

Response to IATA's Pilot  
Aptitude Testing Guidance  
Material and Best Practices  
(Edition 3)



**SYMBIOTICS**



## Document Classification

Document Title	Classification	Issue	Date
IATA Pilot Aptitude Testing Ed. 3 Response	Public	Version 1.0	August 2019

Name	Date
Caroline Busst	06/08/2019

## Document History

Document Issue	Document Date	Comments
1.2	06/08/2019	Document created CB

## Copyright

The copyright in this work is vested in Symbiotics Ltd and the document is issued in confidence for the purpose only for which it is supplied. No information as to the contents or subject matter of this document or any part thereof arising directly or indirectly there from shall be given orally or in writing or communicated in any manner whatsoever to any third party for any purposes without the prior consent in writing of Symbiotics Ltd.

© copyright Symbiotics Ltd (2019)

## Contents

Document Classification .....	1
Document History.....	1
Copyright .....	1
Executive Summary .....	4
1. Introduction.....	5
2. ADAPT Overview.....	6
3. Pilot Aptitude Testing– Critical Aspects.....	7
3.1. Safety and Human Performance .....	7
3.2 ICAO Pilot Competencies.....	7
3.3 Efficiency.....	11
3.4 Fair Testing .....	11
3.5 Safety Risk of Omitting Aptitude Testing.....	12
3.6 Quality Assurance.....	12
4. Legal Aspects of Aptitude Testing .....	13
4.1 Data Protection and Professional Standards.....	13
5. Aptitude Testing, Recruitment and Hiring.....	14
5.1 Testing Supports Recruitment.....	14
5.2 Screening and Selection .....	15
5.3 Structured Aptitude Testing and Recruitment .....	16
5.4 Cultural Aspects.....	17
5.5 Hiring Decision.....	17
6. Predicting Performance of Pilots.....	17
6.1 Test Reliability .....	17
6.2 Test Validity .....	18
7. Measuring Dimensions and Testing Instruments.....	20
7.1 Measuring Dimensions .....	20
7.2 Testing Instruments.....	20
7.3 Norm.....	21
7.4 Measuring Scales .....	22
8. IATA Matrix – Pilot Aptitude Testing .....	22
9. Designing Pilot Aptitude Systems.....	23
9.1 Checklist with Key Questions.....	24
9.2-9.4 Test Battery and Arrangement and Content of Stages .....	25

9.5 Motivation of Applicants .....	25
10. Administration of Aptitude Testing .....	25
10.1 PAT Team .....	25
10.2 Duration of Tests .....	26
10.3 Outsourcing/Acquisition of Tests .....	26
10.4 Preparation Courses .....	26
10.5 Presentation of Results to the Applicant.....	27
10.6 Reapplication .....	27
10.7 Validity Period .....	27
10.8 Evaluation of the Aptitude Testing System .....	27
11.1 Cost Effectiveness of Aptitude Testing Systems.....	28
12. Conclusion .....	29
13. Questions.....	29
References.....	30

## List of Tables

Table 1: Measurement of ICAO competencies by ADAPT .....	10
Table 2: Reliability coefficients for psychometric instruments used in the APQ .....	18
Table 3: Summary of ADAPT score bandings.....	22
Table 4: Example ab-initio assessment process and the dimensions measured .....	23
Table 5: Checklist of key questions when designing a PAT system .....	24

## Executive Summary

The International Air Transport Association (IATA, 2019) has published the third edition of their guidance material for Pilot Aptitude Testing (PAT). Through the guidelines, IATA aims to ‘provide aviation managers with essential knowledge about PAT to support their decision-making process during the design and implementation of an efficient PAT system at their organisation.’ The new edition was driven by the rapidly changing operational environment and a recognition of the need to develop a set of defined competencies for future pilots, that will be deployed throughout the entire career and the assessment of which intends to increase operational safety. Effective PAT supports the prediction of future performance across these pilot competencies.

This response report aims to explore how the ADAPT system addresses the requirements and questions posed by the guidance material, indicating how Symbiotics can support organisations in implementing PAT as part of their selection process.

## 1. Introduction

The International Air Transport Association (IATA) aims to represent, lead and serve the airline industry, with a focus on building the commercial standards of the industry. IATA have collaborated closely with the International Civil Aviation Organisation (ICAO) in refining air transport's resources in the face of expected global shortages of qualified pilots, as the aviation system is projected to double in capacity by 2030 (ICAO, 2013). The pressing challenge is to meet the growing need for skilled air transport personnel who can support the industry's rapid development, while still maintaining high safety standards in an industry where the associated costs and risks are high for both the organisation and the individual. Selecting the right candidates with the right aptitudes for the role is therefore of paramount importance; however, not all selection processes are equally robust.

When measuring pilot performance, it is impossible to account for all environmental factors, such as crew composition, system function, fatigue and other changeable personal factors. There is a need for criteria to be measured that can predict performance beyond the moment of examination; therefore, there has been a shift over the last decade towards concentrating on competencies rather than task-based performance when assessing pilots (Bor and Hubbard, 2006). Competence focusses on the ability to carry out a specified task or role across an array of conditions, through integrating knowledge, skills and attitudes. Traditionally, competency requirements have focussed on individuals rather than the wider team; with the use of technology and human-automaton interfaces, there is a greater need for competency requirements to be systemic and examine the ability to enhance the effectiveness of a team, rather than simply measuring performance in an individual capacity (Kearns, Mavin and Hodge, 2016). The ICAO has therefore developed 8 pilot competencies that every pilot must deploy throughout their training and career, regardless of their role. IATA *'supports a Total Systems Approach, which stands for the application of Competency-Based Training and Assessment across all aviation disciplines in general, and, in particular, to all functions and roles of a pilot's entire career path'*. In order to achieve this, the defined competencies should be consistently applied throughout the whole pilot life cycle, beginning with initial pilot aptitude testing (PAT).

