) tradition. Within the field of ESP, and narrowing the focus to technical instructional genres or sub-genres, several studies can be highlighted. Inspired by the frameworks previously posited by Bhatia (1993) and Lassen (1998), Felices-Lago and Fernández Lloret (2012) devote a volume to providing the rationale for the generic analysis of technical manuals and to their linguistic characteristics, which are illustrated with the analysis of *Silestone*© manuals. Sharpe (2014) describes the macro-generic structure of automotive technical manuals underlining the multiple rhetorical functions that the moves may perform and emphasizing that learners should be acquainted with them. Cristobalena (2015, 2018), by means of the analysis of a corpus of English and Spanish texts, describes the generic structure of instructions manuals for household appliances, establishing their moves and steps together with their linguistic realization. From a more contextual perspective, Isani (2019) also delves into the analysis of the organization of instructions for use of everyday appliances, describing their rhetorical conventions and highlighting the difficulty of assessing the discourse community in which they belong. In her more recent analysis of technical manuals, Lassen (2003) also shifts the focus to a contextual approach to the analysis of these texts, which –inspired by Hasan's (1985) generic structure potential analysis– she now describes in line with the SFG genre tradition as a linear and recursive three-stage schema. Finally, it is worth mentioning that the description and formalization of instructional or procedural discourses is also relevant in the field of computational linguistics both for Natural Language Understanding and for Natural language Processing purposes. To achieve the first task, Aouladormar and Saint-Dizier (2005) study their discourse structure in order to design an annotating tool which can generate text; aiming at the second, in Díaz-Galán and Fumero-Pérez (2021) a first approach is made to the formalization of the generic structure of STE manuals.

What can be appreciated in these studies is a shift towards one or the other of the different, but complementary, approaches to the analysis of genre signalled by Bhatia (2004), that is, a focus on the textual or the contextual, and a variety of purposes, be these professional, pedagogic or computational. This diversity can also be observed when authors spell out the rationale of technical manuals; thus, for Felices-Lago and Fernández-Lloret, "the purpose of a technical manual is to offer enough information to the audience in order to get the job done, i.e. to substitute the engineer's verbal instructions with text" (2012:12), while, for Lassen, "the deepest purpose of a technical manual is to ensure correct use of a given product with the purpose of safeguarding the reputation of a firm" and "to prevent operation errors, which will invariably lead to higher repair and maintenance costs on the part of the manufacturer" (2003: 75). Both definitions are compatible and suitable for aviation maintenance manuals written in STE: they are technical documents with an instructive purpose, and we can understand as such informing about aircraft components and learning how to perform a maintenance task; at the same time, they are procedural, as a number of steps in an established order must be taken to achieve the goal of completing a maintenance procedure which will avoid malfunctions that could have dire consequences for aircraft safety and, eventually, for aviation operators.

Another distinguishing feature of STE maintenance manuals is the discourse community where they are embedded and their participants. If manuals for household appliances, or even recipes, are written by experts and addressed to the general public, in the case of aviation maintenance manuals both writers and readers are knowledgeable experts in their field. The highly specialized nature of the content and the fact that authors are informed technical writers, I will argue, will cause some of the deviations from STE norms that we have observed in the corpus; a second factor which influences the writing of these texts is that, many times, the documents are not produced by a single (anonymous) writer, as they might be re-written, updated, or simply edited by different writers/editors at different stages. A further peculiarity of these written documents is that

they are the outcome of several previous texts –i.e., Maintenance Planning Data Documents, the Air Transport Association (ATA, see note 2) systematics, the STE specification, etc.– which could be considered the "genre colony*"* (Bhatia 2004: 53), with which technical writers should be familiar. It is the fact that they are written in STE that separates this type of text from other technical instructions manuals and which –together with the characteristics just glossed– allows us to classify them as an instructional technical subgenre that serves a specific purpose in a community of practice.

