



**DEVELOPING CORPUS-BASED TECHNICAL WORD
LISTS FOR PILOTS**

BY

PILAIORN PITAYATORNPITUX

**AN INDEPENDENT STUDY SUBMITTED IN PARTIAL
FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF ARTS IN ENGLISH LANGUAGE TEACHING
LANGUAGE INSTITUTE
THAMMASAT UNIVERSITY
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ENTITLED

DEVELOPING CORPUS-BASED TECHNICAL WORD LISTS FOR PILOTS

was approved as partial fulfillment of the requirements for
the degree of Master of Arts in English Language Teaching

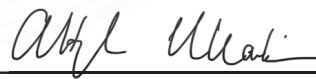
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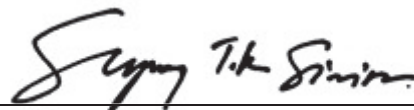
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ABSTRACT

This study aimed to investigate the technical words commonly found in pilot textbooks and create categorized lists of these words for each topic covered in the theoretical examination for obtaining a pilot license. The topics encompassed Air law, Aircraft general knowledge, Flight performance, planning and loading, Human performance, Meteorology, Navigation, Operational Procedures, Principles of flight, and Radiotelephony. Additionally, a separate sub-list was compiled to include words that appeared across these subjects. To identify the frequently used technical words, a corpus-based approach was employed, which involved utilizing lexical profiling and frequency criteria. The words that met both criteria were then evaluated by three experts using a 3-level rating scale. Through this evaluation process, a total of 526 technical words were identified as commonly found in pilot textbooks. In order to develop a comprehensive technical word list for pilots, all frequently found words, along with additional words recommended by the experts, were initially categorized based on their percentage of occurrence within each topic. The experts' judgments were crucial in ensuring the practicality and relevance of each sub-list. Their feedback played a significant role in refining and adjusting each sub-list according to their suggestions, thus enhancing the overall quality and usability of the technical word lists for pilots, pilot cadets, flight instructors, and ESP teachers.

Keywords: Technical words, Word List, Pilot, Theoretical examination

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LIST OF ABBREVIATIONS

Symbols/Abbreviations	Terms
ATPL	Airline Transport Pilot License
AWL	Academic Word List
CAAT	Civil Aviation Authority of Thailand
CPL	Commercial Pilot License
ESP	English for Specific Purposes
GSL	General Service List
ICAO	The International Civil Aviation Organization
PPL	Private Pilot License
PT Corpus	Pilot textbook Corpus
PTWL	Pilot Technical Word List

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Vocabulary is essential in language learning (Nation, 2013; Schmitt, 2010; Drayton & Coxhead, 2023). The famous quotation of David Wilkins “...while without grammar, very little can be conveyed. Without vocabulary, nothing can be conveyed” (Wilkins, 1972, pp. 111- 112), can show the immense importance of vocabulary knowledge. It is a part of the basic knowledge for listening, speaking, reading, writing, pronouncing words and correctly structuring sentences (Laufer & Nation, 1995). Language users, therefore, should possess the knowledge of vocabulary and be able to use it correctly.

English is the main tool used globally in various professions, including the aviation industry. It is one of the official languages of the International Civil Aviation Organization (ICAO). As of Annex 10, Volume 2 of the ICAO states that English should be used in case the communicators do not share the common language (ICAO, 2016). Aviation English specifically contains a tremendous amount of technical vocabulary, which sometimes does not have the same meaning as it does in linguistics (Drayton & Coxhead, 2023) and is required to be studied in order to understand its meaning and usage. According to Zolfagharian (2017), the language used in aviation plays a crucial role in ensuring the safety of flights and passengers. Numerous incidents and accidents have demonstrated that miscommunication and inadequate language proficiency can be contributing factors. For instance, a notable example is the Avianca 707 crash, where the pilot's incorrect declaration of an emergency was a significant factor in the accident. Nation and Kyongho (1995) state that technical words occur with very high or moderate frequency within a very limited range of texts or just within one text. It-Ngarm and Phoocharoensil (2015) add that “technical words are usually related to the subject area of the text and are not so common elsewhere”. Some examples of technical vocabulary are taxiway, fuselage and jettison. With this uniqueness, it is important to study the essential technical vocabulary in order to be able to use English for aviation effectively.

Obtaining a pilot license necessitates passing a comprehensive theoretical examination consisting of nine essential topics, which are as follows: 1) Air law, 2) Aircraft general knowledge, 3) Flight performance, planning and loading, 4) Human performance, 5) Meteorology, 6) Navigation, 7) Operational Procedures, 8) Principles of flight and 9) Radiotelephony (CAAT, 2014). The flight training in flight schools all over Thailand is mostly conducted in the Thai language, despite the fact that all the theoretical examinations for pilot licensing are in English. Given the critical nature of English language usage in aviation, which encompasses numerous technical terms, the potential consequences of incorrect usage can be severe (Drayton & Coxhead, 2023). Therefore, it is regarded as a highly specialized language that requires a thorough understanding by all individuals utilizing it to effectively carry out their tasks.

Corpus analysis has been widely employed in the field of linguistics to comprehend the structure and patterns of naturally occurring language, enabling researchers to derive valuable insights from the collected evidence. Notably, Nation (2013), a renowned scholar in linguistics and teaching methodology, has extensively utilized corpus linguistics in his studies. Through his research, he has authored numerous papers and books focusing on vocabulary learning, wherein he has classified word lists based on frequency into three levels: high-frequency, mid-frequency, and low-frequency word lists. This categorization ensures that learners can effectively acquire vocabulary in the most practical sequence. Furthermore, Nation has also categorized words into specialized types of vocabulary, specifically academic words and technical words, enhancing learners' proficiency in these domains.

Many researchers have studied the phraseology in radiotelephony (two-way radio communication) using spoken language corpus compiled from the conversations over radio between air traffic control (ATC) and pilots, such as the *Radiotelephony Specialised Technical Vocabulary List* of Drayton & Coxhead (2023) and the *Investigation into the Factors that Affect Miscommunication between Pilots and Air Traffic Controllers in Commercial Aviation* (Wu et al., 2019). As stated by Terenzi (2021), aviation English is usually referred to as the language used between pilots and air traffic controllers in international radiotelephony communications, which does not cover all the language varieties used by the different professionals in the area. While technical vocabulary is undoubtedly an intriguing aspect to explore, it represents just

one of several topics that pilots must successfully navigate during the theoretical examination required for obtaining a license. Moreover, throughout their career progression, technical vocabulary continues to play a vital role for pilots in maintaining and updating their language proficiency, particularly when operating within an international context. It is important to recognize that words can serve different functions depending on the specific field in which they are employed. For instance, the term 'chord' typically refers to musical notes, but it also encompasses the measurement of the distance between an aircraft's leading and trailing edges. Considering these factors, the existence of a specialized word list for pilots becomes imperative, as it aids individuals seeking to enhance their English language skills within the realm of aviation.

The present study therefore aims to investigate the aviation language, particularly technical vocabulary, especially for pilots. Specifically, this study aims to identify the frequently found technical words and for the ease of use it will be classified into topics related to theoretical examinations that pilots need to pass in order to obtain their license. This will be beneficial to all the pilots, pilot cadets, flight instructors and flight schools as a reference for their learning and teaching in flight school, as well as serve the purpose of ESP.

1.2 Research Questions

This study aims to answer the following questions:

- 1) What technical words are found most frequently in the Pilot Textbooks Corpus?
- 2) Which words from the frequently found technical words can be classified into each of the topics of pilots' theoretical examination, which are: 1) Air law, 2) Aircraft general knowledge, 3) Flight performance, planning and loading, 4) Human performance, 5) Meteorology, 6) Navigation, 7) Operational Procedures, 8) Principles of flight and 9) Radiotelephony ?

1.3 Research Objectives

The objectives of this study are:

- 1) To identify the frequently found technical words in pilot textbooks.

2) To create technical word lists classified into the nine topics of the theoretical examination for pilot license, which are 1) Air law, 2) Aircraft general knowledge, 3) Flight performance, planning and loading, 4) Human performance, 5) Meteorology, 6) Navigation, 7) Operational Procedures, 8) Principles of flight and 9) Radiotelephony.

1.4 Definitions of Terms

The definition of key terms used in the study are provided as follows:

1) Technical words refers to words that are regularly used by professionals in the aviation field, such as pilots, air traffic controllers and aircraft engineers.

2) International Civil Aviation Organization or ICAO refers to an organization which is a specialized agency of the United Nations who sets standards and regulations for international air navigation and air transport.

3) Civil Aviation Authority of Thailand or CAAT refers to the government department responsible for prescribing, regulating, and auditing Thai civil aviation.

4) Theoretical examination refers to the examination that pilots are required to pass in order to obtain pilot license issued by the CAAT.

5) Private Pilot License or PPL refers to a type of license that will be issued to those who pass all the required qualifications to operate non-revenue flights.

6) Commercial Pilot License or CPL refers to a type of license that will be issued to those who pass all the required qualifications to operate flights for commercial use on aircraft that require only one operator.

7) Airline Transport Pilot license or ATPL refers to a type of license that will be issued to those who pass all the required qualifications to operate flights for commercial use on aircraft that require more than one operator.

1.5 Scope of the Study

This study compiled 14 textbooks for pilots that contain all the theoretical knowledge for all three types of pilot licenses — Private Pilot License (PPL), Commercial Pilot License (CPL) and Airline Transport Pilot License (ATPL) — in order to build a corpus called the “Pilot Textbooks Corpus” or “PT Corpus” for a corpus-based analysis of lexical items. This study intends to investigate the technical words that are frequently found and create word lists. The words are classified into nine

groups of theoretical examination topics by using the expert judgment and one extra sub-list that contain words appearing across subjects.

1.6 Significance of the Study

As regulated by the CAAT, those who wish to obtain Thai pilot license are required to meet the qualifications, one of which is a theoretical examination. This study will investigate the technical words in ATPL textbooks using a corpus-based approach along with experts' judgment to create technical word lists. These will be classified according to nine topics that are required in the theoretical examination. The significance of this study is as follows:

1) The word lists from this study can be used as a guidance for those who are interested in aviation, in becoming a pilot or who is already studying to become a pilot. English is crucial for their study in reading textbooks and taking an examination. Therefore, these word lists can serve as a valuable steppingstone for pilots, providing them with a foundation for further in-depth study and exploration..

2) All technical words found in this study are classified into sub-lists according to the nine topics for convenience and practicality. The users can refer to the specific sub-list when they study for the subject. Moreover, there is a sub-list of words that appear across subjects. This can ensure that the word list users will be able to identify words within the desired topic and can prioritize their study easily.

3) These technical word lists for pilots can be used by ESP teachers, flight instructors, course designers or material developers as a guideline for preparing their teaching, syllabi, or materials.

4) There has been very little research done in the aspect of technical words for pilots, especially corpus-based studies that created word lists to facilitate users' understanding of the overall body of aviation knowledge.

1.7 Organization of the Study

This study is divided into five chapters. Chapter one introduces the background of the study, research objectives, research questions, definitions of key terms, scope of the study and the significance of the study.

Chapter two presents a review of literature on corpus, word lists, word list construction, pilot licensing and textbooks, and previous studies.

Chapter three discusses compiling the corpora, the research instruments and methodology.

Chapter four provides the results of the research.

Chapter five presents a summary of the study, the discussion, the pedagogical implications, the limitations and recommendations for further studies.



CHAPTER 2

REVIEW OF LITERATURE

This chapter provides the background information about the theories related to this research. The areas reviewed are divided into four areas: 1) Corpus, 2) Word list, 3) Word list construction, 4) Pilot licensing and textbooks and 5) Previous studies.

2.1 Corpus

A corpus is a principled collection of text available for qualitative and quantitative analysis (O'Keeffe et al., 2007). It is usually a collection of both written and spoken texts which are stored electronically. Each corpus serves distinct purposes, depending on the resources utilized during its compilation and the intended usage. For instance, Feng (2006) conducted a corpus-based study on research grant proposal abstracts, examining 37 abstracts sourced from the corpus of successful Hong Kong Competitive Earmarked Research Grants (CERG). This study shed light on the characteristics and patterns observed within these abstracts. Furthermore, corpora can also be derived from transcribed spoken language, as demonstrated by Liu and Chen (2019) in their analysis of Academic Spoken Vocabulary in TED Talks. They employed transcripts from TED Talks to analyze vocabulary profiles, aiming to explore the potential usage of TED Talks in English for academic purposes courses. Thus, depending on the specific objectives, corpora can be constructed from various resources to facilitate comprehensive linguistic investigations.

A corpus is widely accepted to be useful for language studies. As mentioned in Bennett (2010), corpus can provide the understanding of what patterns are associated with lexical and grammatical features and help answer various questions. It has also been an effective tool to create many dictionaries, such as Collins COBUILD English Language Dictionary. (O'Keeffe et al., 2007). Many useful and well-known corpora such as the British National Corpus (BNC) and the Corpus of Contemporary American English (COCA), which is commonly used by learners and researchers all over the world, were created using corpus. Furthermore, an influential approach stemming from corpus linguistics, known as data-driven learning (DDL), holds significant value in

foreign or second language learning. DDL enables students to observe language patterns through corpus evidence, facilitating their learning process. Considering the aforementioned characteristics and importance, it becomes evident that the integration of corpus linguistics into learning and teaching practices has become inseparable.