Aptitude testing is used to measure an individual's ability to perform at the required level in a particular competency. PAT has been shown to be both efficient and cost effective in identifying the most suitable candidates for the job, increasing success in training and improving operational safety while maintaining a legally defensible selection system; IATA emphasise that PAT should receive the highest possible attention

from management. The latest edition of IATA's 'Pilot Aptitude Testing Guidance Material and Best Practices' seeks to provide aviation managers with the necessary knowledge to implement a successful PAT process within their organisation, particularly in the context of predicting future performance in the 8 pilot competencies. Throughout the document, the term PAT is used as an overarching term for all screening and selection diagnostics.

## 2. ADAPT Overview

Symbiotics are a human performance organisation with expertise in high-risk, high-consequence industries and have provided assessment, selection and consultancy services to 58 countries across 5 continents, working with airlines, air forces, business jet operators and flight training organisations. Our online selection and assessment tool, ADAPT, provides an easy to use software interface for pilot aptitude testing, with comprehensive reporting across all our assessments. We offer a range of aptitude tests, assessments and services, including bespoke test design, that are designed to measure competence across all levels of candidates. ADAPT offers a detailed breakdown of candidates and their suitability for the training or operational pipeline, providing a prediction of how the candidate may perform in a specific organisational or training culture to support operators in making informed hiring decisions.

## 3. Pilot Aptitude Testing– Critical Aspects

### 3.1. Safety and Human Performance

As the IATA guidelines state, safety is a paramount factor in the selection and assessment of pilots, as the majority of accidents are caused by human error. Investment in human performance is therefore essential, particularly as the growth of technological advancements accelerates, and the ‘need for PAT across the dimensions of performance potential, social interaction and personality traits is undisputed’. PAT seeks to ensure a good fit between the requirements and the human performance limitations of the pilot.

*“The implementation of a robust PAT process will allow an airline to ascertain whether or not a pilot is willing and capable of accepting the inevitable stresses of life-long learning, training and checking; all of which are pre-requisites for flying technologically advanced aircraft.”*

IATA acknowledges that smaller organisations have faced more challenges in the implementation of robust screening and selection systems, which have historically been utilized by military organisations and large operators. Smaller organisations typically experience higher personnel turnover, and as such would benefit from selection procedures that identify candidates who are a good match for the operator culture and are therefore more likely to show long-term commitment; IATA suggests they may benefit from utilising an experienced partner for support in implementing this testing. Symbiotics has experience implementing ADAPT with both large and small operators, with flexible options for utilising PAT in a cost-effective manner.

### 3.2 ICAO Pilot Competencies

A competency is a measure of human performance, measured through behaviours that demonstrate knowledge, skills and attitudes, that is used to reliably predict successful performance in a job role. The ICAO stipulates eight pilot competencies, which are ‘developed by industry and ICAO, that every professional pilot, regardless of their role, should develop during training and deploy throughout his professional career’:

1. Application of procedures and compliance with regulations
2. Communication
3. Aeroplane flight path management, automation
4. Aeroplane flight path management, manual control
5. Leadership and teamwork



6. Problem solving and decision making
7. Situation awareness and management of information
8. Workload management

It is recommended that when measuring pilot aptitude, the following measuring dimensions are used, which are all directly related to these eight pilot competencies:

### **1. English language proficiency**

As an indispensable ingredient to communicate and ensure learning facilitation and global pilot mobility.

### **2. Basic mental abilities**

Components are: memory capacity, speed and accuracy of information processing (perception, classification, transformation), spatial abilities (static), technical comprehension, reasoning (information processing with basic figures), logic abilities, long-term concentration.

### **3. Composite mental abilities**

Components are: allocation of attention, multi-tasking (different tasks combined), psycho motor abilities (pursuit tracking; compensatory tracking), spatial abilities (dynamic).

Note: These dimensions are related to aeroplane flight path management, manual control and automation.

### **4. Operational abilities**

Components are: problem solving and decision-making, workload management, situation awareness and management of information.

### **5. Social-interpersonal abilities**

Components are: communication, leadership and teamwork.

### **6. Personality traits**

Components are: professionalism (professional motivation, self-discipline, self-criticism, self-organization, safety motivation, stress-coping with social confrontation, information load, time pressure), and application of procedures and compliance with regulations

The different assessment components that can be used as part of the bespoke ADAPT process are designed to facilitate measurement of the dimensions above. The table below shows some of the commonly used ADAPT tests, and how these address the ICAO pilot competencies:

