



VERSANT[™]
with Ordinate[®] Technology

Predicting ICAO Levels
from
Versant[™] for English



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Introduction

In March 2008, flight crew members and air traffic controllers will be required to demonstrate the ability to speak and understand aviation radiotelephony communications in English as well as common English as it relates to the aviation domain. These new English language proficiency standards have been established by the International Civil Aviation Organization (ICAO) with the goal of improving the safety of aviation throughout the world.

The ICAO Standard

The ICAO language proficiency rating scale has been created specifically for aviation communication purposes. It defines six levels of proficiency (ICAO 2004). Table 1 lists the levels along with functional and testing requirements associated with each level.

Table 1. ICAO Levels

ICAO Level	ICAO Level Name	Meets proficiency requirement	Recommended testing recurrence
6	Expert	Yes	N/A
5	Extended	Yes	Every six years
4	Operational	Yes	Every three years
3	Pre-operational	No	N/A
2	Elementary	No	N/A
1	Pre-elementary	No	N/A

The minimum English proficiency level required for radiotelephony communication is the Operational Level (Level 4).

The ICAO scale includes six subskills: Pronunciation, Structure, Vocabulary, Fluency, Comprehension, and Interactions. The lowest score on these subskills determines the overall score of the test taker.

Tests specifically designed to assess speaking and listening ability may have the ability to predict performance on the ICAO scale. In general, for a test to be used as a predictor of another test, considerable overlap needs to exist between the constructs underlying each test. Although Harcourt's *Versant for English* (previously known as SET) is not designed specifically for aviation English, the scores cover most of the skills listed on the ICAO scales. Therefore, it may be a suitable measure for predicting ICAO levels.

Versant for English

Harcourt's **Versant for English™** test is administered automatically from a land-line telephone (or a computer with Ordinate software) and scored automatically using speech processing technologies. The construct measured by *Versant for English* is **facility in spoken English** – that is the ability to understand spoken English on every day topics and to respond appropriately at a native-like conversational pace in intelligible English. The construct facility in spoken English refers both to the ease and to the immediacy in understanding and producing appropriate conversational English. This definition overlaps with many of the holistic descriptors defined by ICAO. According to ICAO, pilots and air traffic controllers who are proficient English speakers should be able to communicate effectively in voice-only situations. This requirement aligns well with the telephone administration of the *Versant for English* test.

Proficient speakers should also be able to communicate on common topics with accuracy and clarity. *Versant for English* is designed to test performance in spoken English on common, everyday topics. The ICAO standards also state that proficient speakers need to be intelligible even if they speak a dialect or have an accent. The construct of *Versant for English* acknowledges that responses should be in intelligible English. In addition, the native-like conversational pace of the test requires automaticity in language processing. Automaticity entails the ability to access and retrieve lexical items, to build phrases and clause structures, and to articulate these without conscious attention to the linguistic code (Cutler, 2003; Jescheniak, Hahne, and Schriefers, 2003; Levelt, 2001). In order to handle an unexpected turn of events as mentioned in the ICAO descriptors, the test taker needs to be able to communicate efficiently without conscious awareness of how to articulate a response. Some areas where the two constructs do not overlap include face-to-face communication, work-related topics (specific to the aviation industry), and the ability to resolve misunderstandings.

The *Versant for English* test consists of five parts: Reading, Repeat, Short-Answer Questions, Sentence Builds, and Open Questions. All parts of the test except for the Open Questions are scored automatically. A few minutes after a test is taken, machine-generated scores are posted to a password-protected web site. The score report provides an Overall score and four subscores: Sentence Mastery, Vocabulary, Fluency, and Pronunciation.

The four subscores of *Versant for English* relate to the ICAO subskills of Structure, Vocabulary, Fluency and Pronunciation. It should be noted that the *Versant for English* Vocabulary subscore measures common English and does not directly measure work-related topics in the aviation context. The test consists of listen-then-speak items; as a result, comprehension of spoken English is measured implicitly since comprehension is imperative for accurate responses. With regard to the ICAO subskill called Interactions, *Versant for English* does not directly measure this subskill, but it does track response time and is highly correlated with other well-established measures of English oral proficiency (e.g., the Common European Framework scale) that do measure elements within the Interactions subskill. Table 2 shows the comparison of the ICAO subskills and *Versant for English* subscores.

Table 2. Comparison of ICAO subskills and *Versant for English* subscores.