2.2 Word Lists

Word lists refer to a set of words from a particular corpus that is collected by using a program to generate and compile within the set criteria such as frequency, range and lexical profiling. (O'Keefe et al., 2007). Each word list is different, depending on the purpose, targeted learners and corpus qualities (Nation, 2016). The use of word lists is widely known as a tool to help learners improve their vocabulary both in and outside the classroom. Many researchers have claimed that the use of word lists have considerable benefits and should be integrated into a curriculum. (Ma & Kelly, 2006; MacArthur & Littlemore, 2008; Nation & Waring, 1997, Read, 2000; Schmitt, 1997; Smith, 2020; Vongpumivitch et al., 2009; Laosrirattanachai & Ruangjaroon, 2021). As it is one of the great tools to support language learners, word lists have been created for diverse purposes such as Word List in Social Science (Chanasattru & Tangkiengsirisin, 2016), Word Lists of High School Textbooks and the GAT Examination (Tianson & Yanasugondha, 2021) and Academic Spoken Word List (Dang et al., 2017).

Nation (2013) applied a corpus-based approach to try to understand the amount and lists of words that learners need to know when learning another language. He proposed three types of word lists by frequency and range, which are high-frequency word lists, mid-frequency word lists and low-frequency word lists. He has classified another two special types of word lists by usage, namely academic word lists and technical word lists (Nation, 2013).

2.2.1 High-Frequency Word List

This category of word list contains words that appear frequently in a general text and are found to be used regularly in daily life. The most well-known and widely used as a reference is the General Service List of English or GSL developed by West in 1953. It contains 2,000 high-frequency words, covering both function words: *a, an, the, for*, etc.; and content words: *question, power, wind*, etc. It was claimed to cover

around 80 percent of words in written text and around 90 percent of words in spoken English (Tianson & Yanasugondha, 2021). In 2013, Brown and his colleagues released a new word list, which is an updated version of West's GSL (1953), called the New General Service List or NGSL. This updated and expanded the size of the corpus from 2.5 million words in GSL to 273 million words in NGSL with the hope of increasing the validity and the ability to generalize the list (Brown et al., 2013).

2.2.2 Mid-Frequency Word List

According to Nation (2001), this type of word list was not mentioned in his first edition. Later, Nation's (2006) research revealed the importance of mid-frequency words in comprehension. He determined that acquiring a vocabulary of approximately 6,000-9,000 words, including proper nouns, is essential to achieve an understanding of texts independently. This level of vocabulary covers comprehension of 98% of a text. Mid-frequency words include generally useful, moderately frequent words, including many that almost made it into the high-frequency word list. It should be added as a learning goal for learners alongside the high-frequency words, as it represents the amount of vocabulary needed to deal with English without the need for outside support.

2.2.3 Low-Frequency Word List

The category of word lists known as low-frequency words consists of words that occur infrequently in a given text, typically making up approximately 5 percent of the total running words. However, it is crucial to acknowledge that the specific percentage may vary depending on the field or context in which the text is employed, as highlighted by Chung and Nation (2003) and Hyland and Tse (2007). Low-frequency words are distinct from academic words and technical words that pertain to specific subjects. They can include proper names or words that are rarely utilized (Chanasattru & Tangkiengsirisin, 2016).

2.2.4 Academic Word List (AWL)

This type of word list comprises words frequently found in academic fields. One of the well-known AWL in the early stage was Xue and Nation's AWL (1984), called the University Word List or UWL. However, the updated version of AWL, which is the

most referenced one, is Coxhead's AWL (2000). This AWL is based on a 3.5-million-word corpus of academic English texts from journals, textbooks and coursebooks originating in different parts of the native English-speaking world. It consists of 570-word families that are not in GSL (West, 1953), which account for around 10 percent of the running words in academic corpora. O'keeffe et al. (2007) mentioned in his book that focusing on AWL when learning and teaching vocabulary can rapidly increase the comprehension of academic texts. Therefore, the AWL is very useful for all English learners for academic purposes, and it is used as a reference for creating many word lists, such as the technical word list for cabin crew of Thiankasem and Yanasugondha (2018) that used GSL and AWL as the reference. In the study, words that appeared outside these two word lists were selected as a potential technical word list.

2.2.5 Technical Word List

Technical word lists are often known as specialized word lists, as they are words appearing in a particular field. According to Coxhead (2017), the definition of technical vocabulary is as follows:

People outside the specialized field might have limited knowledge of that vocabulary, or might have never heard these technical items... In some cases, the meaning of a word might be vaguely known by laypeople, but a specialist would be expecting to know much more precise information about this meaning, use and nuances.

Technical words usually cover around 5 percent of the running words in specialized text. They serve the purpose of learning and teaching of vocabulary in specific fields. Nation (2016) mentions that technical words that can help people understand the size of vocabulary of a technical area and can be a guideline in the development of appropriate vocabulary learning strategies. Hence, many research studies have focused on technical vocabulary, such as specialized word lists of English for science and technology (Bunyarat, 2020), a chemistry word list (Valipouri & Nassaji, 2013), an aviation radiotelephony word list (Drayton & Coxhead, 2023) and hospitality word lists (Laosrirattanachai & Ruangjaroon, 2021).

2.3 Word List Construction

There are many criteria used to create a word list proposed by many researchers. The five major criteria that are widely used among scholars are frequency, range, lexical profiling, keyword analysis and expert verification. These criteria are used by scholars in different ways, depending on the nature of the corpus, the target learners and the purposes of use. Table 2.1 displays an example of the size of the corpus and criteria used to create word lists by many scholars.

Firstly, frequency is used to identify words that appear frequently in the corpus, making it one of the most crucial concepts in the study of language use (Lindquist, 2009). By analyzing frequency, we can extract significant words that warrant further investigation. An example of utilizing frequency as a criterion is the General Service List (GSL) (West, 1953), a word list primarily based on frequency. Its purpose was to represent commonly used words.

Secondly, range is another important criterion often considered in conjunction with frequency. Range refers to the number of files in which a word appears. Coxhead (2000) argued that relying solely on frequency for very lengthy texts can introduce bias. However, range is not always a necessary criterion when constructing word lists. In their study, Drayton and Coxhead (2023) omitted range as a criterion due to the usage of only one corpus.

Thirdly, lexical profiling has been a prototype criterion in word list construction (Cobb & Horst, 2001). This criterion disregards words that are irrelevant to the target word list. For instance, in the creation of the Academic Word List (AWL), Coxhead (2000) excluded all words from the GSL. Laosrirattanachai and Laosrirattanachai (2021) attempted to construct a Technical Word List for Thai Tourist Guides by considering frequency, range, and keyness, but the results mainly included function words and simple words from the GSL, which were not the focus of their study. Consequently, they proposed applying lexical profiling as the initial step in creating their technical word list.

Table 2.1*Size of corpus and criteria used to create word lists*

Word list	Corpus size	Criteria				
		Frequency	Range	Lexical profiling	Keyword analysis	Expert verification
General Service List (West, 1953)	5,000,000	✓				
Academic Word List (Coxhead, 2000)	3,500,000	✓	✓	✓		
Medical Academic Word List (Wang et al., 2008)	1,093,011	✓	✓	✓		✓
Technical Word List for Business (Tangpijaikul, 2014)	890,000			✓		✓
Science Academic Word List (It-Ngarm & Phoocharoensil, 2015)	5,500,000	✓	✓	✓		✓
Technical Word List for Thai Tourist Guides (Laosrirattanachai, 2021)	653,196			✓		✓
Aviation Radiotelephony Word List (Coxhead & Drayton, 2023)	4157	✓		✓		✓
Technical Word List for Cabin Crew (Thiankasem & Yanasugondha, 2018)	1,053,941	✓	✓	✓		✓

Note. Adapted from Laosrirattanachai & Ruangjaroon (2021), pp. 50-86

Fourthly, keyword analysis is a criterion that involves comparing two or more corpora to identify words that appear with unusually high frequency. This criterion enhances the usefulness of word lists.

Lastly, expert verification serves as a criterion where the opinions of experts on each word provide valuable input to the word list creator. These experts possess better knowledge and experience in the specific field, enabling them to make informed decisions about what should be included in the target word list.

2.3.1 Identifying Technical Words

In order to create a technical word list, each scholar applies a different approach. Chung and Nation (2004) proposed four approaches of how to identify technical words in a specialized text: (1) using a rating scale, (2) using clues, (3) using a technical dictionary and (4) using corpora. Among these four approaches, using the rating scale has been claimed to be the most accurate but difficult to apply, while using corpus-based is the second most accurate approach and easy to apply. These two approaches have been widely used to create many technical word lists. This present study will apply the corpus-based approach and a rating scale of experts' judgment.

The rating scale approach is sometimes known as expert-judged approach. It is usually used in order to help the word list creator to select the words that are relevant and important to be a part of the target word list. Many researchers also applied this method as a complement to their corpus-based approach, such as Laosrirattanachai and Laosrirattanachai (2021)'s Word List for Thai Tourist Guides and Ackermann and Chen (2013)'s Academic Collocation List. Chung and Nation (2003) introduced a rating scale to measure the relevance of the word to the topic. The scale ranges from level 1 to level 4. Level 1 refers to words that have no particular relationship with the field. Level 2 are words with minimal relationship to the field. Level 3 are words that are also used in general language but may have some restriction of usage and have close relationships with the field. Level 4 are words that have a meaning specific to the field. These 4-level scales sometimes cause uncertainty for experts. It-Ngarm and Phoocharoensil (2015) mentioned in their study that the experts were unsure about level 1 and 2. Therefore, the original 4-level scale was adjusted to a 3-level scale by removing the first level.

2.4 Pilot Licensing and Textbooks

In order to be recognized as a qualified pilot, one must possess the following knowledge of topics: 1) Air law, 2) Aircraft general knowledge, 3) Flight performance, planning and loading, 4) Human performance, 5) Meteorology, 6) Navigation, 7) Operational Procedures, 8) Principles of flight and 9) Radiotelephony (CAAT, 2014). These are the main topics that are being stated in the registration and licensing manual issued by CAAT (2014). Somehow the depth of the knowledge in each topic depends on the type of the license.

PPL is the most basic type of license that is issued for those who wish to operate an aircraft for private purposes or non-revenue flights. CPL, on the other hand, is the initial license that permits a pilot to fly for commercial use on aircraft that require only one person to operate. ATPL is the highest-level license issued to a pilot. This type of license will allow a pilot to operate flights for commercial use on aircraft that require more than one operator. It is the requirement to become a captain of any airline. Therefore, ATPL license holders must possess the highest level of knowledge in all theoretical topics.

There are many textbooks created to serve different purposes of usage, such as textbooks especially designed for PPL or CPL courses. The ATPL ground training series textbooks were chosen for this study due to their association with one of the most renowned aviation training companies, CAE Oxford Aviation Academy. This series comprises 14 books, each containing valuable information as outlined in Table 2.2.

2.5 Previous Studies

Many technical word lists or specialized word lists have been broadly studied in the past decades and have served as great tools for ESP teaching and learning. Each scholar has applied different methodologies and programs in creating their own technical word lists. In this section, the related previous studies will be reviewed.

Tongpoon-Patanasorn (2018) conducted a study to develop a frequent technical word list for finance. The researcher employed a combined method of keyword analysis and a modified rating scale. The corpus used for the study was created from four major text categories: books, journals, websites, and newspapers, randomly selected from the KhonKaen University Library. This corpus consisted of 2,004,964 running words. The research tools WordSmith, AntConc, and a Technical Word Checklist were utilized. Initially, a list of frequent words was generated, followed by keyword analysis comparing the target corpus with the reference corpus, the British Academic Written English (BAWE) Corpus. Chung and Nation's (2003) rating scale was adapted and simplified into a 3-level scale for experts to identify potential technical words. Ultimately, 979 words were identified as technical by two experts, which were further refined by grouping words belonging to the same word families. The final list comprised 569 headwords and their respective word families.

Table 2.2*Lists of titles and subjects in the ATPL series textbooks*

Book	Title	Subject
1	Air Law	Air Law
2	Aircraft General Knowledge 1	Airframes & Systems Fuselage, Wings & Stabilising Surfaces Landing Gear Flight Controls Hydraulics Air Systems & Air Conditioning Anti-icing & De-icing Fuel Systems Emergency Equipment
3	Aircraft General Knowledge 2	Electrics – Electronics Direct Current Alternating Current
4	Aircraft General Knowledge 3	Powerplant Piston Engines Gas Turbines
5	Aircraft General Knowledge 4	Instrumentation Flight Instruments Warning & Recording Automatic Flight Control Power Plant & System Monitoring Instruments
6	Flight Performance & Planning 1	Mass & Balance Performance
7	Flight Performance & Planning 2	Flight Planning & Monitoring
8	Human Performance & Limitations	Human Performance & Limitations
9	Meteorology	Meteorology

10	Navigation 1	General Navigation
11	Navigation 2	Radio Navigation
12	Operational Procedures	Operational Procedures
13	Principles of Flight	Principles of Flight
14	Communications	VFR Communications IFR Communications

In another study, Laosrirattanachai and Laosrirattanachai (2021) created technical word lists for Thai tourist guides to serve as supplementary vocabulary learning and teaching resources. They employed lexical profiling, elimination of off-list words, and expert verification methods. The language data used for the corpus compilation was gathered from www.tourismthailand.org and divided into 5 sub-corpora based on Thailand's regions: north, central, east, south, and northeast. Lexical profiling was conducted using AntWordProfiler, and off-profile words were analyzed using VocabProfiler and eliminated if they appeared at very low frequencies and were rarely used. The potential words were then rated by five experts using a 4-level scale, with words rated 3 or 4 by three or more experts being included in the target technical word lists.