Assessment	1. English language proficiency	2. Basic mental abilities	3. Composite mental abilities	4. Operational abilities	5. Socio-interpersonal abilities	6. Personality traits
Advanced Personality Questionnaire					<b>X</b> <i>(leadership, teamwork)</i>	<b>X</b> <i>(professionalism, motivation, self-discipline, self-organisation, safety motivation, stress coping, application of procedures, compliance with regulations)</i>
Crew Resource Management				<b>X</b> <i>(decision-making, workload management, situation awareness)</i>	<b>X</b> <i>(leadership, teamwork)</i>	<b>X</b> <i>(social confrontation, coping with time pressure)</i>
Conflict Resolution						<b>X</b> <i>(social confrontation)</i>
English test	<b>X</b> <i>(written English and listening skills)</i>					
Aviation Knowledge		<b>X</b> <i>(technical comprehension)</i>				
Cognitive Reasoning		<b>X</b> <i>(information processing, spatial abilities, reasoning, logic)</i>				

<b>FAST</b>		<b>X</b> <i>(information processing, spatial abilities, reasoning, logic, concentration)</i>	<b>X</b> <i>(allocation of attention, multitasking, psycho-motor abilities, spatial abilities)</i>	<b>X</b> <i>(situation awareness, information management)</i>		
<b>Contextual Flying Task</b>			<b>X</b> <i>(psycho-motor abilities, spatial abilities)</i>			
<b>Co-ordination Assessment</b>			<b>X</b> <i>(psycho-motor abilities, spatial abilities)</i>			
<b>MindQ</b>						<b>X</b> <i>(stress coping)</i>
<b>Structured Interview</b> <i>(via Skype, or as part of aviation assessment day)</i>	<b>X</b> <i>(spoken English and comprehension)</i>			<b>X</b> <i>(problem solving, decision-making)</i>	<b>X</b> <i>(communication, leadership, teamwork)</i>	<b>X</b> <i>(professionalism, motivation, self-discipline, self-organisation, stress coping, self-criticism)</i>
<b>Group Exercise</b> <i>(as part of aviation assessment day)</i>	<b>X</b> <i>(spoken English and comprehension)</i>			<b>X</b> <i>(problem solving, decision-making)</i>	<b>X</b> <i>(communication, leadership, teamwork)</i>	<b>X</b> <i>(social confrontation, coping with time pressure)</i>
<b>Full ADAPT</b> <i>(includes Interview, behavioural assessment and debrief)</i>	<b>X</b> <i>(spoken English and comprehension in the applied setting)</i>	<b>X</b> <i>(memory capacity, information processing [speed and accuracy], spatial abilities, reasoning, logic, long-term concentration)</i>	<b>X</b> <i>(allocation of attention, multitasking, psycho-motor abilities, spatial abilities)</i>	<b>X</b> <i>(problem solving, decision-making, workload management, situation awareness, information management)</i>	<b>X</b> <i>(communication, teamwork)</i>	<b>X</b> <i>(professionalism, motivation, self-discipline, self-organisation, self-criticism, safety motivation, stress coping - information load, time pressure, application of procedures, compliance)</i>

Table 1: Measurement of ICAO competencies by ADAPT

### 3.3 Efficiency

This section of the document discusses the efficacy of PAT as a selection method:

*When correctly implemented, PAT can contribute to cost savings for the airline. Experience has shown that the costs associated with implementing an aptitude testing system are significantly lower than the consequences of high failure rates resulting from immature selection or screening processes. It has been proven that success rates in training, in organizations using an aptitude testing system, are extremely high when compared to those organizations that do not use one.*

*The cornerstone of an airline's safety culture includes its First Officers and Captains. PAT is very effective in ensuring not only the professional abilities (flying skills, etc.) of applicants, but also that these professionals fulfil the educational prerequisites. PAT ensures that they have the appropriate experience, possess sufficient motivation to be able to adapt to the new environment within the airline, and that they identify themselves with the company and its safety culture.*

The consequences of failures are complex and can generate negative outcomes not only related to the costs of training, but also the potential for legal costs and damage to the company's brand; it is therefore important to ensure a strong fit between the individual and the organisation. Through organisational profiling, ADAPT can use bespoke criteria and scoring to ensure that candidates of all levels not only possess the appropriate knowledge, skills and attitude for the role, but are also a good fit for the organisational culture and are therefore likely to transition successfully and adopt the company's values as their own. ADAPT can be used to deliver a group of applicants with homogenous attributes, which can allow subsequent training to be tailored precisely to the target group, therefore reducing costs.

### 3.4 Fair Testing

The majority of candidates entering aviation as ab-initio students are self-sponsored. By implementing PAT, the candidate's potential for success in flight training can be predicted, before they commit to a financial investment. However, due to constraints in costs, time and manpower, less rigorous or structured methodologies are often used to select candidates; these methods are often developed in-house without involvement of specialists with appropriate experience. IATA recognises that the least effective selection systems are those where hiring decisions are based on 'casual' freestyle interviews only, or other non-standardised test scenarios. These methods are less legally defensible and usually do not provide the

candidate with a fair assessment of their potential to succeed, as they are not based on reliable objective criteria.

The standardised nature of aptitude testing can ensure the process is more robust and consistent, reducing any opportunity for differential treatment. The ADAPT test battery has been developed with input from relevant specialists in aviation and psychological testing and has a proven record in improving training outcomes. Where interviewing is used as part of the assessment process, Symbiotics implements formalised interview methodology with standardised scoring criteria, as research suggests that selection interviews that are structured and linked to the appropriate competencies have high predictive validity and reliability (McDaniel et al, 1994).