1.3. Aims and method

The aim of this paper is to describe this technical subgenre of manuals through the analysis of a corpus written in the controlled language STE. I will analyse the instantiation of the writing rules prescribed in the STE specification to highlight its main linguistic features and to determine whether writers/editors follow the conventions, that I understand as generic, or if they, sometimes, choose not to conform to the rules, displaying a creativity that clashes with STE prescriptions (but –I will argue– not with professional practice), and that might contribute to the misinterpretation of the text. I also seek to depict aviation maintenance instructions manuals by focusing on the two text types –the descriptive or informative and the procedural– inherent to the genre of instructions manuals. Finally, I will present the elements that seem to constitute the rhetorical structure of the texts which detail the maintenance procedures in these manuals. To this end, I have carried out a qualitative analysis of a corpus of aircraft maintenance texts written in STE employed by the *Airbus* company and which consists of 2480 XML files and 687,345 tokens, and contains "instructions" ("how to use" and "safety procedures"), "descriptions" ("elements", "technical data" or "systems"), and "warnings" (Felices-Lago and Alameda-Hernández 2017: 109-110). The corpus follows the regulated taxonomical organization imposed by the ATA, and, although the original documentation contains images, the sample to which I had access was entirely written and images were removed, as this is an internal document of the company and accessible in its complete version to maintenance crews only. The tool AntConc (Anthony 2020) was used to facilitate corpus search and –since this paper could be inserted in a tradition within ESP in discourse and genre analysis has a context-oriented approach (Gledhill and Kübler 2016)– this tool was employed to detect in the corpus the lexical and syntactic features which would instantiate the rules for STE described in the specification.

The paper has been organized as follows: in section 2 I will approach the discourse of aviation maintenance manuals written in STE as a *text*, that is, as a document that has to conform to the surface-level formal rules of the controlled language as stated in the STE specification; in section 3 I will present the moves and steps that instantiate the generic rhetorical macrostructure of the texts which explicit the procedures in these aviation manuals; 4 will discuss the implications of the analysis; finally, section 5 summarizes and draws conclusions.

2. Aviation maintenance manuals written in STE as *texts*: the STE specification

The language of aviation in particular and, more broadly, technical discourse, have been extensively described, especially for instructional purposes, from a formal standpoint; the STE writing manual would be the epitome of a formal approach centered on the "surface-level properties of discourse" (Bhatia 2004:19). This does not come as a surprise if we take into account that the specification has been designed for writers/editors to meet the requirements of STE, which, as any other controlled language is "a constructed language based on a certain natural language, being most restrictive concerning lexicon, syntax, and/or semantics" (Khun 2014: 3). The specification is, then, a prescriptive guide for technical writers/editors who already have a high degree of expertise on technical writing in English but have to "control" their writing; it is, then, a sort of *meta-manual* and, as such, another of the elements of the "genre set" (Bhatia 2004: 55) with which technical writers/editors need to be acquainted for their professional practice.

The STE specification contains two main sections which are strictly prescriptive: one which spells out "Writing Rules" (Part 1), and another which compiles a lexicon of approved words and approved word forms, the "Dictionary" (Part 2); these two "parts" are preceded by a "General introduction" to the STE language and its purposes. Interestingly enough, the specification opens with what could be called a "Preliminaries" section which contains the usual reference material (i.e. subject index or table contents), and, also, a list of revisions of previous editions (29 pages long in the 2021 edition) together with a "Form to suggest changes" to the current edition. What this seems to indicate is that –different from maintenance manuals– the specification is a dynamic text which allows technical writers/editors the status of qualified participants whose role is not merely to instantiate STE rules. If we have a look at these rules, we realize that they not only try to regulate the use of the formal traditional units of linguistic description (words, phrases, sentences, paragraphs), but that there is also a textual or discursive intent, as they try to homogenize the types of *writing* which they present as inherent to instruction manuals (i.e. descriptive, procedural, and safety instructions). In this section, I will try to provide a brief overview of the most relevant rules and how they are instantiated, or flaunted, in the different levels.