Thiankasem and Yanasugondha (2018) investigated the technical vocabulary present in cabin crew manuals using a corpus-based approach and expert judgment. Their corpus comprised 7 cabin crew manuals, which were divided into 3 sub-corpora: Airbus, Boeing, and Cabin crew manuals. The corpus contained a total of 1,053,941 running words. The study evaluated the vocabulary load required for successful comprehension of the manuals with 95% coverage and identified technical words necessary for cabin crew when reading the manuals. The results revealed that 4,136 word families, including proper nouns, marginal words, transparent compounds, and acronyms, were required to cover 95.76% of the cabin crew manual corpus. To investigate the technical vocabulary, the criteria of range and specialized occurrence were employed. Words that appeared in at least two out of three sub-corpora and were not part of the General Service List (GSL) and Academic Word List (AWL) were then

rated by experts. As a result, 590 word families were selected to create the cabin crew word lists.

Drayton and Coxhead (2023) published an article titled "The Development, Evaluation, and Application of an Aviation Radiotelephony Specialized Technical Vocabulary List." The study focused on creating a corpus-based Tower Aviation Radiotelephony Technical Vocabulary List (TARTVL) derived from ICAO standard phraseology, and discussed its application in English for Specific Purposes (ESP). The corpus used consisted of 4,157 tokens compiled from examples of spoken language documents: ICAO 9432 Manual of Radiotelephony (ICAO, 2007) and ICAO Document 4444 Procedures for Air Navigation Services: Air Traffic Management (ICAO, 2016). The results included 274 technical vocabulary items, comprising 219 word types, 17 number classifications, 16 multiword units, 11 proper noun classifications, and 11 acronyms. The TARTVL was deemed a useful tool for language learning and teaching, catering to both native English speakers and non-native aviation personnel.

2.6 Summary

This chapter presented the related literature and some relevant research about creating technical word lists. Even though plenty of research has investigated and created technical or specialized word lists for the ESP purposes, only a few have focused on aviation English, and most of them studied the phraseology in radiotelephony communication between air traffic controllers and other aviation personnel. It is undeniable that pilots need to have much more knowledge covering not only standard phraseology, but also all the theoretical knowledge in order to be qualified. To fill this gap, this research aims to investigate the technical vocabulary that will appear frequently and will be useful for teaching, learning and preparing for theoretical examinations.

CHAPTER 3

RESEARCH METHODOLOGY

This study focuses on the development of a Pilot Technical Word List (PTWL). Its aim is to identify the frequently found technical words in the Pilot Textbook Corpus and create technical word lists classified into nine topics based on the theoretical examination for a pilot license, including 1) Air law, 2) Aircraft general knowledge, 3) Flight performance, planning and loading, 4) Human performance, 5) Meteorology, 6) Navigation, 7) Operational Procedures, 8) Principles of flight and 9) Radiotelephony. The research procedures are divided into steps, including compiling the Pilot Textbooks Corpus (PT Corpus), setting the word selection criteria, applying expert judgment and creating the PTWL. The methodology used in this study will be described in this chapter.

3.1 Compiling Corpora

The pilot textbooks that were used as the reference for this study were the CAE Oxford ATPL Ground Training Series. This consists of 14 books as mentioned in chapter 2. This series of books was designed to suit the highest level of knowledge for those who wish to obtain the ATPL, which is considered to be the highest level of a pilot license (CAE Oxford Aviation Academy, 2014).

To create the corpora, the 14 textbooks of the ATPL series were divided into nine sub-corpora corresponding to the nine topics of the pilot theoretical examination: 1) Air law, 2) Aircraft general knowledge, 3) Flight performance, planning and loading, 4) Human performance, 5) Meteorology, 6) Navigation, 7) Operational Procedures, 8) Principles of flight and 9) Radiotelephony (CAAT, 2014). The files were converted from .pdf to .txt files by using the software called AntFileConverter. These files were examined and edited to remove erroneous titles, graphs, acknowledgements and other words, numbers and symbols that may be irrelevant to the contents or incorrectly converted to .txt file. The corpus will be from this point onward referred to as “Pilot Textbooks Corpus” or “PT Corpus”. This corpus contains a total of 1,446,521 running words. Table 3.1 shows the details of books and the number of running tokens in each

sub-corpus. Some of the sub-corpus consists of only one textbook, such as Air Law, Meteorology and Radiotelephony. Meanwhile, some of the sub-corpus consists of two or more textbooks, e.g. Aircraft General Knowledge, Flight Performance, Planning and Loading, and Navigation sub-corpus. Aircraft General Knowledge sub-corpus has the biggest total number of 396,570 tokens, as it consists of four books. The communications sub-corpus, on the other hand, is the smallest, with 27,006 running words.

Table 3.1

Word tokens in the PT corpus and its sub-corpora

Sub-corpora of PT Corpus	Books from ATPL series	Tokens
Air Law	Book 1: Air Law	159,463
Aircraft General Knowledge	Book 2: Aircraft General Knowledge 1 Book 3: Aircraft General Knowledge 2 Book 4: Aircraft General Knowledge 3 Book 5: Aircraft General Knowledge 4	396,570
Flight Performance, Planning and Loading	Book 6: Flight Performance & Planning 1 Book 7: Flight Performance & Planning 2	201,367
Human Performance	Book 8: Human Performance & Limitations	133,497
Meteorology	Book 9: Meteorology	120,431
Navigation	Book 10: Navigation 1 Book 11: Navigation 2	184,872
Operational Procedures	Book 12: Operational Procedures	70,600
Principles of Flight	Book 13: Principles of Flight	152,715
Radiotelephony	Book 14: Communications	27,006
	Total	1,446,521

3.2 Research Instruments

To investigate the pilot technical vocabulary and create the word lists that correspond to the nine topics on the theoretical examination, four tools were used in this research.

3.2.1 AntWordProfiler

AntwordProfiler is a freeware tool for profiling the vocabulary levels and complexity of texts created by Laurence Anthony (Anthony, 2022). In this study, AntWordProfiler was used to generate word lists from the corpus and to compare the lists against the reference word lists embedded in the program, which are West's (1953) General Service List (GSL) and Coxhead's (2000) Academic Word List (AWL). The tool is available for download on the website <https://www.laurenceanthony.net/software/antwordprofiler/>. It has been consistently updated with new versions for different operating systems and users' compatibility. In this study, the Macintosh OS X (1.5.1) version, which is the second most recent version for the Macintosh operating system, was used to investigate the PT Corpus and its sub-corpora. The main difference between this version and the latest version is that the files that can be imported into the program have to be .txt files only. In order to do so, the original .pdf files of PT Corpus have to be converted by using the program called AntFileConverter, which will be discussed in 3.2.2.

To select the potential technical words, the PT Corpus was imported into the program and analyzed using two criteria: frequency and lexical profile. Then, the preliminary word lists were later judged by experts.

3.2.2 AntFileConverter

AntFileConverter is a freeware tool to convert PDF and Word (DOCX) files into plain text (.txt) for use in corpus tools. The series of ATPL books that have been collected for the PT Corpus were all in PDF files. In order to process the data in the corpus tool AntwordProfiler using the version for Macintosh OS X (1.5.1) in this study, the files needed to be converted to .txt files.

3.2.3 The Reference Word Lists

The reference word lists utilized for lexical profiling in this study were West's (1953) General Service List (GSL) and Coxhead's (2000) Academic Word List (AWL), both integrated into the corpus tool AntWordProfiler. The GSL comprises 2,000 word families, categorized into two levels: the first 1,000 high-frequency words and the second 1,000 high-frequency words. Known for its significant influence on language learners, the GSL is a highly regarded word list (Gilner, 2011). On the other hand, the AWL consists of 570 word families representing general academic English. It excludes words found within the most frequent 2,000 words of English and was developed for the academic purposes of learners and teachers. Many pilot training programs require a strong command of the English language (CATC, 2019; BAC, 2022). Since this study focuses on investigating frequently encountered technical words and developing a technical word list, words found in the GSL and AWL were intentionally excluded.

3.2.4 Expert Judgment

To enhance the reliability of the technical words included in the Professional Technical Word List (PTWL), the researcher sought input from multiple experts using three distinct profiles. The experts were provided with a comprehensive overview of the word list's purpose and given a set of questions and a rating scale. Their judgment was divided into two parts. Firstly, they were asked to rate the relevance of the words to the field and offer suggestions for inclusion. Secondly, they were requested to assess the relevance of the words to each pre-classified topic determined by the researcher and provide comments or suggestions accordingly.

Originally, the rating scale proposed by Chung and Nation (2003) consisted of four levels, as mentioned in section 2.3.1. However, considering the experts' uncertainties regarding levels 1 and 2, one level was removed. This adjustment aligns with previous studies, such as It-Ngarm and Phoocharoensil's (2015) research, where a 3-level scale was successfully utilized. Additionally, Coxhead & Demecheleer (2018) also employed a modified 3-level scale to mitigate difficulties in distinguishing between each level.

The 3-level scale developed for this study enabled experts to rate potential technical words accurately. The following provides a detailed description of each level:

Level 2: closely related to pilots or highly suggested to introduce to pilots.

Level 1: minimally related to pilots or suggested to introduce to pilots.

Level 0: very general, not related to pilots and not necessary to introduce to pilots.

By utilizing this 3-level scale, the experts could effectively evaluate and rate the potential technical words under investigation in this study.

Table 3.2

Instructions for selecting the technical vocabulary for the subject matter experts to develop the pilot technical word list

Please go through the following list of words from the Pilot Textbook Corpus and decide if each word is:				
2 = closely related to pilots or highly suggested to introduce to pilots.				
1 = minimally related to pilots or suggested to introduce to pilots.				
0 = very general, not related to pilots and not necessary to introduce to pilots.				
Number	Word	Rating scale		
		2	1	0
1.	XXX			

After obtaining the technical words, there were initially classified into each topic by the researcher. The experts were then requested to provide their input on the relevance of each word to the respective topic. If the word was deemed irrelevant to the topic, the experts were asked to suggest which topic it should be assigned to. To facilitate this assessment, a rating scale was employed, as shown in Table 3.3.

Table 3.3

Instructions for the experts to rate the relevance of technical vocabulary to the topic

Please go through the following list of words that have been categorized into topics and decide if each word is:					
2 = closely related to the topic or highly suggested to be included in this topic.					
1 = minimally related to the topic or suggested to be included in this topic.					
0 = not necessary or not suggested to be included.					
Number	Word for topic...	Rating scale			Comments/ Suggestion
		2	1	0	
1.	XXX				

To optimize the usefulness and inclusiveness of the word lists, the experts were asked to provide comments or suggestions at the end of the rating scale. This process can help increase the reliability of the PTWL creation.

3.3 Methodology

This present study aims to develop the PTWL by employing two main approaches: corpus analysis and expert judgment. The methodology will be discussed as follows:

3.3.1 Frequently found Technical Words in the PT Corpus

To select the frequently found technical words that had potential to be included in the PTWL, a corpus-based approach was used by running the corpus in AntWordProfiler. PT Corpus, which was already converted into .txt files, imported into AntWordProfiler and analyzed using two criteria: lexical profiling and frequency.

Lexical profiling is a criterion for classifying words using the reference corpus. It has been one of the prototype criteria used in constructing a word list (Cobb & Horst, 2001). Coxhead's (2000) AWL excluded words that appear in GSL, as they are too general. Thiankasem and Yanasugondha (2018) selected words that occur outside GSL and AWL as their potential words to create their technical word list for cabin crew. The

reference word lists that will be used in this study are GSL and AWL. As it aims to investigate technical vocabulary, words that appear in GSL and AWL will be excluded.

Frequency is another widely used criterion to create a word list. Coxhead's (2000) AWL also applied this criterion. Words that appear at least 100 times in the whole corpus of 3.5 million running words were included. The PT corpus contains 1,446,521 running words. Applying the same mathematical rule, the calculation is as follows: $(100 \times 1,446,521) / 3,500,000 = 41.32$. This means words that appear at least 41 times in the whole corpus pass this criterion. This research has adapted the principle with some adjustment to frequency. As the PT corpus was compiled from a series of 14 books from one publisher (CAE Oxford), to increase the reliability of the results, the frequency set as the criterion had to be raised to 50 times in the whole corpus to ensure that each selected word truly represents the topic.