### 3.5 Safety Risk of Omitting Aptitude Testing

IATA addresses the argument that ‘training itself constitutes the most realistic assessment and selection platform’ by stating that training has been proven to provide low values of predictive validity – that is, it does not predict performance later in the operational pipeline. There are a number of reasons for this: variable factors during training conditions which render it difficult to standardize assessment, frequent instructor changes and insufficient experience of the instructors in measuring dimensions such as personality traits and socio-interactive abilities. IATA acknowledges that as a result, cadets may be successful in getting a license despite potential weaknesses, which they may be able to compensate for in routine operations as their experience increases. However, in high performance or abnormal scenarios, these deficiencies can resurface.

ADAPT is designed to measure the candidate’s aptitudes and personality traits that can influence their ability to respond to increased pressure, dynamic or unforeseen scenarios, and emergencies. ADAPT’s assessment batteries are designed not just to identify cadets who will be successful in meeting the testing requirements of training, but those who can maintain their performance throughout their career and adapt to potential non-normal situations that could arise.

### 3.6 Quality Assurance

The guide states that PAT should be integrated into the companies’ quality system, which can manage pilot performance data through the entire career from the initial stages of selection, to performance in training, line flying and safety audits.

Although this responsibility for this process lies with the airline or training organisation, through the ADAPT online client portal data pertaining to the candidate's performance in the PAT phase of the career cycle can be easily accessed and downloaded to support the company in maintaining this information for their records.

## 4. Legal Aspects of Aptitude Testing

As stated by IATA, the selection of suitable candidates requires discrimination between applicants. While standards for medical fitness, English language proficiency and ability to understand course content have long been in place, regulators have been more reluctant to develop standards regarding personality criteria. However, if the standards for personality criteria are directly relevant to the job, this discrimination can be considered justifiable; recent changes to the EASA regulations require all pilots to have a psychological assessment before they commence line flying (EU, 2018). The ADAPT Advanced Personality Questionnaire (APQ) meets these requirements, identifying the psychological attributes and suitability of the pilot to the work environment to reduce the likelihood of negative interference with the safe operation of the aircraft.

The guide goes on to state 'in all cases, special focus must be given to the reliability of the testing procedure'. The APQ utilises reliable and well-validated psychological concepts that are relevant to the aviation sector, such as the Big Five Factor model of personality and the five hazardous attitudes as defined by the FAA. Scoring within ADAPT is determined through statistical comparison of the candidate's results against a representative target population, ensuring a standardised methodology as well as providing a meaningful interpretation of scores relevant to the aviation context.

### 4.1 Data Protection and Professional Standards

As indicated by IATA, legislative frameworks exist worldwide relating to personal data privacy and protection; Symbiotics operate within the General Data Protection Regulation (EU, 2016) to ensure data is used fairly and responsibly.

In addition, Symbiotics are compliant with the Standard for the Design and Delivery of Assessment Centres laid out by the British Psychological Society's Division of Occupational Psychology (BPS, 2015), as well as the International Organization for Standardization's Standard for Assessment service delivery (ISO 10667)(ISO, 2011). By conforming to these standards, Symbiotics ensures that the assessment process is fair, consistent and legally defensible and offers an evidence-based approach, meaning the criteria and methods used provide

valid information to support selection decisions. Symbiotics have produced documentation as a guide to Clients on how these standards are implemented through our assessments.

## 5. Aptitude Testing, Recruitment and Hiring

### 5.1 Testing Supports Recruitment

This section discusses the typical steps involved in the organisations' recruitment procedure, from advertising the role to the target group, to making a hiring decision. PAT forms part of this process. IATA pose several key questions that need to be addressed during recruitment, which are indicated below alongside an explanation of how the ADAPT process answers these issues:

- **Who is responsible for the process?**

Symbiotics works alongside the organisation in implementing the assessment phase of recruitment. This process is likely to differ between different organisations with differing requirements; Symbiotics will advise on what the responsibilities of both parties are.

- **Who defines the requirements?**

Symbiotics will work closely with the organisation to define the requirements and will make recommendations on the most appropriate ADAPT assessment battery. This can be supported by a job analysis or organisational profile where there is not an existing competency framework within the organisation, to ensure the assessment criteria are tailored to the specific requirements of the operator.

- **Who performs the testing?**

Symbiotics' Online ADAPT tests are designed to be delivered and submitted anywhere in the world through our online system, so can be administered by the client organisation. While some tests require supervision or the presence of trained experts, others can be performed unsupervised from the candidate's home.

Symbiotics provide training and documentation to support test administration and interpretation of results.

- **Who takes the hiring decision?**

ADAPT does not pass or fail candidates; the ADAPT process will provide a detailed breakdown of candidate performance and a recommendation to the organisation, based on statistical scoring models, to support them in making the final hiring decision.

- **Is the decision solely based on the results of aptitude testing?**

The organisation must decide on the scope of their selection process and how PAT fits into this. The bespoke nature of ADAPT means that organisations can use the various ADAPT assessments from the beginning to the end of the selection process, or as one stage of a wider selection protocol, as per their requirements. For example, aptitude testing with ADAPT can act as a screening process for the first stage of selection, enabling the strongest candidates to go forward to the next stage of the organisation's hiring process. Symbiotics can also integrate individual organisation's own selection tests into the ADAPT system, for example organisation-specific technical knowledge tests, so that the process can be delivered smoothly through a single interface.