ICAO Subskill	<i>Versant for English</i> Subscore
Pronunciation	Pronunciation
Structure	Sentence Mastery
Vocabulary	Vocabulary
Fluency	Fluency
Comprehension	(measured implicitly)
Interactions	(Overall score predicts performance)

Versant for English cannot substitute for an English test that covers aviation-specific content; however, given the large amount of overlap between the construct and subscores of *Versant for English* and the ICAO descriptors, the test is appropriate for predicting ICAO levels. The predicted ICAO level will help test takers and organizations prepare for the implementation of the ICAO standards.

Score Prediction Table

In order to determine cut scores for each ICAO level, several experiments were conducted and are described below. Table 3 presents the results of these experiments.

Table 3. *Versant for English* score ranges that predict each ICAO Level.

Versant Overall Score Range	ICAO Level
80	6
74 – 79	5
61 – 73	4
49 – 60	3
23 – 48	2
20 – 22	1
20 (irrelevant material)	0

The score ranges are intended to be conservative. A false positive in which a test taker is associated with a level higher than true ability is considered a more egregious error compared to a false negative in which a test taker's score is below true ability.

What follows is a description of the methodology used to derive the *Versant for English* score ranges.

Method

Two separate approaches were pursued in parallel to determine the *Versant for English* score ranges associated with each ICAO level. The first approach involved selecting a set of scored *Versant for English* calls. Human raters then listened to unscored open responses from these calls and assigned a best estimate of the test taker's ICAO level. Using linear regression techniques, the predicted ICAO level was computed for each *Versant for English* score. This method will be referred to as the Regression Approach.

The second approach, called the Alignment Approach, provided a way to corroborate the results from the Regression Approach. In previous research, *Versant for English* scores were equated with the Common European Framework (CEF) of Reference for Languages (Council of Europe, 2001). The CEF claims to provide a common base for describing language learning, teaching, and assessment. The CEF offers more than 50 scales and tables describing (aspects of) growth in language proficiency. The scale ranges from A1, which is a low level of proficiency, and extends up through C2, representing native-like proficiency. In the Alignment Approach, a testing professional who is an expert in the Common European Framework and who was involved in the research relating *Versant for English* scores to the CEF scale, aligned rubrics of the CEF with those of the ICAO levels. Then curves depicting the probability of meeting the descriptor requirements on all ICAO subscales for a given Overall *Versant for English* score were generated. These probability curves provided ranges of Overall scores associated with ICAO levels.

The combination of these two approaches produced the predictive scores in Table 3. Each method will be described in more detail below.

Regression Approach

Test Takers

As part of the Regression Approach, a set of 201 calls from the *Versant for English* test was compiled. The proficiency levels of the test takers for these calls ranged from 20 to 80, with a relatively flat distribution of scores, in which each score decile was represented by at least 30 callers. The details of the distribution are provided in Table 4.

Table 4. Score distribution of test takers

Score Range	Number of Test Takers
70-80	31
60-69	35
50-59	34
40-49	32
30-39	43
20-29	30

Of the 201 test takers, 100 were professionals in the aviation industry including pilots, air traffic controllers, and flight attendants. The native countries of the test takers included China, France, Germany, India, Japan, Korea, Philippines, and Taiwan. Eight native English speakers were also included in the sample to provide a benchmark of performance at the high end of the scale.

All test takers were presented with three randomly-selected Open Questions at the end of the test. The Open Questions are intended to elicit spontaneous spoken responses. The questions are about opinions and personal choices. For the current study, two of the three Open Question responses for each test taker were selected for human rating, for a total of 402 responses. The selection of the two responses was random.

Human Raters

Two expert human raters participated in the experiment. One rater had been a flight instructor for seven years with many flying licenses and certifications. This rater also had over ten years of professional experience in English language training and testing and participated in many sessions of the ICAO Proficiency Requirements in Common English study group, which defined the ICAO language proficiency standards. The other rater was a civilian and military pilot with numerous flying certifications. This rater also had over ten years of experience in English language testing.

Procedure

The responses to the Open Questions were played over a telephone from Ordinate's human rating system. For each response, an expert human rater estimated the test taker's ICAO level and entered the level on the telephone keypad. Both raters analyzed at least one response from each test taker. In total, 727 ratings were analyzed for an average of 3.7 ratings per test taker.