Range was not applied in this study due to the fact that each sub-corpus in the PT corpus contains the different information, and it might not appear in a wide range. For example, the word fuselage appears frequently in the topic of aircraft general knowledge but not the topic of air law. This research aims to build a corpus that contains useful words for all the topics covered in the pilot theoretical examination. Therefore, range was not taken into account.

Words that passed the lexical profiling and frequency criteria were then refined by removing proper names, abbreviations, acronyms, numbers and non-words. After the removal, the potential words were judged by three experts.

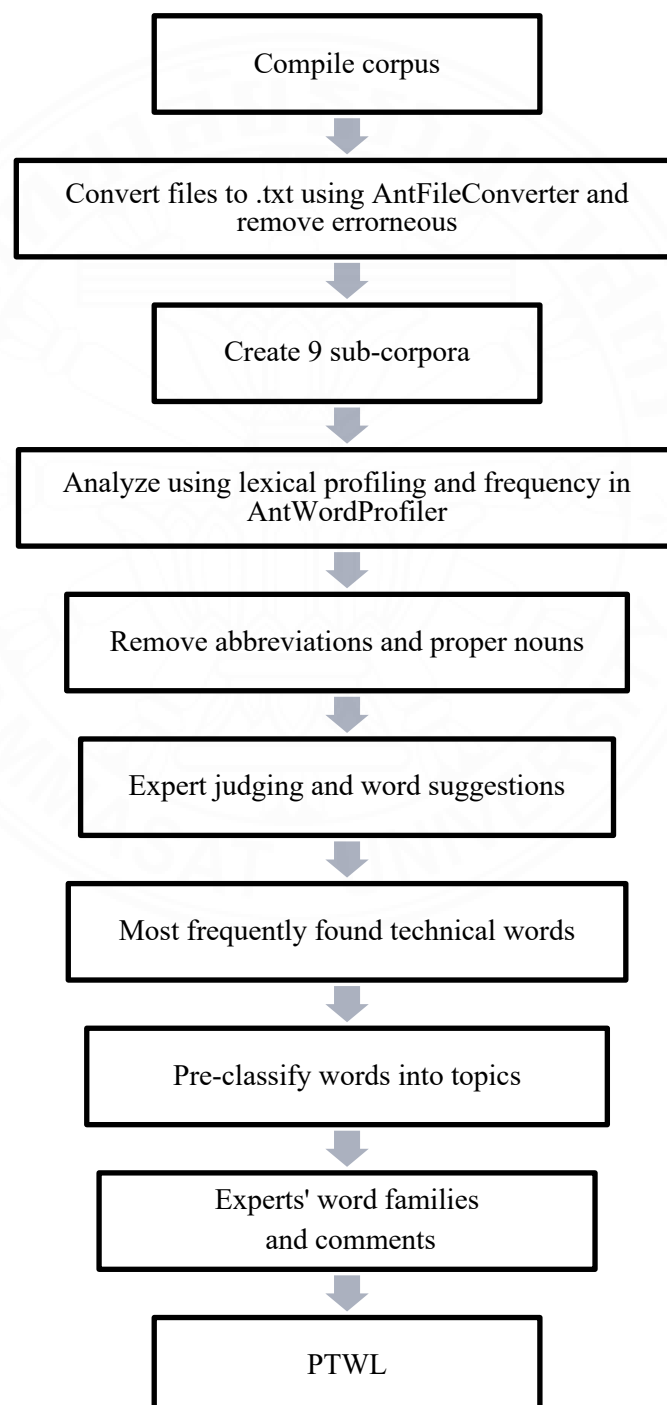
3.3.2 Creating the PTWL

To develop the PTWL, the researcher initiated the process by categorizing words into specific topics. The criterion used for classification was that a word must appear in a particular topic with a frequency of at least 25 percent of the total frequencies in the entire corpus. Subsequently, these pre-classified word lists were submitted to the experts for rating the importance and relevance of the words to each topic, utilizing the rating scales mentioned in section 3.3. Words that received a rating of 0 (indicating they were not necessary or not suggested for inclusion) from two out of the three experts were excluded. Finally, based on the results of the rating scale, including the suggested words from the experts, the researcher compiled words that

appeared across multiple subjects into an additional sub-list, creating a necessary common word list for the PTWL. The procedures undertaken in this study are illustrated in Figure 3.1.

Figure 3.1

Procedures for the PTWL Creation



CHAPTER 4

RESULTS

This chapter reports the results of the development of the corpus-based Pilot Technical Word Lists (PTWL), which will be explained according to each research question.

4.1 Frequently Found Technical Words in the PT Corpus

The PT corpus contains a total of 1,446,521 running words, consisting of nine sub-corpora, namely Air law, Aircraft General knowledge, Flight performance, planning and loading, Human performance, Meteorology, Navigation, Operational procedures, Principle of flight, and Radiotelephony. By processing the data in the AntWordProfiler, 1,023,521 tokens, counted as 963 family groups, were found to be in the first 1,000 words in GSL. 89,640 tokens, counted as 774 word families were found in the second 1,000 words in GSL. Combining the GSL together, it accounted for 76.78% of the running words. Coxhead and Nation (2001) reported that the AWL words cover around 8.5-10% of the running words in academic texts. However, the data has shown that 107,221 tokens, counted as 554 word families or only 7.41% of running words, were found to be in the AWL. Words that did not belong to the GSL or AWL were labelled as “Others”. Nation and Waring (1997) and Coxhead (2000) mentioned that words that fall into the category of “Others” usually covers around 10% of running words. In this study, as can be seen in Table 4.1, “Others” contains 226,139 tokens or 13,218 word families, accounting for 15.63%, which is considered to be a high percentage.

Table 4.1*Tokens and word families of the PT corpus*

Level	Tokens		Word families	
	Number of tokens	Percent	Number of word families	Percent
GSL 1 st 1,000 words	1,023,521	70.76%	963	6.21%
GSL 2 nd 1,000 words	89,640	6.2%	774	4.99%
AWL	107,221	7.41%	554	3.57%
Others	226,139	15.63%	13218	85.23%
Total	1,446,521	100%	15509	100%

To answer the first research question “What technical words are found most frequently in the PT Corpus?”, two criteria were used to analyze the corpus in order to find the frequently found technical words. First is lexical profiling, which was used to classify words using the reference corpora. In this study, two corpora, namely the GSL (West, 1953) and AWL (Coxhead, 2000), were used as the reference corpora. Words that were not classified into the GSL nor the AWL will appear in “Others”. These words were taken into consideration as technical words. Second is frequency. As explained in 3.3.1, words that appear at least 50 times in the whole corpus were considered as a preliminary word for the PTWL. After applying both criteria, 978 words were found to be satisfactory. Proper names, abbreviations, acronyms, numbers, and non-words were then removed. As it consists of a lot of abbreviations and proper nouns, 395 words were removed. Therefore, there were a total of 583 words that passed all the criteria. These words were sent to three experts for verification. Figure 4.1 displays the 50 most frequently found words (see Appendix A for the full list with the frequency).

Figure 4.1

The list of 50 highest frequency words that passed all the criteria

Note: Frequency in italicized numbers

1. aircraft 8827	14. static 892	27. clearance 665	40. glide 531
2. fuel 2958	15. traffic 865	28. compass 603	41. icing 530
3. altitude 2685	16. radar 853	29. turbine 587	42. cabin 526
4. pilot 2093	17. pitch 819	30. circuit 586	43. altimeter 524
5. runway 1832	18. airspeed 796	31. gear 585	44. piston 524
6. thrust 1336	19. valve 791	32. generator 581	45. compressor 507
7. aerodrome 1235	20. mach 781	33. gradient 580	46. flaps 501
8. navigation 1165	21. vertical 770	34. voltage 573	47. emergency 493
9. crew 1125	22. propeller 704	35. airflow 571	48. switch 486
10. height 1112	23. density 696	36. aviation 552	49. gyro 463
11. stall 1065	24. altitude 694	37. departure 541	50. polar 462
12. magnetic 1005	25. reference 672	38. cruise 536	
13. descent 901	26. jet 671	39. axis 532	

4.1.1 Expert Judgment

The purpose of the expert-judge approach was to eliminate words that were not relevant, too common, or not necessary to be introduced as technical words. The first expert was a flight instructor with more than 15 years of flying experience. The second expert was a co-pilot on a commercial airline with seven years of experience. The third expert was a PPL pilot preparing for CPL exams. He had five years of experience in the field. They were all briefed about the purpose and objectives of the study and how to use the 3-level scale, as shown in the table 3.2, to rate all 583 words that passed the lexical profiling and the frequency criterion, with the proper names, abbreviations, acronyms, numbers, and non-words removed. Words that were rated 0 means they are very general, not related to pilots and not necessary to be introduced. If the certain word was rated 0 by two out of three experts, it was removed from the list of potential technical words for PTWL. The results showed that out of 583 potential words, 57 words were removed from the final PTWL. Table 4.2 shows the rating score of all words that were eliminated.

Table 4.2*The words excluded from the final PTWL and the rating score.*

No.	Words	Rating Score		
		Rater 1	Rater 2	Rater 3
1	abbreviation	0	0	1
2	absorbed	0	1	0
3	acid	0	0	0
4	additionally	0	1	0
5	alert	0	2	0
6	allowable	0	1	0
7	arousal	0	0	2
8	auto	0	2	0
9	cable	0	2	0
10	cell	0	1	0
11	column	1	0	0
12	digital	0	1	0
13	drugs	0	1	0
14	dual	0	2	0
15	exam	0	1	0
16	exit	0	1	0
17	feed	0	2	0
18	feedback	0	1	0
19	filter	0	2	0
20	holder	0	1	0
21	lag	2	0	0
22	laser	0	0	0
23	layout	0	1	0
24	lens	0	1	0
25	loop	0	1	0
26	meter	0	1	0
27	minus	0	1	0
28	muscles	0	1	0
29	notified	0	2	0
30	objectives	0	1	0
31	personality	0	0	0
32	personnel	0	1	0
33	plot	0	1	0
34	privileges	1	0	0
35	profile	0	2	0
36	reactance	0	0	1

(Continued)

37	reception	0	2	0
38	recorder	0	1	0
39	rectangular	0	1	0
40	reference	0	2	0
41	reset	0	1	0
42	settings	0	1	0
43	sunrise	0	1	0
44	sunset	0	1	0
45	switch	0	2	0
46	syllabus	0	2	0
47	temperate	0	1	0
48	thereafter	0	0	1
49	triangle	0	1	0
50	twin	0	1	0
51	tyre	0	2	0
52	usable	0	2	0
53	versa	0	0	0
54	vice	0	0	0
55	warmer	0	1	0
56	warnings	0	2	0
57	zone	0	2	0

Out of 57 words that were eliminated, 54 words were suggested by the first expert, 53 words by the third expert, and only 12 words by the second expert. There were 50 words that the first and the third experts had agreement on a 0 rating. On the contrary, there were 16 words that were rated 0 by the first and the third experts but rated 2 by the second expert, such as *alert*, *auto*, *cable*, *filter*, *switch* and *tyre*.

In this regard, the researcher is aware that experts' disagreements can be attributed to three main factors: informants, information, and uncertainty (Deroover et al., 2022). With the differences of the current roles in aviation of three experts, gaps in the information received and uncertainty can cause the disagreement among the experts, resulting in the rating scores as shown in Table 4.2.

Upon the completion of the process to extract the frequently found technical words using lexical profile, frequency and expert judgment, the finalized technical words consist of 526 words.

4.2 Classification of PTWL

After obtaining the most frequently found technical words in the PT Corpus, all the words were classified into nine topics according to the pilot theoretical examination. The classification of words into different topics serves the purpose of facilitating effective utilization of the PTWL as a study resource. Each topic possesses its own distinct characteristics. For instance, the word "annex," referring to the 'basic standards and recommended practices of international civil aviation,' appears more frequently and is particularly relevant to the Air Law topic. Similarly, the word "hypoxia," denoting 'low levels of oxygen in body tissues,' is prominent in the Human Performance topic.

The frequency criterion is employed to classify words into their respective topics. If a word appears in a specific topic with a frequency exceeding 25 percent of the total frequency in the entire corpus, it is assigned to that particular topic. In addition to the technical words that meet the criteria of lexical profiling, frequency, and expert judgment, there are also additional words suggested by the experts. Towards the end of the rating scale, the experts were requested to propose words for each topic to ensure the inclusion of useful words in the word list. These suggested words may be deemed necessary but might not possess a sufficiently high frequency. Table 4.3 presents all the words suggested to be added by the experts.

The experts suggested a total of 45 words. All the words were related and useful to the subject, such as cowling, empennage, yoke, and wingtip, which are names for parts of an aircraft. One of the topics that received 26 suggested words is Radiotelephony. Interestingly, these words consist of the ICAO phonetic alphabet, which assigns code words to the 26 letters of the English alphabet. In the aviation industry, these alphabets serve as valuable tools to enhance safety and minimize misunderstandings. They play a crucial role in ensuring clear communication and avoiding confusion between the cockpit and the control tower. Certain letters, such as M and N, or G and J, can sound similar and lead to confusion, particularly when individuals have different accents or communication conditions are poor. Familiarity with the ICAO phonetic alphabet is fundamental knowledge for those involved in the aviation industry.