2.1. STE words

The lexicon of a document written in STE consists of the company-specific technical vocabulary (technical nouns, verbs, and adjectives) together with the "approved" words and word forms and meanings listed on the specification dictionary. What the rules concerning the STE lexicon seek is to avoid the ambiguity inherent to the complexity of technical language. In the case of nouns, they try to prevent noun clusters or noun compounds that may be difficult to understand by reducing them to a maximum of three words or by indicating that they are single units with hyphens. This practice, however, does not seem to prevent either inconsistencies or the intricacy of nominal compounds, as in the following example (emphasis indicated with italics henceforth):

(1) The lower *lock link* is attached to the *drag stay assembly* with the *drag-stay center joint-pin.*

The pronominal system in STE is also controlled, thus, first and third person personal or possessive pronouns are "not approved" ([*n.a.*], henceforth), nor are self-pronouns or some indefinite pronouns (e.g. *any*, *few, many*); demonstrative pronouns have mainly a textual function, as they are a means to provide anaphoric cohesion:

(2) Wait for a minimum of 2 seconds before *you* click CONTINUE. *This* will make it possible to find continuous failure, if *any* [*n.a*.].

As for verbs, their forms are also considerably reduced in terms of (i) their constituency (no phrasal or prepositional verbs), (ii) their morphology (e.g. *–ing* or *–ed* participles can only be used as adjectives or as technical nouns); (ii) their combinatory ("no complex verb structures"), or (iv) in modality (i.e no epistemic uses of modals). These rules entail, first, a reduction of the set of auxiliary verbs to primary *do, be,* and *will,* and to epistemic *can, could, and must;* secondly, the combination of the prescriptions on verbs also rules out aspectual distinctions and the use of the passive voice. In the case of the latter, the specification devotes a whole section (pp. 1-3-5 to 1-3-8) to explaining how to avoid the use of passive sentences; actual usage, however, shows different:

(3) The rigging of the proximity sensor *is done* [*n.a*.] *by* a change of the jam nuts position on he target.

Adjectives and adverbs –and their inflection– are also regulated, and alternative words provided when they are not allowed. In (4) we see, for instance, an approved use of the comparative adjective *soft* in a resultative construction and in (5) a non-approved use of the word *soon* as an adverb in a parenthetic adverbial clause:

(4) It can be used to make the contact between the bracket (9) and the electrical connectors (4) and (13) *softer*.
(5) In normal mode, as *soon* [*n.a*.] as the Kneeling System is energized, the system BITE sends all the fault messages to the CMS in real time and resource BITE of the CPIOM-G.

Textual uses of adverbs are also allowed, again, to achieve cohesion between two sentences. Notice the standard use of *then* in (6) and the deviant (and unnecessary) use of the same adverb in (7):

(6) Click "FUNCTION SELECTION" or "RETURN", *then* close the "System report test" page.
(7) The module monitoring-system partitions keep the failure reports to *then* [*n.a*.] download them through the CMS.

Although the set of approved linking adverbs is limited to *also*, *then,* and *thus*, examples of other conjuncts could also be identified:

(8) The U-turn is designed to do it with the engine-pumps. *Therefore* [*n.a*.], if the MLG legs do not get the static condition, it is necessary to do the U-turn and reset again

2.2. STE phrases

The complexity of technical words necessarily derives into a parallel complexity of phrases. In their proposal of formalization of STE phrasal constituents for their automatic parsing, Cortés-Rodríguez and Rodríguez-Juárez (2018: 102) affirm that the possibility of complementing the restricted vocabulary with company-specific technical terms combined with the use of hyphenation implies that, *de facto,* STE vocabulary cannot be controlled and that, as a consequence, the complexity of phrase structures cannot be prevented. The fragment in (9) is an illustration of the structural convolutedness of some phrases in STE, a complexity which, in this

extract, is enhanced by sentences which exceed the allowed word count and include the non-approved use of the passive voice:

(9) The IRDCs monitor the CPIOMs-G output hydraulic pressure and send *the signal to open he NBSELV to supply the blue hydraulic pressure to the servovalves of the NBCMs* [1 noun phrase = 18 words]. *With tachometers and pressure transducers feedback during the landing operation* [1 prepositional phrase = 10 words], it is given [passive, *n.a.*] *the pressure control loop to the servovalves to command sufficient braking-pressure and brake to the aircraft* [1 noun phrase= 16 words].