- **How and by whom is the recruitment process, including the PAT system, maintained and evaluated?**

Symbiotics is focused on continual improvement of our systems and as such, will conduct regular reviews of our assessments to identify any changes that may need to be made, as the industry and associated requirements evolve over time. We can also support our Clients in evaluating the effectiveness and predictive validity of their assessment process, through measuring the training outcomes and ongoing performance of candidates against the initial selection criteria.

## 5.2 Screening and Selection

This section focuses on the differences between screening and selection, and how these can be used.

'Screening' is used at the beginning of the process to eliminate any candidates who do not meet predefined requirements, or to identify the best candidates to move to the next stage of assessment. Screening typically consists of collecting relevant data on qualifications, knowledge and experience, but can also include the testing of basic mental abilities. The 'selection' phase is then used to identify the candidates who best meet requirements from the screened candidates and requires more elaborate methods to measure the relevant criteria, which can include interviews and group exercises.



Including a screening stage in the assessment process can make the process more cost—effective and increase return on investment (Aberdeen, 2015), as those who do not meet the requirements of basic mental aptitude are excluded before moving to the more resource-intensive stage of the process. The ADAPT battery includes tests of basic mental abilities, such as FAST and cognitive reasoning, that can be used as part of a pre-selection screening process to significantly reduce assessment costs.

### 5.3 Structured Aptitude Testing and Recruitment

The guide states that ‘a clear definition of the requirement profile is the starting point’. The requirement profile should be based on job analysis activities, which aim to develop an in-depth understanding of the job content, responsibilities and requirements. Symbiotics are experienced in conducting job analysis and organisational profiling, working with personnel from the organisation’s HR, flight operations and training departments to develop an understanding of all aspects of the role and what key skills and attributes are reflective of a ‘perfect candidate’.

Once the requirement profile is defined, the target group can be identified. IATA recommends structuring the target group by experience level, as follows:

**Graduates**, comprising:

- o Ab-initio cadets – beginners who join an ATO/AOC (sponsored or self-sponsored) approved training course (e.g., an MPL course or an integrated CPL/IR course)
- o Licensed pilots with low experience – this group comprises CPL/IR and MPL holders with less than 1000 hours, or with less than 500 hours on MPA

**Professionals**, comprising:

- o First Officers and ex-military pilots – type rated with more than 500 hours on MPA
- o Captains – type rated, with successful completion of an AOC command course

The resulting battery of tests used for selection must be appropriate for the target level. ADAPT recognises that these roles have different responsibilities and operate within different environments and offers tests suited to all levels of candidates, to assess the capabilities required throughout the pilot career cycle. ADAPT also has tests specifically tailored towards instructors and First Officers about to commence their command upgrade, in addition to the levels specified by IATA.

## 5.4 Cultural Aspects

IATA highlight the need for a homogenous skill set of pilots globally, as the operating philosophies for flying modern aircraft are standardised worldwide; the ICAO competencies were collaboratively defined across the industry and therefore do not vary between different cultures. Symbiotics are cognisant of other cultures and have experience working with operators across the globe; ADAPT is designed to assess candidates against the ICAO pilot competencies anywhere in the world. We remain culturally aware in our assessments, recognising that although different cultural environments can influence experiences and expectations, the core role requirements remain the same; the ADAPT system has been developed around the work of Hofstede on organisational culture, ensuring that the role competencies are consistently and independently assessed without adverse impact arising from different cultural backgrounds.

## 5.5 Hiring Decision

This section discusses how the hiring decision is informed and made. In-line with the methods discussed by IATA, ADAPT produces a profile of the applicant, with a detailed breakdown of the test results. This can support operator selection teams in their decision-making, also enabling organisations to consider which candidates have deficits that can be remedied in training, during times of high hiring demand.

## 6. Predicting Performance of Pilots

Although aptitude testing can never provide a 'perfect' prediction, IATA acknowledges the consensus amongst experts that PAT is a strong predictor of pilot performance. Reliability and validity measures are used to determine how effective a test is in providing these predictions.

### 6.1 Test Reliability

Reliability measures how precise and consistent the test is. The reliability 'coefficient' is used to express the test's reliability; the higher the coefficient, the smaller the margin of error is, and the more likely the results are to be the same each time. Reliability coefficients of above 0.7 are considered to be at the accepted level for psychometric tests (Robinson, 2017). There are different methods that can be used to give a measure of reliability:

**Test / re-test reliability:** This examines whether a group of individuals receive the same result from repeating the test after a certain time.

**Alternative form reliability:** Where tests exist in several versions, this examines the correlation of scores between these forms to ensure they consistently measure the same constructs.

**Internal consistency:** This examines the consistency throughout the test by splitting the test in half and correlating the two halves.

**Inter-rater reliability:** This examines the consistency of measurements or ratings made between different assessors.

The measures used within the ADAPT Personality Questionnaire (APQ) draw on a collection of highly reliable psychometric instruments; the table below demonstrates the reliability coefficients for several scales that form the APQ:

Construct	Instrument	Reliability coefficient(s)
OCEAN Scales (5 Factor Model)	Big-5 Questionnaire (Goldberg, 1999)	0.77 - 0.83
Hazardous Attitudes	Hazardous Attitudes Scale (Hunter, 2005)	0.74 – 0.86
Cognitive and Somatic Anxiety	State-Trait Inventory for Cognitive and Somatic Anxiety (Ree et al, 2000)	0.88
Intrinsic/Extrinsic Motivation	Work Preference Inventory (Amabile et al, 1994)	0.78 – 0.79
Locus of Control	Locus of Control Scale (Levenson, 1973)	0.83 – 0.87
Cultural Attitudes	Hofstede’s Cultural Dimensions (Hofstede, 2001)	0.72 – 0.84

Table 2: Reliability coefficients for psychometric instruments used in the APQ

In order to improve inter-rater reliability, Kearns, Mavin and Hodge (2016) propose training assessors to be aware of the forms of bias, familiarising assessors with the assessment tool and carrying out moderated group training in assigning scores. Symbiotics incorporates all these methods into the training provided to our assessors.