Table 4.3*Words suggested to be added to the PTWL by the experts*

Topics	Suggested Words
Air Law	hijack, marshaller
AC General Knowledge	cowling, empennage, yoke, wingtip
Flight Performance, Planning and Loading	-
Human Performance	fatal
Meteorology	windsock, mist, haze
Navigation	compulsory
Operational Procedure	ditching, recurrent, galley, malfunction
Principle of Flight	chandelle, lift, drag
Radiotelephony	Alpha, Bravo, Charlie, Delta, Echo, Foxtrot, Golf, Hotel, India, Juliette, Kilo, Lima, Mike, November, Oscar, Papa, Quebec, Romeo, Sierra, Tango, Uniform, Victor, Whiskey, X-ray, Yankee, Zulu

4.2.1 Expert Judgment

After the words were pre-classified by the researcher using the percentage of the frequency, the experts were asked to give their opinions on whether the word should belong to that topic. If not, then they were asked to give comments or suggestions as to where it should belong to. They could suggest that the word should appear in some other topic than the one it was pre-classified as by the researcher. The results are displayed in Table 4.4.

Table 4.4*Suggestions Made Regarding The Word List Classification*

Words	Pre-classification	Experts' suggestions
terminology	<ul style="list-style-type: none"> • Aircraft general knowledge 	<ul style="list-style-type: none"> • should be moved to Radiotelephony
microburst	<ul style="list-style-type: none"> • Operational procedure • Principle of flight 	<ul style="list-style-type: none"> • should also be in Meteorology
runway	<ul style="list-style-type: none"> • Air law 	<ul style="list-style-type: none"> • should also be in flight performance, planning and loading
onset	<ul style="list-style-type: none"> • Flight performance, planning and loading • Principle of flight 	<ul style="list-style-type: none"> • should also be in human performance

Based on the table above, it can be concluded that there was a consensus among the experts regarding the appropriateness of most of the words pre-classified by the researcher based on frequency criteria for each topic. Only one word, "terminology," was suggested to be moved from "Aircraft General Knowledge" to "Radiotelephony," and three words were recommended to be included in other topics in addition to their pre-classified categories. These few suggestions made by the experts indicate that the frequency criteria were effective in classifying words for each topic. However, it should be noted that words can appear in multiple contexts, such as the word "brake," which appears in both "Aircraft General Knowledge" and "Flight Performance, Planning, and Loading." It can refer to the braking system of the aircraft or the verb "to slow down." The qualitative approach of the experts' judgment ensures the relevance of the technical words for each topic.

After applying the criteria, incorporating expert ratings, and considering the suggested adjustments, the PTWL has been finalized. It consists of nine sub-lists, including an additional sub-list that compiles words appearing across subjects. These sub-lists contain practical and suitable words for PTWL users. They can serve as study materials for specific subjects or be utilized by ESP teachers, flight instructors, course

designers, or material developers as a guide for preparing their teaching materials, syllabi, and courses. Please refer to Appendix C for the complete list of PTWL and sub-lists..

4.3 Summary

The purpose of this chapter is to present the findings of the study, which address the research questions. The study aimed to achieve two main objectives: (1) identifying the most frequently occurring technical words in the PT Corpus, and (2) classifying these frequently occurring technical words into the topics covered in pilots' theoretical examinations, namely Air Law, Aircraft General Knowledge, Flight Performance, Planning and Loading, Human Performance, Meteorology, Navigation, Operational Procedures, Principles of Flight, and Radiotelephony. Appendix B provides a list of the 526 technical words that were identified as the most frequently found in the PT Corpus and met all the criteria, including expert judgment.

The next step involved classifying these technical words into their respective topics. It should be noted that certain words appeared in multiple topics, leading to the creation of additional sub-lists to accommodate them. The complete lists of the technical words classified into each topic can be found in Appendix C. It is expected that this PTWL will serve as a valuable resource and guide for individuals interested in aviation, aspiring pilots, and those already studying to become pilots. Chapter 5 will serve as the conclusion of the study and will discuss recommendations for future research.

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This chapter is separated into four parts. The first part is the summary of the study. The second part is the discussions. The third part discusses the pedagogical implications of the study. The fourth part is the limitations of the study. Finally, some recommendations for further studies are presented.

5.1 Summary of the Study

This corpus-based study aimed to investigate the frequently found technical vocabulary from the PT corpus and to create word lists that classify words into nine different topics for the pilots' theoretical examination. The vocabulary was compiled from 14 ATPL books in a series of CAE Oxford, the most complete source for those studying for the highest level of license issued to a pilot. The PT corpus consists of nine sub-corpora that were created using textbooks that relate to each topic of the pilots' theoretical examination. The study investigated the most frequently found technical words and classified them into topics for the ease of word list users.

The first research question focused on identifying the most frequently found technical words, employing both the corpus-based approach and the expert-judge approach. The AntWordProfiler tool was utilized in this process. Initially, 978 words were identified through lexical profiling and the frequency criterion. The researcher then qualitatively filtered the data by excluding proper names, abbreviations, numbers, and non-words. Subsequently, the remaining words were rated by three experts using the 3-level scale (refer to Table 3.2). Ultimately, a total of 526 words successfully met all the criteria and were determined to be the most frequently found technical words in the PT Corpus (see Appendix B).

The second research question aimed to classify these technical words into sub-lists corresponding to the pilots' theoretical examination topics. The classification was based on the percentage of words appearing in each sub-corpus. The results indicated that all three experts agreed on the usefulness of the technical words in each sub-list, despite variations in the number of words within each sub-list. The sub-list with the

highest number of words, 259 in total, was 'Aircraft General Knowledge,' followed by 'Principles of Flight' with 96 words. On the other hand, the sub-list 'Operational Procedures' had the fewest words, consisting of only 22 technical terms.

5.2 Discussion

5.2.1 Methodology in the Research

This study applied a corpus-based approach that has been widely used by many scholars (Drayton & Coxhead, 2023; It-Ngarm & Phoocharoensil, 2015; Coxhead & Demecheleer, 2018). It is commonly used to investigate the actual usage and the characteristics of lexical items in order to improve teaching and learning the language (Almutairi, 2016). To investigate the technical vocabulary from pilots' textbooks, a corpus-based approach was an appropriate approach, as it can reveal words which are authentic and significant. AntWordProfiler was used to profile the lexical items comparing with the GSL (West, 1953) and AWL (Coxhead, 2000). The frequency criterion was also applied to ensure the distinctiveness of the words. Coxhead's (2000) frequency criteria required words to appear at least 100 times in the corpus. Following the same principle, the cutoff point for this study would be a minimum of 41 occurrences. However, to ensure that the selected words have high frequency and significance to the topic, the threshold was increased to 50 occurrences in the entire corpus. It is important to note that the corpus used in this study was compiled from a series of books published by CAE Oxford. The range of frequencies was not considered as a criterion since each sub-list represents different topics with their own distinctiveness. For example, Drayton and Coxhead's (2023) study on Aviation Radiotelephony Specialized Vocabulary only used one corpus, without considering the range as a criterion. However, this research provides further insight into the words found.

In addition to the quantitative process used to identify technical words, this study also employed a qualitative approach by incorporating expert judgment. This approach is considered the most thorough method for identifying specialized words and ensures a high degree of reliability (Chung & Nation, 2003). Three experienced experts, including a flight instructor, a commercial pilot, and a CPL student, contributed their opinions from different perspectives, enhancing the research's reliability. The

combination of quantitative and qualitative techniques in this study provided distinct perspectives and insights. The quantitative method analyzed word frequencies to collect numerical data, offering quantitative information on the frequency of specific technical words in the corpus. The qualitative methods helped narrow down the list by ensuring the selected words were relevant to the topic and suggested necessary words, enriching the word list with additional insights and perspectives. Therefore, the integration of both quantitative and qualitative techniques in this research ensured the selection of relevant and appropriate specialized words for the PTWL.

In conclusion, after following all the procedures, a total of 526 words were selected as the most frequently found technical words in the PT Corpus. Table 5.1 provides examples of words with high frequency, low range, and a rating of 2 (should be introduced to pilots) from all three experts.

Table 5.1

Examples of words appearing in low ranges, which were rated 2 (should be introduced to the pilot) by the three experts

Words	Range	Frequency
aerofoil	4	255
aileron	3	227
autothrottle	3	72
chord	4	250
clearway	3	68
inlet	3	155
pneumatic	3	87
rhumb	2	199
sideslip	2	128
tailplane	4	194

These words were then pre-classified into topics for the pilots' theoretical examination by the researcher using the occurrence percentage of the word. After being judged by the experts, the feedback revealed agreement among them and only a few suggestions were made.

Table 5.2 presents examples of words in each topic, demonstrating their relevance to the subject matter and their ability to represent the topic effectively. For instance, the word "hypoxia," which refers to a low level of oxygen in the blood; "illusion," meaning a thing that is or is likely to be wrongly perceived or interpreted; and "circadian," pertaining to the physical, mental, and behavioral changes in humans that follow a 24-hour cycle, are all words related to the topic of human performance.

Table 5.2

Examples of words in each sub-list

Topic	Words
Air Law	airspace, authorized, hijack
Aircraft General Knowledge	fuselage, flaps, combustion, turbine
Flight Performance, Planning and Loading	ceiling, endurance, diversion
Human Performance	hypoxia, illusion, circadian
Meteorology	convection, cumulonimbus, hemisphere, turbulence
Navigation	electromagnetic, localizer, perpendicular, starboard
Operational Procedure	jettison, ditching, decompression
Principle of Flight	aerodynamic, camber, stall, supersonic
Radiotelephony	Alpha, Bravo, Charlie

It is important to note that, while these words have general definitions, their specific interpretations can vary depending on the context in which they are used. For example, in the context of aviation, "hypoxia" specifically refers to the oxygen deficiency experienced at high altitudes. In a medical context, it may refer to oxygen deprivation caused by various medical conditions. Therefore, understanding the context is crucial for accurately interpreting the meaning of these words and using them appropriately in communication.

In addition to the nine sub-lists that represent each topic of theoretical examination, namely Air Law, Aircraft General Knowledge, Flight Performance, Planning and Loading, Human Performance, Meteorology, Navigation, Operational

Procedures, Principles of Flight, and Radiotelephony, an extra sub-list has been created to compile words that appear across subjects. This sub-list contains a total of 143 words. This implies that each word can be used in more than one topic, as there are connections and relationships between the information presented in different topics. For example, the word "thrust" appears in three topics: Aircraft General Knowledge, Flight Performance, Planning and Loading, and Principles of Flight, with frequencies of 527, 494, and 291, respectively. These three topics are interconnected, as the word is introduced in the general knowledge section and further explained in the sections where the knowledge is applied in practical action.

5.2.2 Experts' Ratings

Table 4.2 (earlier discussed in 4.1.1) displayed the scores rated to be removed by three experts; expert 1 and expert 3 identified 50 words to be removed, while expert 2 only selected 16 words. This discrepancy in expert opinions has been acknowledged by the researcher, as there were several factors that contributed to the observed disagreement among the experts. One such instance is the suggestion provided by one expert to include the International Civil Aviation Organization (ICAO) phonetic alphabet, which may be considered widely known and potentially unnecessary for new learners.

The reasons for the discrepancy can be attributed to several factors. Firstly, the experts themselves have different backgrounds and levels of familiarity with the textbooks and the pilots' theoretical examination. Secondly, the information provided to the experts may not have been adequate or clear enough to eliminate ambiguity. Lastly, the disagreement could arise from the subjective interpretation of the word relevance or uncertainty about the degree of relevance of certain words.

In future research, it is important to consider specific criteria for selecting experts, particularly in fields like aviation that encompass various sub-fields. For example, in this study, although all the experts were pilots, they possessed different areas of expertise. This consideration would help ensure a more balanced and diverse expert panel.

Additionally, incorporating the Kappa statistic would significantly enhance the overall quality of the research. The Kappa statistic is a widely used measure that

assesses the agreement between two raters when categorizing or classifying items. By applying this statistical tool, especially in inter-rater reliability studies, valuable insights can be gained regarding the level of agreement among experts.

Lastly, it is advantageous to encourage experts to engage in discussions and establish expectations before independently rating the words. This approach fosters mutual understanding and can help align their perspectives, leading to improved agreement and consistency in the ratings.

5.3 Pedagogical Implications

The results found in this study have significant pedagogical implications. The PTWL should be beneficial for pilots, pilot cadets, flight instructors, ESP teachers, and all that are interested in aviation. Firstly, this PTWL consists of technical words that were compiled from ATPL textbooks, which are the textbooks for the highest level of license issued to a pilot. The technical words selected to be included in the word list are suitable for those who are preparing for all types of licenses: PPL, CPL, and ATPL. They can use this list as a guideline for their own study to measure their vocabulary knowledge or to use it as an initial list of important words they should know before starting to study the topic. Secondly, the PTWL is a good source for flight instructors and ESP teachers for selecting the vocabulary when preparing for their lessons. As this PTWL contains useful technical words and has been categorized into topics, the instructor can use the lists to set an assignment for their student to find the meaning or the definition of each word before the beginning of the course. Some topics such as aircraft general knowledge contain a lot of words for parts of the aircraft. Suggesting that students study frequently found technical vocabulary before the class will help them to learn the content quicker and more productively. Thirdly, all the sub-lists of the PTWL are useful for pilot cadets to use in supporting their studies for particular topics. It is aimed to facilitate learners to be able to independently use the word lists to aid in their preparation for examinations. Lastly, it can be used as a reference for flight instructors and ESP teachers to measure the technical vocabulary knowledge of their students.