Another source of ambiguity is the approved and frequent use of clausal postmodification. Relative clauses are very common, and equally so are adjectival non-finite *–ed* and *–ing* clauses, exacerbating the complexity of noun phrases. In (10) I highlight two approved but, nonetheless, potentially equivocal modifiers: an *–ed* adjectival participle (in fact, a reduced non-restrictive relative clause) and an ungrammatical non-restrictive relative clause introduced by *that*:

(10) The tires, *installed on the wheels*, absorb the energy when the aircraft operates along a rough surface or during landing. They also cause friction with the ground, *that gives directional control and deceleration* [*sic*].

Finally, it is worth noting that the STE rule that specifies that *–ed* and *–ing* forms of the verbs are to be used as "adjectives" (that is, as noun modifiers) is, many times, not observed. In (11) we can see the adverbial use of the *–ing* clause (see also example (18)).

(11) The servovalves get [*n.a.*] the differential-braking *adjusting the hydraulic pressure from the blue system to each wheel.*

2.3. STE sentences

STE rules concerning sentences are aimed at the simplification of these units. The main stipulations concern: (i) word count, which prescribes a maximum of 25 words for descriptive texts and 20 for procedural writing (hyphenated words, parentheses, and lists count as a single word); (ii) the simplification of sentence structure in terms of content (summarized as 1 topic per sentence), and (iii) avoiding the use of ellipses. As regards the first of these prescriptions, although writers/editors generally seem to adhere to word count rules, sometimes they are flouted, as indicated in (9) above. Notice also how devices such as parentheses, in actual use, may result in longer sequences than desired:

(12) The NLG leg assembly gives structural support to the steering mechanical assembly (two steering pistons and a steering rack contained in the two steering cylinders to protect them from unwanted objects), hydraulic block, towing box, swivel valve and anti shimmy valves. [1 sentence = 41 words with parenthesis; 22, without]

The sentence in (12) is also a good example of how, sometimes, in order to conform to the regulated number of words, authors, eventually, do employ ellipses (the information in parenthesis could have been clearer if conveyed as a relative clause instead of as a nominal apposition) and end up providing more than one topic per sentence. In (14) below I provide another example of a potentially ambiguous elliptical structure.

Another area where STE sentences prove especially complex is in their syntactic structure. It is very common for them to present non-compositional or argumental constructions, specially, those which involve impersonal agents or multiple adverbials indicating a source and/or goal to express motion:

(13) *The accumulator manifold* sends the hydraulic flow *to* the PBSELV *from* the brake accumulator and the hydraulic flow goes *to* the NBCMs.

Hypotactic and paratactic structures also seem to be very usual in STE[4]. The coordinator *and* is the 4th most frequent token in the corpus, while the most common subordinators are *that* and *if* (10th and 13th on the frequency list):

(14) Hold the actuator *when* you remove *or* install the pins. *If* you do not [ellipsis], the actuator can fall *or* move. This can cause injury to persons *and/or* damage to equipment.

[4] I refer the reader to Martín-Díaz (2019) and González-Orta and Martín-Díaz (2022) for a formalized account of coordination and subordination in STE aimed at the computational processing of such sentences.

(15) *If* a fault occurs during the LGERS control inhibition, do the step *that* follow [*sic*].

Adverbial clauses, both finite and non-finite, are salient too:

(16) The brake accumulator is pre-charged with Helium and contains a pressure transducer on the fluid side *to sense the pre-charge pressure* [*purpose adjunct*] and for internal Brake and Antiskid Control System checks.
(17) Put the retraction actuator (1) in the correct position *so that* [*n.a.*] *the EMA (16) is in the outboard side* [*result adjunct*].
(18) The hydraulic power to pressurize the brake units (*using* [*n.a.*] *the hydraulic line with available hydraulic pressure* [*instrument adjunct*]).

2.4. STE texts

As stated previously, STE instruction manuals may contain both descriptive and *how to* texts, the latter could concern the instructions for a maintenance procedure or for a safety procedure. In the specification these two procedural uses are differentiated and, accordingly, there are specific sections devoted to three types of "writing": descriptive, procedural, and safety instructions.