Analysis

Once all the ratings were collected, they were analyzed using a one-parameter Rasch model as implemented in the computer program FACETS (Linacre, 2003). The FACETS program estimates rater severity, ability level of the test takers, and item difficulty (Linacre, Wright, and Lunz, 1990). The model assumes a single underlying dimension, where values along this dimension are expressed in mathematical units called logits. Each test taker was thus associated with a *Versant for English* score and an estimate of the test taker's ICAO level in logits.

The inter-rater reliability of the two expert human raters was 0.94, indicating a high level of consistency between the two raters. The correlation between the *Versant for English* scores and the ICAO ratings was 0.85, suggesting that the two independent measures are closely related.

From the data, the following linear regression equation was generated:

$$y = 0.26x - 13.32$$

For each *Versant for English* score, an ICAO level was computed. Given that the predicted scores are intended to be conservative, a lower bound was selected. With a lower bound of the ICAO score, a prediction that the test taker is at a given ICAO level or higher can be made with 75% confidence. To compute the lower bound score, the following equation was used:

$$y' = y - .67 \left(\text{SEE} \times \sqrt{1 + \frac{1}{N} + \frac{(x - \text{mean}_x)^2}{(N-1) s_x^2}} \right)$$

where

- y' is the ICAO lower bound score,
- y is the ICAO predicted score,
- SEE is the standard error of the estimate, and
- x is the *Versant for English* score.

Finally, the logits were converted back to the ICAO scale from 1 to 6 using cut scores defined by the FACETS analysis. Figure 1 is a scatterplot of each test taker's Overall *Versant for English* score and ICAO level estimate.

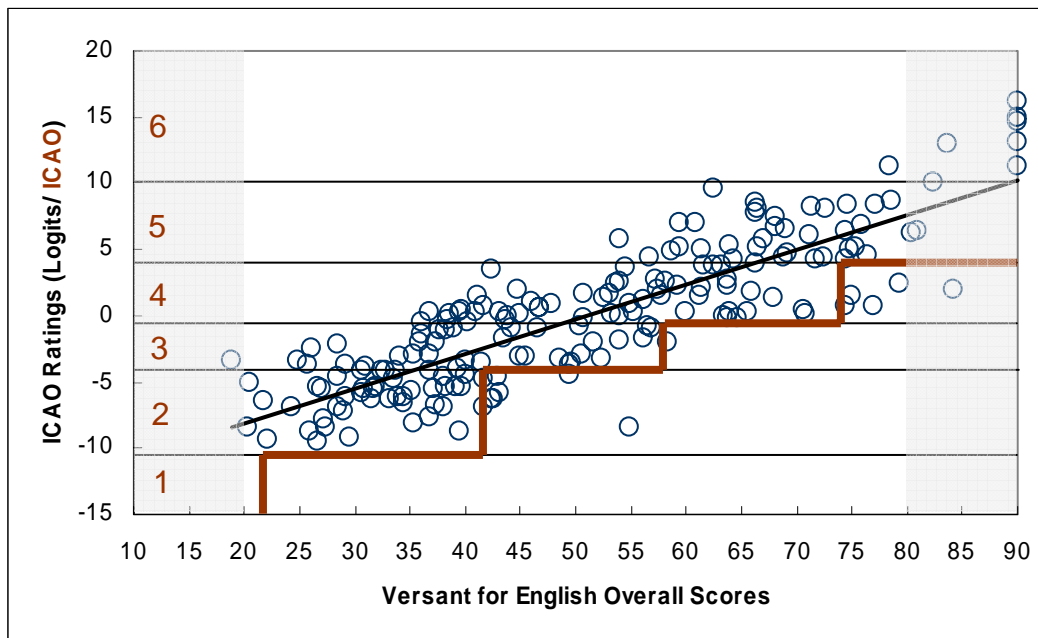


Figure 1. *Versant for English* Overall scores as a function of ICAO ratings in the Regression Approach.

The ICAO estimates are presented on a logit scale with the ICAO levels shown. The diagonal regression line is the line associated with the linear regression function. The step function represents the lower bound ICAO estimate for each *Versant for English* score. Note that the range of scores displayed in this figure is from 10 through 90, whereas the *Versant for English* scores are reported on a scale from 20 to 80. Scores outside the 20 to 80 range (in the shaded area) are deemed to have saturated the intended measurement range of the test and are reported as 20 to 80.

The procedure above yielded *Versant for English* score ranges and associated ICAO levels as presented in Table 5.