5.4 Limitations of the Study

There are several limitations that have been identified in this research. Firstly, the corpus used in this study was compiled from the 14 ATPL textbooks of CAE Oxford, which means it represents a comprehensive source of knowledge from a single company. This limited range of sources could potentially introduce bias and may not fully capture the variety of technical words used in the aviation domain. Due to this limitation, the range of the corpus was not used as one of the criteria in selecting technical words, and instead, the cut-off point for frequency was raised to ensure inclusion of words with high frequency and significance to the topic.

Secondly, it is important to note that the PTWL, while providing sub-lists for each topic of theoretical examination, should not be perceived as an exhaustive list that covers all necessary words. Users should view the PTWL as a guideline and prioritize learning the frequently found words as a foundation for further study based on their individual objectives and goals.

Thirdly, the PTWL does not provide definitions for the words. As mentioned earlier, some words can appear in multiple topics, highlighting the importance of using the list with care and context awareness. Users should seek additional resources to understand the specific meanings and applications of each word in different contexts.

Fourthly, by not investigating the part of speech of the words, this research may limit the comprehension and application of words in specific contexts, especially for words with multiple meanings. Understanding the function or role of each word becomes essential for effective utilization of the word lists.

Lastly, in this research, a group of experienced pilots with different areas of expertise was selected as experts. However, their varying skills and perspectives have led to disagreements among them. Additionally, there is a possibility of uncertainty among the experts due to potential inadequacies in the information provided to them.

5.5 Recommendations for Further Studies

For future research, it is suggested that more textbooks from other publishers be collected to create a PT Corpus. The choice of textbooks should represent a variety of English, such as textbooks in American English, British English, and Australian English. This will allow the researcher to investigate a wider range of vocabulary.

During the process of selecting technical words, 'range' criteria can be applied, which can make the findings more generalizable.

To improve the quality of the word lists, future researchers could provide sub-lists of technical vocabulary that assist learners in studying vocabulary in order of importance.

Future research could also provide the definitions and parts of speech along with the list of frequently found words for more efficient usage of the word lists.

This study aimed for words that are useful for pilots; however, there are many other aspects relating to aviation awaiting further study, such as English for aeronautical engineering.

It is crucial to establish specific criteria for selecting experts, particularly in multidisciplinary fields like aviation. Additionally, incorporating the Kappa statistic would enhance the research's quality by evaluating the agreement between raters. Encouraging experts to engage in discussion and establish expectations before rating independently promotes mutual understanding.

5.6 Summary

This chapter presented the discussion, the conclusion of the study, the pedagogical implications, and some recommendations for future research. The PTWL, which contains words frequently found in pilots' textbooks were classified into nine sub-lists according to theoretical examination and one sub-list of words appearing across subjects, is hoped to be useful for all the word list users. Further study on varieties of English from a wider range of textbooks and the continued development of more efficient word lists with parts of speech and definitions are suggested.

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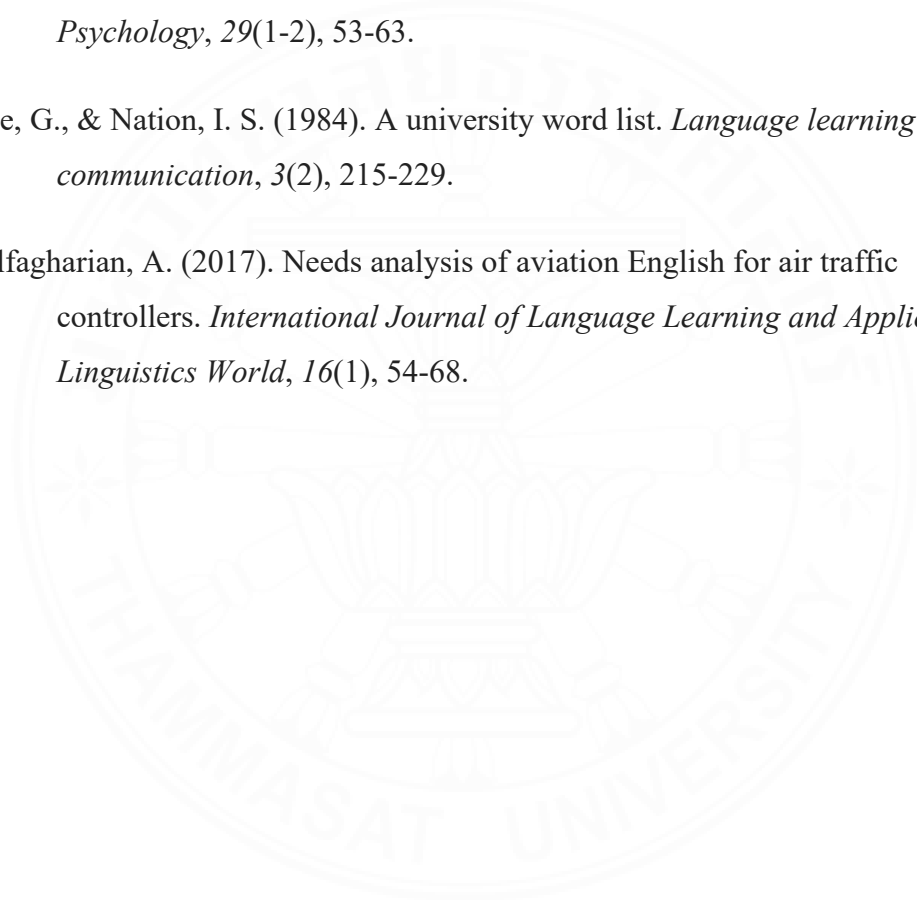
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APPENDICES



APPENDIX A

583 WORD OF PRELIMINARY LIST FOR EXPERT JUDGMENT

Note: numbers in italics are the frequency

1	abatement	63	33	align	55	65	autopilot	338
2	abbreviations	50	34	allowable	66	66	autothrottle	72
3	absorbed	52	35	almanac	55	67	auxiliary	58
4	accelerate	150	36	alternator	191	68	aviation	552
5	accumulator	53	37	altimeter	524	69	axis	532
6	acid	67	38	altitude	2685	70	azimuth	92
7	activated	56	39	amber	79	71	barometric	72
8	actuator	112	40	ambient	137	72	beacon	191
9	additionally	51	41	ammeter	52	73	boost	85
10	advection	50	42	amplifier	51	74	brake	324
11	adverse	115	43	amplitude	81	75	buffet	151
12	advisories	50	44	amps	58	76	bulb	57
13	aerial	135	45	analogue	70	77	bypass	112
14	aerodrome	1235	46	angular	126	78	cabin	526
15	aerodynamic	415	47	annex	296	79	cable	50
16	aerofoil	255	48	annunciator	52	80	calibration	51
17	aeronautical	189	49	antenna	81	81	camber	113
18	aft	270	50	anticlockwise	55	82	capacitance	66
19	aileron	227	51	anticyclones	51	83	capacitive	55
20	airborne	229	52	apron	96	84	capsule	72
21	aircraft	8827	53	arc	180	85	capture	67
22	aircrew	78	54	arctic	62	86	carbon	167
23	airfield	323	55	armature	102	87	carburettor	101
24	airflow	571	56	arousal	54	88	cargo	225
25	airframe	153	57	asymmetric	52	89	carrier	67
26	airline	92	58	atmosphere	412	90	casing	64
27	airport	225	59	atmospheric	159	91	ceiling	120
28	airspace	537	60	augmentation	52	92	cell	104
29	airspeed	796	61	aural	89	93	centrifugal	149
30	airway	100	62	authorized	89	94	certificate	141
31	airworthiness	79	63	auto	112	95	certified	57
32	alert	169	64	autoland	69	96	chamber	203

97	checklist	58	129	contamination	90	161	depressions	146
98	chord	250	130	continental	68	162	descent	901
99	circadian	54	131	contingency	84	163	designated	150
100	circuit	586	132	continually	50	164	destination	316
101	circulation	55	133	contour	50	165	detonation	65
102	clearance	665	134	controllability	57	166	dew	82
103	clearway	68	135	convection	56	167	diagram	248
104	climatology	88	136	convergence	208	168	diameter	84
105	clockwise	95	137	cope	51	169	diesel	51
106	cockpit	303	138	coriolis	53	170	differential	189
107	coefficient	231	139	corrective	51	171	digital	126
108	coil	147	140	corrosion	72	172	dihedral	115
109	collision	109	141	counter	59	173	dioxide	71
110	column	116	142	crankshaft	73	174	directional	292
111	combustion	321	143	crew	1125	175	directive	50
112	compartment	106	144	crosswind	101	176	disc	69
113	compass	603	145	cruise	536	177	discharge	114
114	compliance	69	146	crystals	54	178	disconnect	56
115	comply	97	147	cumulonimbus	76	179	disengage	55
116	compressed	54	148	cumulus	55	180	distress	110
117	compressibility	102	149	currents	84	181	divergence	55
118	compression	137	150	cylinder	261	182	diversion	93
119	compressor	507	151	damping	78	183	doppler	61
120	condensation	62	152	database	54	184	downward	50
121	conditioning	72	153	datum	293	185	downwash	99
122	conductor	58	154	deceleration	65	186	downwind	55
123	cone	99	155	deck	264	187	drain	55
124	configuration	312	156	decompression	63	188	drift	428
125	conformal	60	157	deflection	109	189	drizzle	55
126	conical	55	158	density	696	190	droplets	148
127	conjunction	61	159	departure	541	191	drugs	55
128	consecutive	58	160	deployed	63	192	dual	68

193	duct	69	225	forecast	216	257	headings	59
194	easterly	87	226	fraction	50	258	headwind	238
195	elapsed	50	227	frequencies	215	259	heater	56
196	electrics	228	228	friction	219	260	height	1112
197	electromagnetic	58	229	frontal	108	261	hemisphere	312
198	electronic	256	230	fronts	72	262	hinge	106
199	electrons	82	231	frost	100	263	holder	102
200	elevation	288	232	fuel	2958	264	horizontal	453
201	elevator	157	233	fuse	78	265	horsepower	50
202	emergency	493	234	fuselage	263	266	humidity	194
203	endurance	199	235	gauge	155	267	hydraulic	281
204	engaged	177	236	gear	585	268	hydroplaning	57
205	equator	360	237	gearbox	62	269	hypoxia	120
206	equatorial	72	238	generator	581	270	icing	530
207	equilibrium	118	239	geographical	50	271	ident	66
208	evaporation	54	240	geometric	55	272	identifier	52
209	exam	55	241	geostrophic	72	273	ignition	134
210	exhaust	259	242	gimbal	107	274	illuminated	61
211	exit	60	243	glide	531	275	illusion	70
212	extinguishers	58	244	goods	116	276	impeller	54
213	fatigue	131	245	gradient	580	277	inboard	54
214	feed	75	246	graph	285	278	inbound	71
215	feedback	70	247	graticule	60	279	inductance	55
216	filter	116	248	gravity	226	280	inductive	57
217	fin	143	249	grid	217	281	inertia	77
218	flap	419	250	gross	160	282	inlet	155
219	flare	73	251	guidance	166	283	inoperative	216
220	fleet	52	252	gust	123	284	installation	53
221	fluid	271	253	gyro	463	285	instrumentation	86
222	flutter	63	254	hail	99	286	intake	127
223	flux	133	255	hazard	89	287	intercept	58
224	fog	215	256	hazardous	54	288	interrogation	57

289	intersection	70	321	malfunction	55	353	occlusion	78
290	inversion	75	322	mandatory	59	354	oceanic	70
291	ionization	52	323	manifold	145	355	ohms	70
292	isobars	98	324	manoeuvre	195	356	omni	72
293	jet	671	325	maritime	82	357	onset	55
294	jettison	60	326	markings	170	358	optimum	186
295	junction	51	327	mercator	161	359	orbit	58
296	kinetic	158	328	mercury	56	360	ordinated	50
297	lag	69	329	meridian	278	361	orographic	56
298	landings	82	330	meteorology	50	362	oscillation	104
299	lapse	70	331	meter	59	363	outboard	54
300	laser	53	332	microburst	54	364	outbound	75
301	latent	65	333	minima	166	365	outflow	66
302	lateral	260	334	minus	109	366	outlet	70
303	latitude	694	335	modulation	89	367	overhead	101
304	layout	57	336	moist	66	368	overheat	50
305	lens	56	337	moisture	69	369	parasite	165
306	lever	178	338	momentum	50	370	paved	57
307	liability	60	339	monoxide	59	371	peak	71
308	lightning	60	340	mounted	168	372	permissible	66
309	linear	98	341	multi	275	373	perpendicular	53
310	localizer	213	342	muscles	52	374	personality	87
311	longitude	356	343	nautical	172	375	personnel	105
312	loop	169	344	navigation	1165	376	phraseology	60
313	lubrication	70	345	nerve	53	377	physiological	55
314	mach	781	346	nervous	70	378	pilot	2093
315	machmeter	59	347	newton	52	379	piston	524
316	magnet	197	348	nitrogen	60	380	pitch	819
317	magnetic	1005	349	notified	51	381	pitot	211
318	magnetism	165	350	nozzle	89	382	pivot	52
319	magneto	56	351	objectives	54	383	platform	75
320	magnitude	99	352	obstacle	342	384	plot	62