2.4.1. Descriptive texts

According to the specification, descriptive texts are meant to provide information on a system or component, or to clarify an instruction. Formally, descriptions must not contain more than six sentences per paragraph; in terms of content, each sentence should convey a single idea, and paragraphs must start with a topic sentence which is to be supported by the following sentence/s. In (19) we partially reproduce a text, which, could be a good exemplar of this type of writing. It presents, in my opinion, most of the features which characterize a linear rhetorical organization as described, for instance, by Monroy-Casas (2008: 177-178): thematic unity, thematic progression, paragraph unity, inter-paragraph cohesion, concreteness, and sentence simplicity.

(19) AJ A 32 2 1 00 00 AA0 040 AA
General
The Nose Gear System is a forward-retracting Landing Gear (L/G) installed in the forward fuselage of the aircraft. The Nose Gear System absorbs and transmits the related loads to the aircraft structure during taxiing, take-off and landing. Also, the Nose Gear System supports the weight of the aircraft during ground maneuvers. The Nose Gear System controls the direction of the aircraft with the Steering System.

Nose Gear Description
The Nose Gear System is a twin-wheeled forward-retracting L/G that helps the Main Landing Gear to support the weight of the aircraft on-ground. It has these primary components:

The NLG leg assembly
The shock absorber assembly
The upper drag stay
[…]

The NLG receives the aircraft loads and transmits them to the ground through the structural components. The NLG is […]

Descriptive passages may appear on their own (sometimes in separate files in the corpus) or, more frequently, in shorter sequences and embedded as part of a procedure fulfilling different rhetorical functions, as we will see in section 3.

2.4.2. Procedural texts

The texts which spell out procedures, and which, therefore, constitute the core of instructions manuals, have to be written following strict rules: (i) unless two actions occur at the same time or as a result of one another, they must contain only one command per sentence; (ii) sentences should not be longer than 20 words (with the aforementioned exceptions); (iii) they must be written in the imperative (including *let* imperatives and deontic *must*); (iv) if they contain descriptive information, it must be separated from the command with a comma;

finally, (v) instructions are to be written in the body of the text, and never as a note. Although in the following section we will see a longer extract of a procedure, as an illustration of their realization, in (20) we reproduce a standard instance; (21) would, however, be deviant, as it contains an order within a parenthesis:

(20) During this procedure, if a fault message related to the LGERS is shown, record this message. Then do the related fault isolation procedure.

(21) Click "FUNCTION SELECTION" or "RETURN", then close the "System report test" page (in the top taskbar, click the "Close Page" button then the "CLOSE SYSTEM" button).

2.4.3. Safety instructions: *warnings* and *cautions*

Equally inherent to the subgenre are safety instructions; these are also procedural or *how to* texts, and as such, commands, but they are specifically devoted to preventing hazardous situations. Although, depending on the area where they operate, there might be official security standards to which the companies have to adhere (e.g. ANSI Z.535 or ISO 45001), when these do not apply, the specification establishes a distinction between *warnings* and *cautions*: the first imply that there is potential harm to personnel; the second, damage to components or systems. Linguistically, these cautionary speech acts can be instantiated with words like *risk*, *damage*, *danger, injury* or, else, syntactically by means of zero negative conditionals, negative imperative sentences, and the constructions *make sure that* and *be (very) careful when* (Díaz-Galán and Fumero-Pérez 2020). The paragraph in (22) is a common example of this type of advisory passages:

(22) Movement of components can cause *death* or *injury to persons* and/or *damage to equipment.*
Let the brakes and the wheels become cool before you go near the landing gear. Do not apply a liquid or gas fire extinguisher directly on a hot wheel or brake unit. *If you do not obey these precautions*, there is a *risk* of explosion.
Make sure that the wheel chocks are in the correct position. This will prevent unwanted movement of the aircraft, and thus possible *damage.*