## 6.2 Test Validity

Validity determines whether a test is measuring what it is designed to measure, and therefore is extremely important in order to produce meaningful results. Validity can be expressed in a number of ways:

**Content validity:** This provides an indication of whether test items are a true representation of the construct being measured.

**Concurrent validity:** This examines the correlation between test measurements and other performance criteria at the same time.

**Construct validity:** This examines whether the construct being measured by the test is consistent with the intended purpose of the test, and is assessed by correlating test scores with scores on a different test measuring the same construct.

**Predictive validity:** This examines the correlation between test measurements and performance in the job over time to see if there is a relationship between the variables, suggesting that the test is good predictor of future behaviour. Typically, this is tracked over several years. IATA recognises that for successful measurement of predictive validity, there must be a large sample of pilots assessed by standardised, reliable criteria of job performance over time. Only a few operators are capable of providing this environment in an ideal way currently, however the use of the ICAO competencies to measure performance should allow operators to harmonise their performance measurement systems.

In order to ensure content validity, initial development of new ADAPT tests involves careful prior examination of the construct before items are written (Anastasi, 1990), and Subject Matter Experts (SMEs), including Psychologists, Human Factors Specialists and Senior Pilots, are then consulted to provide an assessment of the validity of items (Murphy and Davidshofer, 1994).

In addition to the well-validated existing psychometric instruments drawn on in the APQ, the ADAPT tests developed by Symbiotics also demonstrate construct validity: for example, the cognitive test shows good correlation with the Differential Aptitude Tests and Wechsler Adult Intelligent Scale IV (correlations between 0.79 and 0.91).

As the current iteration of the ADAPT system has been live for under a year, there is insufficient data to determine predictive validity at present, however Symbiotics is committed to assisting our Clients in conducting relevant analysis in the future, providing the necessary job performance data exists.

## 7. Measuring Dimensions and Testing Instruments

### 7.1 Measuring Dimensions

This section of the guide reiterates the measuring dimensions used to measure the ICAO competencies (see Page 8 of this document). A note is also included regarding the measurement of personality traits across different operators; often operators feel the specific nature of their operation (e.g. charter, long-haul, low cost etc.) demands a unique profile of personality traits. However, upon closer examination, the differences are generally of a more minimal nature. The Advanced Personality Questionnaire can capture these small differences, through applying a different organisational profile when examining candidates' ability to adapt to a specific culture, whilst remaining consistent in the measurement of core role attributes that are unlikely to vary between operators.

### 7.2 Testing Instruments

This section presents a summary of the common methodologies used to assess aptitudes:

**Questionnaires** – used for collecting biographical information, such as qualifications, interests and general education. These are used to determine whether the candidate meets the necessary intellectual prerequisites to qualify for the role, and usually form part of the operator's screening phase. This does not include measurements of personality, such as the Advanced Personality Questionnaire, which are classed as psychometric instruments.

**Free-style interviews** – free-style interviews are those lacking standardisation, which result in different candidates facing a different interview scenario. The lack of standardised criteria means the method is subjective, lacking in reliability and not suitable for measuring aptitude or basing hiring decisions on. All Symbiotics interviews are standardised and do not use this methodology.

**Standardised interviews** – unlike freestyle interviews, these interviews followed a pre-determined set of questions and use a clearly defined rating system to score responses. Providing assessors have had the appropriate training, this can be a good method for capturing personality traits and social competence. Symbiotics utilise standardised interview procedures carried out by experienced assessors as part of our Assessment Centres and stand-alone Skype interviews.

**Targeted selection** – this involves the interviewer collecting job-related behaviours from a candidate’s history that demonstrate competency and can also be referred to as a behavioural interview. Behavioural interviews are strong predictors of future behaviour, as they examine how the candidate has behaved in previous similar scenarios (Levashina et al, 2014). Performance is then rated on a standardised scale using performance indicators. Symbiotics utilises behavioural interviewing techniques in our standardised interviews.

**Psychometric tests** – These tests are used to measure aptitudes, including personality, attitudes and skills. Previously these were usually administered in a paper-based fashion, but more recently have been replaced by PC-based testing. The ADAPT battery includes a number of psychometric tests, including personality instruments such as the Advanced Personality Questionnaire and reasoning tests such as cognitive reasoning. These tests can be completed online and are considered both reliable and cost-effective.

**Work sample tests** – these tests create a task for the candidate that is reflective of the job role, therefore showing good predictive validity, and can be carried out in low fidelity simulators or fixed-base simulators. These sessions are not aimed at the completion of specific exercises, but at measuring the ability of the candidate to adapt to various unknown situations. The candidate’s behaviour is then observed and evaluated by an experienced assessor against standardised criteria. The Full ADAPT process is an example of a work-sample test, examining the aptitude of the candidate when adapting to a novel, changing situation, in order to reflect abnormal events that may be experienced in the cockpit. The candidate’s performance is observed by an experienced certified pilot examiner, and the computer system also generates objective data to be included in the evaluation.