Table 5. *Versant for English* score ranges that predict each ICAO Level from the Regression Approach

<i>Versant for English</i> Overall Score Range	ICAO Level
74 - 80	5
58 - 73	4
42 - 57	3
22 - 41	2
20 - 21	1

These results were then corroborated with the Alignment Approach.

Alignment Approach

The relations between *Versant for English* scores and the ICAO levels were estimated by triangulation. Several sources were used including the set of descriptors for the ICAO levels, the CEF illustrative scales, the descriptors accompanying the SET scale, and finally the empirical data on the relation between the *Versant for English* scale and the CEF levels.

The procedure adopted was to compare the ICAO descriptors with sets of corresponding descriptors in the CEF. Table 6 provides an overview of the scales selected from the CEF that provided opportunities for comparison with the ICAO scales. For some ICAO scales more than one CEF scale was selected.

Table 6. Sets of comparable scales from ICAO and CEF

ICAO Scales	CEF Scales
Pronunciation	Phonological Control
Structure	Grammatical Accuracy
Vocabulary	Vocabulary Control Vocabulary Range Compensating
Fluency	Spoken Fluency Coherence
Comprehension	Overall listening Comprehension Listening to Announcements and Instructions
Interactions	Overall Spoken Interaction Goal Oriented Cooperation

The exercise involved analyzing the wording of the descriptors to determine what functional, real-life language ability the levels represent within each of the two descriptive systems. An example of a comparison is reproduced in Figure 2.

ICAO	STRUCTURE	CEF	Grammatical Accuracy
Expert 6	Both basic and complex grammatical structures and sentence patterns are consistently <u>well controlled</u> .	C2	Maintains consistent grammatical control of complex language, even while attention is otherwise engaged (e.g. in forward planning, in monitoring others' reactions).
Extended 5	Both grammatical structures and sentence patterns are consistently well controlled. Complex structures are attempted but <u>with errors which sometimes interfere with meaning</u> .	C1	Consistently maintains a high degree of grammatical accuracy; errors are rare and difficult to spot.
Operational 4	Basic grammatical structures and sentence patterns are used creatively and are usually well controlled. Errors may occur, particularly in <u>unusual or unexpected circumstances</u> , but rarely interfere with meaning.	B2.2	Good grammatical control. Occasional "slips" or non-systematic errors and minor flaws in sentence structure may still occur, but they are rare and can often be corrected in retrospect.
Preoperational 3	Basic grammatical structures and sentence patterns associated with predictable situations are not always well controlled. Errors frequently interfere with meaning.	B2.1	Shows a relatively <u>high degree of grammatical control</u> . Does not make mistakes which lead to misunderstanding.
Elementary 2	Shows only <u>limited control</u> of a few simple <u>memorized</u> grammatical structures and sentence patterns.	B1.2	Communicates with reasonable accuracy in familiar contexts; generally good control though with noticeable mother tongue influence. Errors occur, but it is clear what he/she is trying to express.
Preelementary 1	Performs at a level below the Elementary level.	B1.1	Uses reasonably accurately a repertoire of frequently used "routines" and patterns associated with more <u>predictable situations</u> .
No evidence 0	Insufficient evidence to decide on score category: Silence, irrelevant, or unintelligible (speech in other language than English) material.	A2	Uses some simple structures correctly, but still systematically makes basic mistakes - for example tends to mix up tenses and forget to mark agreement; nevertheless, it is usually clear what he/she is trying to say.
		A1	Shows only <u>limited control</u> of a few simple grammatical structures and sentence patterns in a <u>learnt repertoire</u> .

Figure 2. Comparing ICAO and CEF descriptors

As seen in Figure 2, within the ICAO system a person's level of control of language structure at Level 2 is described with the words, "shows only limited control." The range is described to cover "simple memorized" structures. The closest correspondence to this description within the CEF can be found at level A1, where the level of control is described with exactly the same words and the range is described as "simple" and "learnt repertoire." Within the limits of the precision of each of these sets of descriptors, one is led to assume that the Elementary level in the ICAO set refers to the same level of functional ability as the A1 level of the CEF. Similar analyses were applied to all levels and all ICAO scales.

The next step was to summarize the findings from the individual scales in a graph. Figure 3 shows the CEF levels on the horizontal axis and each of the ICAO scales on the vertical axis. An ICAO level is associated with a CEF interval only where satisfactory correspondence was found in the content analysis. For example, a match was found between descriptors for ICAO Level 2 and CEF A2.