3. Aviation maintenance manuals written in STE as a *genre*: the rhetorical structure of procedures

Drawing on Swales' (1990) seminal analysis of research article introductions into moves and steps, and in light of the analysis of the corpus, in this section, I will describe the elements which characterize the rhetorical structure of aviation maintenance instructions written in STE. Of the studies of instructional texts mentioned before, it is Sharpe's (2014) analysis of automotive technical manuals that I think bears the closest resemblance to the Airbus texts. The author depicts the macro-generic framework of instructional texts as consisting of three consecutive stages: orientation > execution > consolidation. The orientation stage seeks to acquaint maintenance technicians with "system and mental processes/actions that the user can or must engage is to prepare for task of working on the system" (par. 4); the execution stage states "the actions the user can or must perform during the realization of a task" (par. 5); the validation stage indicates the actions to be carried in order to confirm that the execution is effective. These stages are associated with six explicit rhetorical functions, namely, orientation/familiarization, instruction, validation, facilitation, optimization, and optioning. The implicit rhetorical function of these texts, in line with Lassen (2003), is to persuade the reader to complete the task successfully.

Elaborating on this proposal, in Table 1 I put forward the moves and steps which could account for the macrostructure of the instructional aviation texts written in STE in the corpus (compulsory steps and sub-steps are marked with *):

Table 1: Rhetorical macro-structure of STE maintenance procedures in aviation manuals

MOVES	STEPS and SUB-STEPS
1. ORIENTATION	1. Identification (ID)* 1.1. ATA systematics ID* 1.2. System or Component ID* 1.3. Procedure ID* 2. Context* 2.1. Legal Frame* 2.2. ATA systematics ID * 2.2. Reason for procedure* 2.3. Conditions 3. Safety instructions - Opening*

2. EXECUTION	1. Instructing* 2. Facilitating 3. Validating 4. Procedure-specific safety instructions
3. CONSOLIDATION	1. General procedure validation 2. Instructions- Closing 3. General safety instructions- Closing*

To illustrate the elements in this structure I analyse below a file (DMC-AJ-32-33-00-01AAA-320A-A_025) that contains the instructions for an Operational Check of the Emergency Extension System of the Landing Gear (ATA chapter 32, see note 2). Instructional texts in the corpus always open with a compulsory introductory move that identifies the procedure and its context, and indicates the general safety instructions which are to be followed before the actual procedure starts. In (23) we can appreciate how the standard opening move is instantiated in the sample text.

(23)

ORIENTATION	
1. Identification (ID)*	
1.1. ATA systematics ID*	AJ A 32 3 3 00 01AAA 320 A A
1.2. System / Component ID*	Emergency Extension
1.3. Procedure ID*	Operation test (Operational test of the emergency extension system (aircraft on jacks))
2. Context*	
2.1. Legal Frame*	Obey the national regulations for export control.
2.2. ATA systematics *	AJ A 00 0 0 00 03 ZZZ 021Z D
2.2. Reason for procedure*	OPERATIONAL CHECK OF EMERGENCY EXTENSION SYSTEM.
2.3. Conditions	These Required Conditions are not applicable if you cannot lift the aircraft on jacks. In this case, you must do the Required Conditions of the operational test on ground.
3. General safety instructions – Opening*	Put the SAFETY BARRIERS in position Make sure the propeller is locked on the applicable engine On the center pedestal, on panel 1010VM, make sure that the engine master levers are in the OFF position. Put a WARNING NOTICE in position to tell persons not to operate them

The second move, the execution, is –needless to say– the central constituent in these instructional texts; the commands are stated in an iconic sequence that reproduces each of the steps to be taken to complete the procedure. Optionally, this move may also contain (i) descriptive information to facilitate the task, (ii) statements to validate whether the command has been effectively implemented, and/or (iii) safety instructions aimed at a specific instruction in the procedure. Some of the more complex procedures present a recursive pattern in which one or several of the commands in the sequence present their own facilitating, validating and safety procedures instructions. Example (24) partially reproduces one of such complex sequences.