385	plug	57	417	recorder	75	449	shaft	183
386	pneumatic	87	418	rectangular	53	450	shear	54
387	polar	462	419	reference	672	451	shunt	51
388	pole	366	420	refraction	63	452	sideslip	128
389	port	93	421	refuelling	76	453	simulator	56
390	practicable	65	422	registry	53	454	simultaneously	54
391	precession	82	423	relay	82	455	sine	72
392	precipitation	183	424	remote	94	456	situational	54
393	predetermined	50	425	reservoir	66	457	skid	77
394	prescribed	84	426	reset	60	458	slat	56
395	pressurization	103	427	residual	54	459	slipstream	56
396	pressurized	84	428	resultant	73	460	slot	50
397	prevailing	56	429	retina	64	461	slush	54
398	privileges	62	430	retracted	103	462	solar	74
399	probe	79	431	rhumb	199	463	solenoid	58
400	proficiency	50	432	rotate	138	464	span	84
401	profile	120	433	rotation	288	465	spanwise	50
402	propagation	158	434	rotor	280	466	spark	50
403	propeller	704	435	routine	54	467	specimen	162
404	proximity	124	436	rudder	283	468	spoiler	65
405	pulse	177	437	runway	1832	469	spool	50
406	radar	853	438	satellite	148	470	squared	80
407	radial	186	439	saturated	80	471	squawk	62
408	radiation	184	440	scavenge	50	472	stabilizer	86
409	radius	150	441	seal	53	473	stall	1065
410	ratings	59	442	sectional	54	474	standby	78
411	reactance	52	443	segment	193	475	starboard	80
412	rear	126	444	sensor	88	476	starter	99
413	rearward	52	445	sensory	65	477	static	892
414	recall	70	446	serviceable	52	478	stationary	116
415	reception	53	447	servo	80	479	stator	76
416	reciprocal	67	448	settings	83	480	stereographic	71

481	stopway	65	513	terrain	233	545	twin	173
482	stowed	52	514	thereafter	55	546	tyre	199
483	stratus	54	515	thermal	158	547	undercarriage	132
484	subscale	60	516	threshold	306	548	unserviceable	51
485	subsonic	96	517	throttle	277	549	urgency	59
486	subtropical	86	518	thrust	1336	550	usable	60
487	suction	74	519	thunderstorm	83	551	valve	791
488	sump	54	520	tilt	61	552	vane	55
489	sunrise	102	521	timing	54	553	vapour	134
490	sunset	86	522	tolerance	56	554	vector	109
491	supercharger	57	523	topographical	52	555	velocity	454
492	supercooled	68	524	torque	261	556	vent	77
493	supersonic	83	525	touchdown	175	557	venturi	57
494	supervision	50	526	traffic	865	558	versa	54
495	surge	53	527	trailing	177	559	vertical	770
496	surveillance	114	528	trainer	56	560	vibration	72
497	sweepback	55	529	transformer	52	561	vice	52
498	switch	486	530	transmitter	171	562	vicinity	87
499	syllabus	78	531	transonic	55	563	viscosity	65
500	symmetrical	53	532	transponder	151	564	vital	59
501	symptoms	94	533	triangle	98	565	volcanic	54
502	synchronization	52	534	trim	388	566	voltage	573
503	synthetic	55	535	tropical	152	567	volts	148
504	tailplane	194	536	tropopause	122	568	vortex	100
505	tailwind	210	537	troposphere	56	569	vortices	121
506	tank	261	538	trough	51	570	warmer	107
507	taxiing	92	539	turbine	587	571	warnings	139
508	taxiway	198	540	turbo	64	572	wastegate	68
509	temperate	54	541	turbojet	113	573	watts	51
510	tempo	59	542	turboprop	67	574	wavelength	62
511	termed	51	543	turbulence	459	575	waypoint	148
512	terminology	57	544	twilight	103	576	westerly	106

577	windscreen	<i>51</i>
578	windshear	<i>217</i>
579	wingspan	<i>51</i>
580	withstand	<i>63</i>
581	workload	<i>67</i>
582	yaw	<i>256</i>
583	zone	<i>318</i>



APPENDIX B

526 MOST FREQUENTLY FOUND TECHNICAL WORDS IN PT CORPUS AS VALIDATED BY EXPERTS

1	abatement	33	amber	65	boost
2	accelerate	34	ambient	66	brake
3	accumulator	35	ammeter	67	buffet
4	activated	36	amplifier	68	bulb
5	actuator	37	amplitude	69	bypass
6	advection	38	amps	70	cabin
7	adverse	39	analogue	71	calibration
8	advisories	40	angular	72	camber
9	aerial	41	annex	73	capacitance
10	aerodrome	42	annunciator	74	capacitive
11	aerodynamic	43	antenna	75	capsule
12	aerofoil	44	anticlockwise	76	capture
13	aeronautical	45	anticyclones	77	carbon
14	aft	46	apron	78	carburettor
15	aileron	47	arc	79	cargo
16	airborne	48	arctic	80	carrier
17	aircraft	49	armature	81	casing
18	aircrew	50	asymmetric	82	ceiling
19	airfield	51	atmosphere	83	centrifugal
20	airflow	52	atmospheric	84	certificate
21	airframe	53	augmentation	85	certified
22	airline	54	aural	86	chamber
23	airport	55	authorized	87	checklist
24	airspace	56	autoland	88	chord
25	airspeed	57	autopilot	89	circadian
26	airway	58	autothrottle	90	circuit
27	airworthiness	59	auxiliary	91	circulation
28	align	60	aviation	92	clearance
29	almanac	61	axis	93	clearway
30	alternator	62	azimuth	94	climatology
31	altimeter	63	barometric	95	clockwise
32	altitude	64	beacon	96	cockpit

97	coefficient	129	corrosion	161	dioxide
98	coil	130	counter	162	directional
99	collision	131	crankshaft	163	directive
100	combustion	132	crew	164	disc
101	compartment	133	crosswind	165	discharge
102	compass	134	cruise	166	disconnect
103	compliance	135	crystals	167	disengage
104	comply	136	cumulonimbus	168	distress
105	compressed	137	cumulus	169	divergence
106	compressibility	138	currents	170	diversion
107	compression	139	cylinder	171	doppler
108	compressor	140	damping	172	downward
109	condensation	141	database	173	downwash
110	conditioning	142	datum	174	downwind
111	conductor	143	deceleration	175	drain
112	cone	144	deck	176	drift
113	configuration	145	decompression	177	drizzle
114	conformal	146	deflection	178	droplets
115	conical	147	density	179	duct
116	conjunction	148	departure	180	easterly
117	consecutive	149	deployed	181	elapsed
118	contamination	150	depressions	182	electrics
119	continental	151	descent	183	electromagnetic
120	contingency	152	designated	184	electronic
121	continually	153	destination	185	electrons
122	contour	154	detonation	186	elevation
123	controllability	155	dew	187	elevator
124	convection	156	diagram	188	emergency
125	convergence	157	diameter	189	endurance
126	cope	158	diesel	190	engaged
127	coriolis	159	differential	191	equator
128	corrective	160	dihedral	192	equatorial

193	equilibrium	225	goods	257	inboard
194	evaporation	226	gradient	258	inbound
195	exhaust	227	graph	259	inductance
196	extinguishers	228	graticule	260	inductive
197	fatigue	229	gravity	261	inertia
198	fin	230	grid	262	inlet
199	flap	231	gross	263	inoperative
200	flare	232	guidance	264	installation
201	fleet	233	gust	265	instrumentation
202	fluid	234	gyro	266	intake
203	flutter	235	hail	267	intercept
204	flux	236	hazard	268	interrogation
205	fog	237	hazardous	269	intersection
206	forecast	238	headings	270	inversion
207	fraction	239	headwind	271	ionization
208	frequencies	240	heater	272	isobars
209	friction	241	height	273	jet
210	frontal	242	hemisphere	274	jettison
211	fronts	243	hinge	275	junction
212	frost	244	horizontal	276	kinetic
213	fuel	245	horsepower	277	landings
214	fuse	246	humidity	278	lapse
215	fuselage	247	hydraulic	279	latent
216	gauge	248	hydroplaning	280	lateral
217	gear	249	hypoxia	281	latitude
218	gearbox	250	icing	282	lever
219	generator	251	ident	283	liability
220	geographical	252	identifier	284	lightning
221	geometric	253	ignition	285	linear
222	geostrophic	254	illuminated	286	localizer
223	gimbal	255	illusion	287	longitude
224	glide	256	impeller	288	lubrication

289	mach	321	nozzle	353	pneumatic
290	machmeter	322	obstacle	354	polar
291	magnet	323	occlusion	355	pole
292	magnetic	324	oceanic	356	port
293	magnetism	325	ohms	357	practicable
294	magneto	326	omni	358	precession
295	magnitude	327	onset	359	precipitation
296	malfunction	328	optimum	360	predetermined
297	mandatory	329	orbit	361	prescribed
298	manifold	330	ordinated	362	pressurization
299	manoeuvre	331	orographic	363	pressurized
300	maritime	332	oscillation	364	prevailing
301	markings	333	outboard	365	probe
302	mercator	334	outbound	366	proficiency
303	mercury	335	outflow	367	propagation
304	meridian	336	outlet	368	propeller
305	meteorology	337	overhead	369	proximity
306	microburst	338	overheat	370	pulse
307	minima	339	parasite	371	radar
308	modulation	340	paved	372	radial
309	moist	341	peak	373	radiation
310	moisture	342	permissible	374	radius
311	momentum	343	perpendicular	375	ratings
312	monoxide	344	phraseology	376	rear
313	mounted	345	physiological	377	rearward
314	multi	346	pilot	378	recall
315	nautical	347	piston	379	reciprocal
316	navigation	348	pitch	380	refraction
317	nerve	349	pitot	381	refuelling
318	nervous	350	pivot	382	registry
319	newton	351	platform	383	relay
320	nitrogen	352	plug	384	remote

385	reservoir	417	slipstream	449	supersonic
386	residual	418	slot	450	supervision
387	resultant	419	slush	451	surge
388	retina	420	solar	452	surveillance
389	retracted	421	solenoid	453	sweepback
390	rhumb	422	span	454	symmetrical
391	rotate	423	spanwise	455	symptoms
392	rotation	424	spark	456	synchronization
393	rotor	425	specimen	457	synthetic
394	routine	426	spoiler	458	tailplane
395	rudder	427	spool	459	tailwind
396	runway	428	squared	460	tank
397	satellite	429	squawk	461	taxiing
398	saturated	430	stabilizer	462	taxiway
399	scavenge	431	stall	463	tempo
400	seal	432	standby	464	termed
401	sectional	433	starboard	465	terminology
402	segment	434	starter	466	terrain
403	sensor	435	static	467	thermal
404	sensory	436	stationary	468	threshold
405	serviceable	437	stator	469	throttle
406	servo	438	stereographic	470	thrust
407	shaft	439	stopway	471	thunderstorm
408	shear	440	stowed	472	tilt
409	shunt	441	stratus	473	timing
410	sideslip	442	subscale	474	tolerance
411	simulator	443	subsonic	475	topographical
412	simultaneously	444	subtropical	476	torque
413	sine	445	suction	477	touchdown
414	situational	446	sump	478	traffic
415	skid	447	supercharger	479	trailing
416	slat	448	supercooled	480	trainer

481	transformer	513	volts
482	transmitter	514	vortex
483	transonic	515	vortices
484	transponder	516	wastegate
485	trim	517	watts
486	tropical	518	wavelength
487	tropopause	519	waypoint
488	troposphere	520	westerly
489	trough	521	windscreen
490	turbine	522	windshear
491	turbo	523	wingspan
492	turbojet	524	withstand
493	turboprop	525	workload
494	turbulence	526	yaw
495	twilight		
496	undercarriage		
497	unserviceable		
498	urgency		
499	valve		
500	vane		
501	vapour		
502	vector		
503	velocity		
504	vent		
505	venturi		
506	vertical		
507	vibration		
508	vicinity		
509	viscosity		
510	vital		
511	volcanic		
512	voltage		