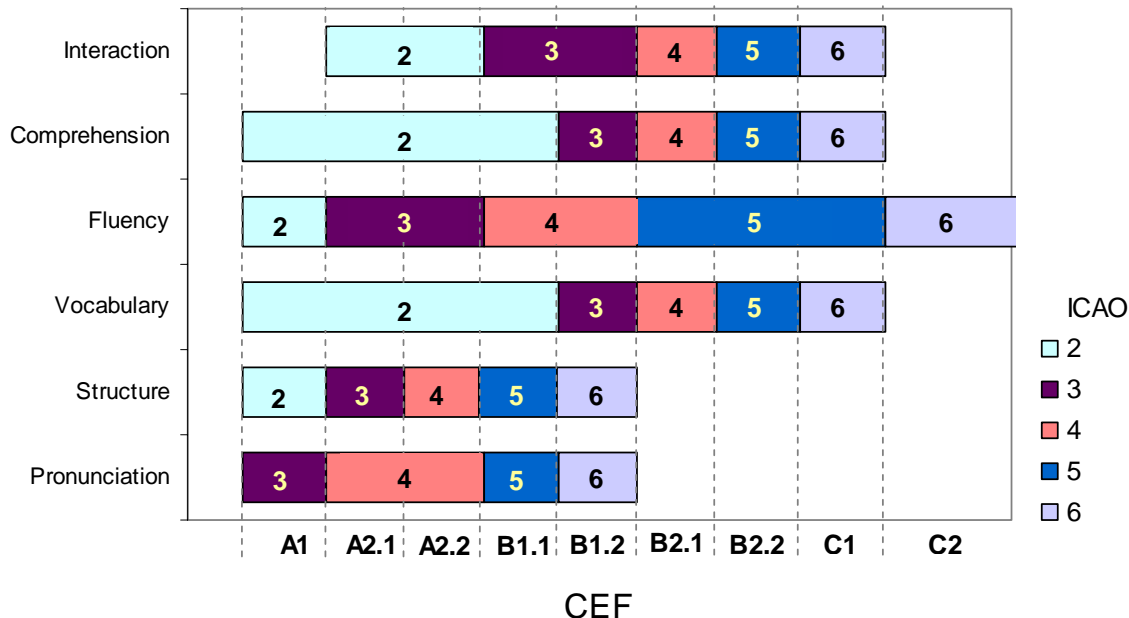


Figure 3. Correspondence between ICAO and CEF levels

The ordering of the ICAO levels on each of the scales parallels the CEF levels in all cases when matching descriptors could be located in one or more of the CEF scales. This means that the underlying conceptions of what constitutes progress in language proficiency are comparable. All ICAO descriptors at the levels 0 and 1 fall below the lowest officially described level (A1) of the CEF. It must be noted, however, that in a number of contexts (e.g., requirements for immigration in France and in the Netherlands) the CEF has been extended downwards.

Estimate of Correspondence between *Versant for English* and CEF

The relation between reported scores from *Versant for English* and the CEF levels has been summarized in the Can-Do Guide (Ordinate, 2004). Table 7 presents a summary of the results.

Table 7. Relation of *Versant for English* scores to CEF levels

<i>Versant for English</i> Score range	CEF Level
79 - 80	C2
69 - 78	C1
58 - 68	B2
47 - 57	B1
36 - 46	A2
26 - 35	A1
20 - 25	<A1

Estimate of Correspondence between *Versant for English* and ICAO

Comparing the ICAO set of scales and the description of the scoring logic which drives the *Versant for English* subscores, one can derive a hypothesis about the predictive relations between *Versant for English* subscores and the ICAO scales. This hypothesis is graphically represented in Figure 4, where bold, solid arrows represent true relations as defined in the test specification between items types and the reported subscores derived from them, whereas grey dotted arrows represent the hypotheses about the predictive power of *Versant for English* subscores in relation to the ICAO scales.