(24)

EXECUTION (partial sequence)	
1. Instructing*	On the center pedestal, on panel 11VU, lift the guard of the L/G EMER EXTN switch and set the switch to the RESET position.
3.Validating	The "L/G EMER EXTN RESET" label comes on at the start of the emergency reset sequence. The electromechanical actuators move to their initial positions.
4. Procedure-specific safety instructions	When you open/close the NLG doors, make sure that there are no objects or persons in the travel range of these doors. The travel range of the NLG doors must be clear of: Persons Access platforms Tools and equipment. If you do not do this, injury and damage can occur.
1. Instructing*	Wait until the end of the reset procedure of the Emergency Extension System.

2. Facilitating	Approximately 60 seconds are necessary to do the reset procedure of the Emergency Extension System.
3. Validating	The "L/G EMER EXTN RESET" label goes off. The NLG doors position indication shows green horizontal lines (doors uplocked).

The final move aims at confirming that the whole procedure has been successfully completed. As optional steps, it may provide (i) instructions to validate the effectiveness of the procedure sequence explicated before and/or (ii) the instructions to bring the procedure to an end. All the texts analysed finish with a compulsory step which mirrors the safety instructions in the opening move and which has accordingly been labelled *General safety instructions-Closing*:

(25)

CONSOLIDATION	
1. General procedure validation	The NLG doors indication shows amber outboard oblique-lines during the extension and green horizontal lines when it is completed (NLG doors uplocked). All the triangles of the L/G legs indications come on in green. […] On the EWD: "L/G GEAR NOT LOCKED DOWN" is shown during the extension and goes off when it is completed.
2. Instructions-Closing	Depressurize the Yellow hydraulic system On the center pedestal, on panel 11VU, lift the guard of the L/G EMER EXTN switch and set the switch to the OFF position
3. General safety instructions- Closing*	On the center pedestal, on panel 15VU, remove the WARNING NOTICE(S). On the LMCP and on the LMWS, on the L/G section, remove the WARNING NOTICE. Remove the SAFETY BARRIERS

4. Discussion

Addressing the description of maintenance aviation manuals written in STE as a genre according to Bhatia (2004: 23) involves analysing its formal and discoursal aspects in the context of a community of practice.

From a formal standpoint, STE specifications try to standardize lexis, syntax, and discourse to avoid the misreading of the texts that may face the users of these manuals worldwide and which have been proved to be one of the possible triggers of aircraft incidents. In a volume that reviews the implementation of some of the most common controlled languages employed in technical documentation, Crabe (2017) lists what are considered to be the desirable "linguistic best-practice features" (2017: 51) that controlled languages should implement to improve their readability. Although the author does not mention STE, the enumeration, unsurprisingly, coincides with many of the lexico-grammatical prescriptions mentioned in the STE specification: use of short and simple structures; use of the active voice; use of the imperative for orders; use of simple verb tenses and avoidance of *–ing* participles; avoidance of unnecessary wordiness; avoidance of long strings of words, and consistent use of vocabulary. The examination of STE rules and their implementation in a corpus of maintenance texts has revealed, however, that controlled languages might not be a panacea for reducing the complexity of technical texts or for improving their understandability.

If as Crabbe (2017: 109) affirms, the adequacy of a controlled language can be assessed by means of the results of a readability test, STE might not perform to the highest levels, as many of the sentences analysed in the previous sections would prove obscure. As an example, the excerpt partially reproduced in (9), when tested with the free tool Automatic Readability Calculator (Scott, n.d.), was rated as "difficult to read" in the Flesch Reading Ease Score, as "hard to read" in the Gunning Fog test, and as a "college" reading in the remaining scales. Processing this type of descriptive passages is, therefore, not a straightforward task either for a human reader or for a computer program. As pointed out, one of the reasons could be that some STE rules are unable to prevent the intricacy of the sentences; the other, that writers/editors, on occasions, disregard some of the prescriptions concerning units at lower levels than the text. The analysis of the implementation of STE rules concerning textual elements other than descriptions, by contrast, does not reveal them to be problematic. Procedures and safety instructions –the other two types of STE *writing*– appear in shorter and fixed sequences, which are, to some extent, formulaic, and, therefore, well known to authors/editors. The same could be affirmed about the discoursal level. Authors/editors seem to be consistent in organizing the texts which specify the different aviation maintenance procedures in three macrostructural moves –orientation, execution and consolidation– which are similar to those of other instructional genres. At the same time, they

also possess the generic competence necessary to deploy the compulsory steps and sub-steps which set apart this instructional subgenre from others.