**Simulator assessments** – Assessments in full-flight simulators provide more realistic and complex scenarios which are highly reflective of the work environment. They are valuable tools to complement aptitude testing but should not replace it.

### 7.3 Norm

This section focusses on the recommended use of statistical norms; norming is used to give meaning to scores. Knowing the candidate’s percentage score on a test alone does not provide meaningful information about a candidate’s performance; for example, 85% may seem like a positive score on a test, but if the average score is 95% then the candidate has in fact performed below standard. Using a norm group provides information about

the candidate’s performance in relation to a comparison group, which allows for a meaningful pass/fail result by determining a cut-off point for scores.

Symbiotics uses statistical norming procedures to provide a scoring interpretation for all our tests. Scores are standardised using ‘sten’ values (standard tens) which involves dividing the spread of scores into ten units, based on the normal distribution, or ‘bell curve’, of scores. This provides an indication of the candidate’s performance in relation to the population, for example, a sten of 1 would indicate they are in the group of lowest performers, whereas a sten of 5 would be average. IATA highlight the importance of choosing an appropriate norm group; the norm groups selected by Symbiotics are relevant to the candidates’ level and can also be bespoke to the organisation, ensuring a like-for-life comparison of the target population.

## 7.4 Measuring Scales

IATA recommend using 5-point scales, to express the results of performance measurements in a numeric way. They state expressing each point on the scale in a useful manner with behaviourally anchored ratings, such as ‘unsatisfactory’ to ‘highly qualified’. Symbiotics uses a 5-point scale of colour bandings as follows:

Green	High	Excellent skills
Blue	Above Average	Has skill, but some isolated minor issues or areas of improvement
Yellow	Average	Has skill, but some global issues for development, although should be capable of improvement
Amber	Below Average	Critical issues requiring additional training or support
Red	Low	Substantial areas of concern

Table 3: Summary of ADAPT score bandings

## 8. IATA Matrix – Pilot Aptitude Testing

This section provides suggestions on how measurement of the competencies can be achieved across the different dimensions and different levels of candidate.

A complete PAT process consists of at least three components:

- Screening formal requirements (biographical data)
- Tests of basic and composite mental abilities (psychometric data)
- Tests to capture professionalism and the pilot competencies, including operational abilities, interpersonal/social abilities and personality traits

A matrix of measuring dimensions mapped against appropriate testing instruments for each level of candidate is then provided in section 8.1, followed by a matrix of suggested allocation of measuring scales to the stages of the PAT process in section 8.2. Symbiotics can advise Clients on the most appropriate tests for each level of candidate, to ensure measurement of the full scope of the competencies. For example, a complete ab-initio process may look like:

Test	Dimensions Measured
Screening (pre-ADAPT)	Relevant biographical data, e.g. qualifications, language proficiency
APQ	Social-interpersonal abilities, personality traits
Cognitive Reasoning	Basic mental abilities
FAST	Basic mental abilities, composite mental abilities, operational abilities
Contextual Flying Task/Coordination Assessment	Composite mental abilities
Standardised Interview	Social-interpersonal abilities, personality traits
Group Exercise	Social-interpersonal abilities

Table 4: Example ab-initio assessment process and the dimensions measured

## 9. Designing Pilot Aptitude Systems

IATA highlight here the goals the PAT system should be capable of achieving:

- Identify the most suitable candidate for the job
- Delivery of selected personnel at lowest possible cost
- Providing a fair and legally defensible architecture

Symbiotics delivers testing solutions that are consistent with all 3 of the above goals. In adhering to the assessment standards of the BPS and ISO 10667, we ensure testing methods are evidenced-based, offering



maximum value and return on investment in providing valid information to support hiring decisions, and promote a fair, legally defensible process, helping to protect the Client from claims of unfair assessment.

## 9.1 Checklist with Key Questions

This section of the guide presents a table of the key questions and actions to be considered when designing a PAT system; the table below identifies how Symbiotics can support these requirements:

Checklist		
Key Question	Related Action	Symbiotics' Role
What is our problem/goal?	Define the criterion (criteria) which shall be achieved by the Aptitude Testing System.	Initial contact will involve a scoping meeting to understand the Client's requirements.
What do we want to measure (test)?	Mental abilities, operational and social-interpersonal abilities and personality traits as prerequisites to develop the pilot competencies.	The ADAPT test battery measures the ICAO competencies, as outlined previously. Further criteria that may be more specific to the operator can be developed through organisational profiling.
How do we measure? Which tests serve us best?	Decide about the test battery (set of tests/measuring instruments) and their sequence. Decide on the selection team members.	Symbiotics will advise on the most appropriate tests to meet the requirements, and can provide personnel training where appropriate.
How do we get from tests results to a hiring decision?	Combine all test scores (profile). Define cut-off criteria, decide at which stages to exclude applicants and decide when and by whom the hiring decision is taken.	The ADAPT system uses statistical algorithms to combine all test scores into a profile to assist with decision-making. Symbiotics can create bespoke scoring to develop cut-off criteria relevant to the organisation and will also advise on how to structure the stages of PAT in a fair and cost-effective manner.
How can we validate our selection system?	Construct the evaluation system by implementing a data feedback process from training/operation back to the selection team, assure supporting IT environment to enable data management.	Symbiotics can carry out validation procedures to determine predictive validity of the selection system, when provided with training/job performance data by the Client. The ADAPT Client portal also provides efficient access to assessment data, to support the Client's wider data management procedures.