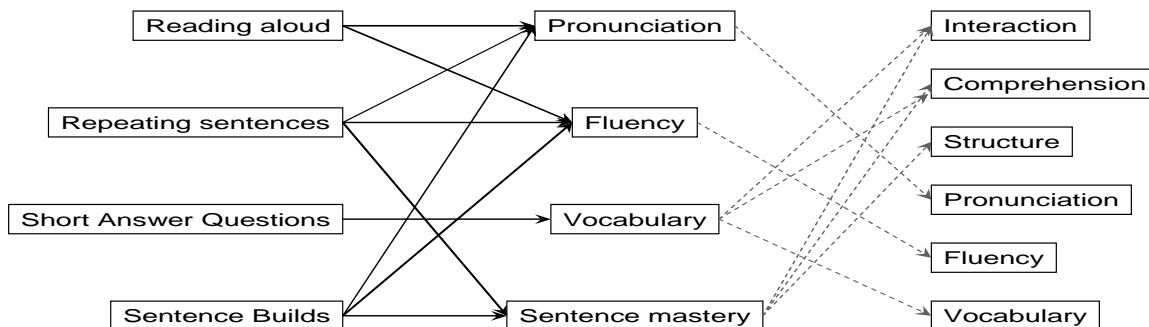


Figure 4. Hypothetical predictive network between *Versant for English* scores and ICAO scales

The rationale for relating the four *Versant for English* subscores with their equivalent ICAO scales is straightforward; however, the ICAO scales of Comprehension and Interaction do not have direct subscore equivalents. It was hypothesized that the content scores of Vocabulary and Sentence Mastery contribute significantly to Comprehension. The test taker's understanding of the Short Answer Questions contributes to the test taker's ability to provide the correct answer. Also, in order to repeat lengthy sentences or build sentences from phrases, an understanding of the content of what is said is paramount. Vocabulary and Sentence Mastery were also viewed as skills with predictive power of Interaction skills. In order to handle an unexpected turn of events or clarify a misunderstanding, the test taker needs to be able to articulate a response without conscious effort so that more cognitive resources can be devoted to communication strategies such as confirming information. The Vocabulary and Sentence Mastery subscores measure the ability to access and retrieve lexical items, and to build phrases and clause structures automatically. These skills are required to articulate responses without attention to the linguistic code.

For the ICAO scale, a conjunctive scoring model is used such that the Overall reported ICAO standard is defined by the test taker's lowest rating over all six scales. Based on a conjunctive scoring model, a criterion score must be met for all four subscores of *Versant for English*. To determine these criterion scores, the relation between the CEF levels and the ICAO scale presented in Figure 3 and the cut scores in Table 7 that link the *Versant for English* and CEF scales are combined. As an example, consider the criterion scores for ICAO Level 4:

- For **Interaction** to be at Level 4 of the ICAO standards, the predictors from the *Versant for English* subscores must be achieved at B2.1 of the CEF, ergo the subscores Vocabulary and Sentence Mastery need to average to 58 or higher.

- For **Comprehension** to be at Level 4 of the ICAO standards, the predictors from the *Versant for English* subscores must be achieved at B2.1 of the CEF, ergo the subscores Vocabulary and Sentence Mastery need to average to 58 or higher.
- For **Structure** to be at Level 4 of the ICAO standards, the predictor from the *Versant for English* subscores must be achieved at A2.2 of the CEF, ergo the subscore Sentence Mastery needs to be 42 or higher, the lower bound for A2.2 being halfway between the lower bounds of A2.1 (36) and B1.1 (47).
- For **Pronunciation** to be at Level 4 of the ICAO standards, the predictor from the *Versant for English* subscores must be achieved at A2.1 of the CEF, ergo the subscore Pronunciation needs to be 36 or higher.
- For **Fluency** to be at Level 4 of the ICAO standards, the predictor from the *Versant for English* subscores must be achieved at B1.1 of the CEF, ergo the subscore Fluency needs to be 47 or higher.

Using this procedure, cut-off scores for ICAO levels 6 to 2 were defined and are presented in Table 8. The Overall score is the score that would be computed if a candidate obtained exactly the particular set of subscores.

Table 8: Critical *Versant for English* scores above which probability of meeting ICAO requirements become greater than failing to meet them

ICAO Level	PRON	FLU	VOC	SENT	Overall
6	53	79	69	69	69
5	47	58	64	64	59
4	36	47	58	58	50
3	26	31	51	51	40
2	21	26	29	29	27

For each *Versant for English* score, the probability of being at a particular ICAO level was estimated based on subscore profiles of actual test takers. A random stratified sample of *Versant for English* test takers was selected that contained 100 speakers each of Cantonese, Gujarati, Hungarian, Japanese, Korean, and Spanish. These probabilities are presented in Figure 5. For each Overall score the probabilities of being above the lower bounds of the ICAO Levels 2 through 6 are plotted. The probabilities are estimated from the proportion of candidates at a particular score that meets all four of the subscore requirements.