It is precisely this generic competence or *genre knowledge* of writers/editors that might explain many of the deviations and non-compliance with STE rules at lexical, phrasal o sentential levels observed. Although further quantitative research is needed, the explanation I put forward is that the knowledgeable writers/editors of these texts deviate from the controlled language rules when the specifications are at conflict with the prescriptions of technical writing rooted in their expertise. This would explain, for instance, the futile effort of avoiding the complexity of technical vocabulary, or the use of the linguistic features described by Biber (1988: 151-153) as inherent to technical genres and that have also been attested in the corpus: frequent use of (approved and non-approved) conjuncts; agentless and *by* passive sentences; past participial clauses; reduced clauses, or adverbial subordination.

From a contextual point of view, an additional factor concerning this subgenre that might be affecting the compliance to STE rules and the obscurity of some passages is the fact that these texts are multi-authored. Technical texts undergo numerous updates and revisions which might be implemented at different stages by different writers and editors; a complex production process already described in 1963 by Gould, which has become further complicated by the delocalization of writing/editing services to save costs. The anonymity of writers and editors (Isani 2009: 12) blurs the limits of the discourse communities where a genre belongs to such an extent that they become "folocal discourse communities" (Swales 2016: 6), that is, "hybrid communities whose members have a double –and sometimes split– allegiance, as they are confronted by internal and external challenges and pressures" (Swales 2016: 6). The result of these practices is a detachment between the writers/editors and the end product, and, consequently, a lack of authorial responsibility for the quality of the final text.

What the analysis presented here seems to indicate is that the implementation of a controlled language cannot be addressed only as a matter of complying with the set of rules in a writing manual. No matter how detailed the specifications are, or how many examples of *goo*d and *bad* writing they offer, if the training in the controlled language disregards the social practices associated with this subgenre, achieving the desired simplification of technical language will prove an elusive undertaking.

5. Summary and concluding remarks

Drawing on the qualitative analysis of a corpus, in this paper I set out to characterize aviation instructions manuals written in STE as a subgenre of technical instructional manuals. This subgenre, which presents the same rhetorical functions as other technical instructions manuals, can be singled out by means of two distinguishing features: the restrictions imposed by the STE specification on the surface level linguistic expression, and the defining rhetorical macrostructure of the instructional texts.

By means of corpus examples, the main rules of STE have been outlined, showing that on many occasions –and especially at sentential or lower levels– writers/editors do not conform to the prescriptions of STE, thus compromising the readability of texts. Although further quantitative analysis is needed to assess deviations, it has been argued that many of the non-STE examples seem to be motivated by the fact that the STE prescription clashes with standard technical writing practices. Compliance with STE rules, however, seems to be the norm in the case of supra-sentential units, which, with some exceptions, meet the writing requirements of the controlled language.

The other defining feature of this subgenre is the rhetorical organization of the instructional texts which lay at the core of instructional genres. Accommodating Swales moves and steps analysis to the structure first outlined by Sharpe (2014) for automotive technical manuals, this paper proposes an economical three-move structure with obligatory and intermediate steps which can account for simple and complex maintenance procedures and which seems to be followed consistently in the Airbus corpus.

This paper has presented a thorough description of STE as used in a corpus of real aviation maintenance texts which might be of use for writers/editors and instructors in the controlled language and which could shed some light on the issue of the misinterpretation of such texts. Although further quantitative data-driven analysis is needed, as an explanation to the deviations I tentatively put forward the argument that writers/editors, rather than following STE rules, on many occasions, choose to conform to the conventions of technical writing that are ingrained in their professional expertise; it also argued that the writing and editing practices associated with corporate technical texts play a part in their readability. As Bhatia (2004) suggests, the analysis of surface text, when mediated by genre analysis, proves related to social practices. What seems to follow is that, 35 years after the implementation of STE, either the training in the use of the controlled language or the specifications themselves might have to be readdressed.

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