APPENDIX C

PTWL SUBLISTS

Sublist 1: Air Law

1	aerodrome	22	hijack	43	registry
2	aeronautical	23	identifier	44	runway
3	airline	24	inbound	45	segment
4	airspace	25	intersection	46	simulator
5	airworthiness	26	landings	47	span
6	annex	27	liability	48	stopway
7	apron	28	mandatory	49	supervision
8	authorized	29	markings	50	synthetic
9	aviation	30	marshaller	51	taxiing
10	carrier	31	minima	52	taxiway
11	certificate	32	obstacle	53	threshold
12	checklist	33	omni	54	tolerance
13	clearance	34	outbound	55	touchdown
14	collision	35	paved	56	traffic
15	comply	36	pilot	57	trainer
16	consecutive	37	practicable	58	transponder
17	departure	38	prescribed	59	urgency
18	designated	39	proficiency	60	vicinity
19	directive	40	radar	61	volcanic
20	distress	41	ratings		
21	guidance	42	reciprocal		

Sublist 2: Aircraft General Knowledge

1	accumulator	33	boost	65	counter
2	activated	34	brake	66	cowling
3	actuator	35	bypass	67	crankshaft
4	advisories	36	cabin	68	crystals
5	aileron	37	calibration	69	currents
6	aircraft	38	capacitance	70	cylinder
7	airflow	39	capacitive	71	damping
8	airframe	40	capsule	72	deceleration
9	airspeed	41	capture	73	deck
10	align	42	carbon	74	density
11	alternator	43	carburettor	75	detonation
12	altimeter	44	casing	76	diagram
13	altitude	45	centrifugal	77	diameter
14	amber	46	chamber	78	diesel
15	ambient	47	circuit	79	differential
16	ammeter	48	clockwise	80	directive
17	amplifier	49	cockpit	81	disc
18	amps	50	coil	82	discharge
19	analogue	51	collision	83	disconnect
20	annunciator	52	column	84	disengage
21	anticlockwise	53	combustion	85	downward
22	armature	54	compartment	86	drain
23	atmospheric	55	compass	87	duct
24	augmentation	56	compressed	88	electrics
25	aural	57	compressibility	89	electromagnetic
26	autoland	58	compression	90	electronic
27	autopilot	59	compressor	91	electrons
28	autothrottle	60	conditioning	92	emergency
29	auxiliary	61	conductor	93	empennage
30	axis	62	conjunction	94	engaged
31	azimuth	63	corrective	95	exhaust
32	barometric	64	corrosion	96	extinguishers

97	flare	129	installation	161	overheat
98	fluid	130	instrumentation	162	peak
99	flutter	131	intake	163	permissible
100	flux	132	intercept	164	piston
101	friction	133	jet	165	pitch
102	fuel	134	junction	166	pitot
103	fuse	135	kinetic	167	pivot
104	fuselage	136	lever	168	platform
105	gauge	137	linear	169	plug
106	gear	138	localizer	170	pneumatic
107	gearbox	139	lubrication	171	pole
108	generator	140	mach	172	port
109	gimbal	141	machmeter	173	precession
110	gravity	142	magnet	174	predetermined
111	gyro	143	magnetic	175	pressurization
112	hazardous	144	magnetism	176	pressurized
113	headings	145	magneto	177	prevailing
114	heater	146	magnitude	178	probe
115	height	147	malfunction	179	propeller
116	hinge	148	manifold	180	proximity
117	horizontal	149	manoeuvre	181	rear
118	horsepower	150	mercury	182	rearward
119	hydraulic	151	moisture	183	refuelling
120	icing	152	momentum	184	relay
121	ignition	153	mounted	185	remote
122	illuminated	154	newton	186	reservoir
123	impeller	155	nitrogen	187	residual
124	inboard	156	nozzle	188	resultant
125	inductance	157	ohms	189	retracted
126	inductive	158	outboard	190	rotate
127	inertia	159	outflow	191	rotation
128	inlet	160	outlet	192	rotor

193	rudder	225	thermal	257	withstand
194	scavenge	226	throttle	258	yaw
195	seal	227	thrust	259	yoke
196	sensor	228	tilt		
197	servo	229	timing		
198	shaft	230	tolerance		
199	shear	231	torque		
200	shunt	232	touchdown		
201	simultaneously	233	transformer		
202	sine	234	trim		
203	skid	235	turbine		
204	solenoid	236	turbo		
205	spark	237	turbojet		
206	spoiler	238	turboprop		
207	spool	239	undercarriage		
208	stabilizer	240	unserviceable		
209	standby	241	valve		
210	starter	242	vane		
211	static	243	velocity		
212	stationary	244	vent		
213	stator	245	venturi		
214	stowed	246	vertical		
215	subscale	247	vibration		
216	suction	248	viscosity		
217	sump	249	vital		
218	supercharger	250	voltage		
219	surge	251	volts		
220	synchronization	252	wastegate		
221	synthetic	253	watts		
222	tank	254	waypoint		
223	termed	255	windscreen		
224	terrain	256	wingtip		

Sublist 3: Flight Performance, Planning and Loading

1	abatement	23	descent	45	optimum
2	accelerate	24	destination	46	outbound
3	aft	25	diversion	47	parasite
4	airfield	26	elapsed	48	paved
5	airport	27	elevation	49	permissible
6	airspeed	28	endurance	50	prescribed
7	airway	29	flap	51	rearward
8	altitude	30	fleet	52	recall
9	brake	31	fuel	53	retracted
10	buffet	32	gradient	54	runway
11	cargo	33	graph	55	segment
12	ceiling	34	gravity	56	serviceable
13	certified	35	gross	57	skid
14	clearway	36	headwind	58	stopway
15	compartment	37	hydroplaning	59	subscale
16	compliance	38	inoperative	60	tailwind
17	comply	39	intersection	61	thrust
18	configuration	40	jet	62	topographical
19	contingency	41	multi	63	turbo
20	cruise	42	nautical	64	turbojet
21	datum	43	obstacle	65	turboprop
22	deployed	44	onset		

Sublist 4: Human Performance

1	aircrew	13	dioxide	25	routine
2	aviation	14	fatal	26	sensory
3	carbon	15	fatigue	27	situational
4	checklist	16	hypoxia	28	specimen
5	circadian	17	illusion	29	symptoms
6	circulation	18	monoxide	30	synchronization
7	cockpit	19	nerve	31	tolerance
8	continually	20	nervous	32	vibration
9	cope	21	nitrogen	33	vital
10	crew	22	onset	34	windscreen
11	deck	23	physiological	35	workload
12	decompression	24	retina		

Sublist 5: Meteorology

1	advection	22	droplets	43	isobars
2	anticyclones	23	easterly	44	jet
3	arctic	24	equator	45	lapse
4	atmosphere	25	equatorial	46	latent
5	bulb	26	evaporation	47	lightning
6	circulation	27	fog	48	maritime
7	climatology	28	forecast	49	meteorology
8	condensation	29	friction	50	microburst
9	continental	30	frontal	51	mist
10	contour	31	fronts	52	moist
11	convection	32	frost	53	moisture
12	coriolis	33	geographical	54	occlusion
13	crystals	34	geostrophic	55	orographic
14	cumulonimbus	35	hail	56	outflow
15	cumulus	36	hazard	57	polar
16	currents	37	haze	58	precipitation
17	depressions	38	height	59	prevailing
18	dew	39	hemisphere	60	radiation
19	diameter	40	humidity	61	saturated
20	downwind	41	icing	62	solar
21	drizzle	42	inversion	63	stratus

64	subtropical	69	tropical	74	vapour
65	supercooled	70	tropopause	75	volcanic
66	tempo	71	troposphere	76	westerly
67	thermal	72	trough	77	windshear
68	thunderstorm	73	turbulence	78	windsock

Sublist 6: Navigation

1	aerial	27	electromagnetic	53	polar
2	airborne	28	equator	54	pole
3	airway	29	fraction	55	port
4	align	30	frequencies	56	propagation
5	almanac	31	glide	57	pulse
6	amber	32	graticule	58	radar
7	amplitude	33	grid	59	radial
8	angular	34	ident	60	reciprocal
9	antenna	35	inbound	61	refraction
10	arc	36	interrogation	62	rhumb
11	augmentation	37	ionization	63	satellite
12	azimuth	38	latitude	64	sine
13	beacon	39	localizer	65	solar
14	carrier	40	longitude	66	starboard
15	compass	41	magnetic	67	stereographic
16	compulsory	42	magnetism	68	surveillance
17	cone	43	mercator	69	tilt
18	conformal	44	meridian	70	timing
19	conical	45	modulation	71	topographical
20	convergence	46	nautical	72	transmitter
21	crosswind	47	navigation	73	transponder
22	database	48	omni	74	twilight
23	diagram	49	orbit	75	vector
24	diameter	50	outbound	76	wavelength
25	doppler	51	overhead	77	waypoint
26	drift	52	perpendicular		

Sublist 7: Operational Procedure

1	abatement	9	galley	17	proficiency
2	authorized	10	goods	18	recurrent
3	cabin	11	jettison	19	simulator
4	crew	12	landings	20	slush
5	decompression	13	malfunxion	21	stowed
6	ditching	14	microburst	22	supervision
7	emergency	15	minima		
8	extinguishers	16	oceanic		

Sublist 8: Principle of Flight

1	adverse	27	deployed	53	onset
2	aerodynamic	28	dihedral	54	ordinated
3	aerofoil	29	directional	55	oscillation
4	aft	30	divergence	56	outboard
5	aileron	31	downwash	57	parasite
6	airflow	32	drag	58	perpendicular
7	airframe	33	elevator	59	phugoid
8	airspeed	34	equilibrium	60	pitch
9	amplitude	35	fin	61	propeller
10	asymmetric	36	flap	62	radius
11	axis	37	flutter	63	rearward
12	buffet	38	frost	64	rectangular
13	camber	39	fuselage	65	resultant
14	chandelle	40	geometric	66	rudder
15	chord	41	gust	67	sectional
16	clockwise	42	hinge	68	servo
17	coefficient	43	inboard	69	shear
18	compressibility	44	kinetic	70	sideslip
19	configuration	45	lateral	71	slat
20	contamination	46	lift	72	slipstream
21	contour	47	mach	73	slot
22	controllability	48	magnitude	74	span
23	counter	49	microburst	75	spanwise
24	damping	50	momentum	76	spoiler
25	deflection	51	mounted	77	squared
26	density	52	newton	78	stabilizer

79	stall	85	symmetrical	91	velocity
80	static	86	tailplane	92	vortex
81	subsonic	87	trailing	93	vortices
82	suction	88	transonic	94	windshear
83	supersonic	89	trim	95	wingspan
84	sweepback	90	vane	96	yaw

Sublist 9: Radiotelephony

1	Alpha *	12	Kilo *	23	Tango *
2	Bravo *	13	Lima *	24	terminology
3	Charlie *	14	Mike *	25	Uniform *
4	Delta *	15	November *	26	urgency
5	distress	16	Oscar *	27	Victor *
6	Echo *	17	Papa *	28	Whiskey *
7	Foxtrot *	18	phraseology	29	X-ray *
8	Golf *	19	Quebec *	30	Yankee *
9	Hotel *	20	Romeo *	31	Zulu *
10	India*	21	Sierra *		
11	Juliette *	22	squawk		

* The ICAO phonetic alphabet assigned to 26 letters of English alphabet.

Sublist 10: Words appearing across subjects

1	abatement	13	authorized	25	cockpit
2	aft	14	aviation	26	collision
3	aileron	15	axis	27	compartment
4	airflow	16	azimuth	28	compass
5	airframe	17	brake	29	comply
6	airspeed	18	buffet	30	compressibility
7	airway	19	cabin	31	configuration
8	align	20	carbon	32	contour
9	altitude	21	carrier	33	counter
10	amber	22	checklist	34	crew
11	amplitude	23	circulation	35	crystals
12	augmentation	24	clockwise	36	currents

37	damping	73	moisture	109	skid
38	deck	74	momentum	110	solar
39	decompression	75	mounted	111	span
40	density	76	nautical	112	spoiler
41	deployed	77	newton	113	stabilizer
42	diagram	78	nitrogen	114	static
43	diameter	79	obstacle	115	stopway
44	directive	80	omni	116	stowed
45	distress	81	onset	117	subscale
46	electromagnetic	82	outboard	118	suction
47	emergency	83	outbound	119	supervision
48	equator	84	outflow	120	synchronization
49	extinguishers	85	parasite	121	synthetic
50	flap	86	paved	122	thermal
51	flutter	87	permissible	123	thrust
52	friction	88	perpendicular	124	tilt
53	frost	89	pitch	125	timing
54	fuel	90	polar	126	tolerance
55	fuselage	91	pole	127	topographical
56	gravity	92	port	128	touchdown
57	height	93	prescribed	129	transponder
58	hinge	94	prevailing	130	trim
59	icing	95	proficiency	131	turbo
60	inboard	96	propeller	132	turbojet
61	inbound	97	radar	133	turboprop
62	intersection	98	rearward	134	urgency
63	jet	99	reciprocal	135	vane
64	kinetic	100	resultant	136	velocity
65	landings	101	retracted	137	vibration
66	localizer	102	rudder	138	vital
67	mach	103	runway	139	volcanic
68	magnetic	104	segment	140	waypoint
69	magnetism	105	servo	141	windscreen
70	magnitude	106	shear	142	windshear
71	microburst	107	simulator	143	yaw
72	minima	108	sine		