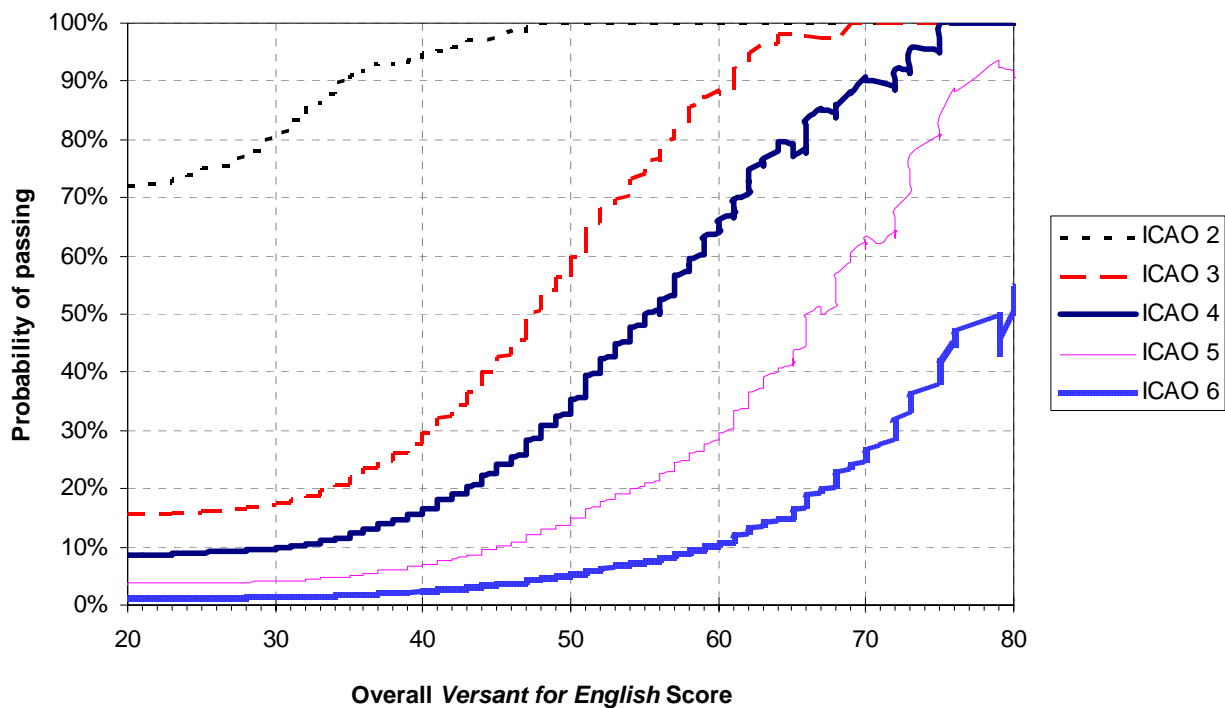


Figure 5. Probability of meeting descriptors on all ICAO subscales given Overall Versant for English score

In Figure 5, an Overall score of 50 on *Versant for English* indicates that a candidate has a probability of about 60% of meeting the requirements of ICAO Level 3, a probability of 33% of meeting requirements for ICAO Level 4, 15% for ICAO Level 5, and only about 5% for ICAO Level 6.

Taking a conservative estimate, a probability of 75% was selected. Table 9 shows the *Versant for English* score ranges associated with each ICAO level as derived from the Alignment Approach.

Table 9. Score ranges associated with each ICAO level from the Alignment Approach

Versant for English Score Range	ICAO Level
80	6
73 - 79	5
63 - 72	4
55 - 62	3
24 - 54	2
20 - 23	1

The final step involved comparing the *Versant for English* score ranges from the two different approaches and defining a final set of *Versant for English* score ranges for predicting ICAO levels.

Combining the Two Approaches

The two sets of *Versant for English* score ranges derived from each approach are presented in Table 10.

Table 10. Score ranges predicting ICAO levels from both approaches

ICAO Level	<i>Versant Overall Score Range (Regression Approach)</i>	<i>Versant Overall Score Range (Alignment Approach)</i>	<i>Versant Overall Score Range</i>
6		80	80
5	74 - 80	73 - 79	74 - 79
4	58 - 73	63 - 72	61 - 73
3	42 - 57	55 - 62	49 - 60
2	22 - 41	24 - 54	23 - 48
1	20 - 21	20 - 23	20 - 22

To arrive at the final *Versant for English* score ranges, the average thresholds for each ICAO level were computed. For example, the lower threshold for the Regression Approach at ICAO Level 2 is 22, while the lower threshold using the Alignment Approach is 24. The average lower threshold for this level is 23. An average was also computed for each higher threshold. The last column of Table 10 presents an average of the ranges. The three score ranges are also represented graphically in Figure 6.

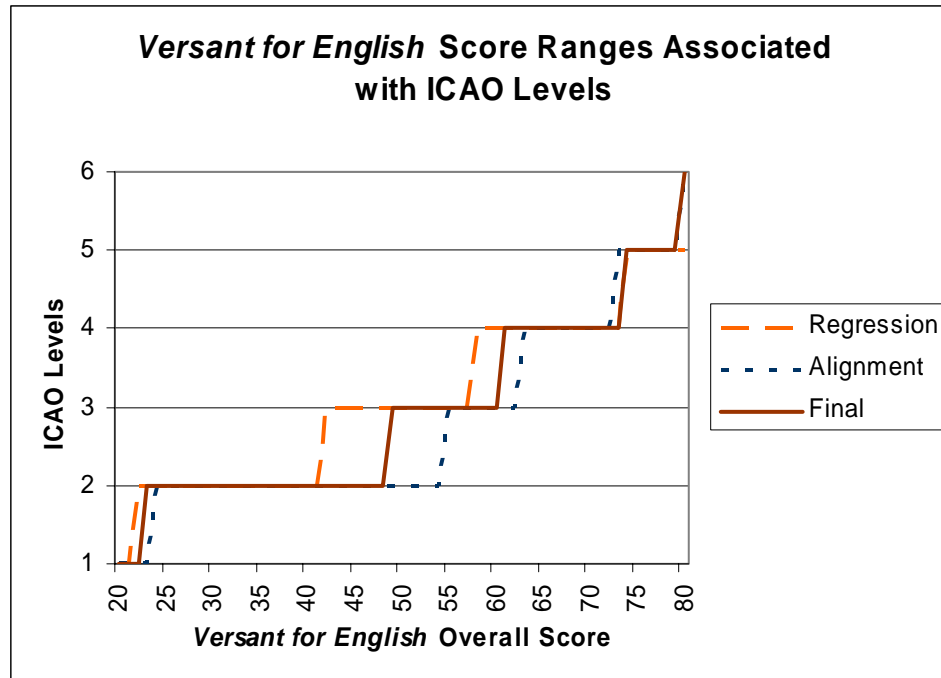


Figure 6. Graphic representation of Versant for English score ranges associated with ICAO levels

As seen in Figure 6, the differences between the cut-scores from the two approaches differ by a few points (from 1 to 5) for most levels. The largest discrepancy is between the lower cut score for ICAO Level 3, which has a difference of 13 points. Although the results of the two approaches are different for this range, the cut score between ICAO Levels 2 versus Level 3 is not associated with high stakes decisions. In the final table, ICAO Level 0 was added for scores of 20 with irrelevant material.

Conclusion

A comparison of the *Versant for English* construct and subscores and the ICAO descriptors shows that there is considerable overlap between the *Versant for English* test and the ICAO standards. The close relation between the two suggests that *Versant for English* scores are suitable for predicting ICAO levels.

To derive the score range associated with each ICAO level, two approaches were taken. The Regression Approach involved assigning a best estimate of test takers' ICAO levels by listening to open responses from the *Versant for English* and then using linear regression to associate each *Versant for English* score with an ICAO level. In another method, called the Alignment Approach, the two scales were related to one another using triangulation between *Versant for English*, the Council of Europe Framework, and the ICAO descriptors. In each approach, the estimates were conservative to reduce incidents of predicted ICAO scores being higher than the test taker's true ability. The estimates from the two approaches resulted in similar *Versant for English* score ranges. The ranges were combined to produce a final set of score ranges that predict ICAO levels.

The predicted ICAO level will help test takers and organizations prepare for the implementation of the ICAO standards. The score ranges can be used as an initial assessment of a pilot or air traffic controller's facility with common spoken English. The score ranges can also be used for progress monitoring to measure gains in spoken English performance.

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