Table 5: Checklist of key questions when designing a PAT system

## 9.2-9.4 Test Battery and Arrangement and Content of Stages

These sections focus on the arrangement of tests. The series of tests arranged together is typically referred to as a test battery. In order to ensure cost-effectiveness, test batteries are arranged in stages. Typically screening proceeds selection procedures. Psychometric tests usually come first in the selection process, saving costs as these tests are generally less expensive and some tests can be performed from the candidate's home, reducing travel and resourcing costs. More complex testing then follows in the next stage, such as interviews and group exercises. Symbiotics offer flexible solutions for arranging the test battery and selection stages in a cost-effective manner to support efficient recruitment.

## 9.5 Motivation of Applicants

IATA considers that tests should be user-friendly for the candidate, in order to motivate them to demonstrate their full potential. In order to do this, tests should be seen to be job-relevant, fair and of a low degree of difficulty to complete. Instructions on how to perform during the test and instructions for operating the testing instruments should be provided. Symbiotics provides a comprehensive candidate handbook, as well as clear, easy to understand instructions at the beginning of each ADAPT test.

# 10. Administration of Aptitude Testing

## 10.1 PAT Team

This section discusses the expertise required to implement a successful PAT system. The development of the system should be facilitated through close cooperation among all departments involved, and the team should consist of a combination of psychological, methodical, statistical and flight operation expertise. The ADAPT team consists of Chartered Occupational Psychologists and Psychology Consultants with experience in statistics and psychometric testing, rooted in an Aviation Psychology background, helping us to provide expert support to our Clients.

Administrative tasks, such as organising the testing and managing the data, can be covered by the HR department; Symbiotics will provide relevant training and documentation to support efficient administration of the testing procedures.

Administration of the tests themselves can be conducted either by trained personnel or the required experts, depending on the nature of the tests. For example, monitoring of automated tests can be supervised by trained invigilators, whereas observation of group exercises needs to be conducted by a Psychologist or trained expert because of the complexity of the task. Symbiotics will advise on who is able to administer the tests and what the requirements for competence are. We also provide the relevant initial and recurrent training required to administer the necessary tests.

## 10.2 Duration of Tests

IATA recommend between 6-8 hours of testing per day maximum with breaks, to prevent candidate fatigue, which can impact on performance and prevent candidates. A typical ADAPT Online test battery may take 2-4 hours to complete, but can often be administered in stages, with certain tests being completed at home before attending the test centre and the opportunity for breaks between tests. Assessment days comprising of interviews and group exercises may last up to 8 hours, but with significant breaks in between activities to ensure candidates are not overly fatigued throughout the process.

## 10.3 Outsourcing/Acquisition of Tests

This section advises that outsourcing tests to an experienced partner, like Symbiotics, can be an effective option, particularly for smaller operators who may not have the resources to conduct testing and evaluation of the PAT process. When taking on test batteries from other entities, it is essential to align them to the needs of the specific organisation; Symbiotics will work to tailor the ADAPT process to the Client's specific needs.

## 10.4 Preparation Courses

IATA acknowledge that there is a rise in commercial preparation seminars to allow candidates to prepare for the assessment process. However, these seminars should not be confused with technical information about the aptitude testing programs' sequence and content, which will be provided on the operator website. This can cause challenges for the testing systems, where different candidates may display different levels of preparation.

It is important that candidates are given an equal chance to prepare adequately; Symbiotics provides a comprehensive candidate handbook summarising test content, to be sent to candidates in advance by the operator. While Symbiotics offers the opportunity for candidates to complete practice tests through our

website, these are designed to maintain assessment integrity; while the practice tests are representative of the Client versions, the content is differentiated to ensure that the candidate is not presented with the same test again as part of a selection process, preventing any unfair advantage.

### 10.5 Presentation of Results to the Applicant

This section discusses the benefits of delivering feedback to candidates, irrespective of associated costs; this should be considered, in addition to how and when the candidates will be given their results. Symbiotics are experienced in the delivery of feedback and can support our Clients in this, either delivered through written reports, or orally in person via phone call. Symbiotics also produce a candidate feedback version of the APQ.

### 10.6 Reapplication

In some circumstances, test repetition is acceptable if there is reason to believe the candidate's performance may have improved. The ADAPT grading system can allow for identification of more marginal fails that are closer to the cut-off value, and therefore may be suitable for retesting. In order to preserve the test integrity and ensure individuals cannot 'learn' test items rather than improving their performance, ADAPT uses item banks to ensure a unique set of items is presented on each testing occasion, as well adopting a number of features to reduce potential for plagiarism.

### 10.7 Validity Period

It must be determined how long the test results remain valid. Previous research by IATA revealed that results are most frequently kept valid for two years; ADAPT tests are consistent with this.

### 10.8 Evaluation of the Aptitude Testing System

IATA recommends incorporating the PAT into the organisation's quality assurance system; service providers should also have certified quality system as well. As aforementioned, Symbiotics maintains assessment quality by adhering to the standards of the BPS and ISO 10667. We are committed to regular evaluation of the ADAPT tests and our assessment procedures and can also assist our Clients in measuring long-term predictive validity of the selection process, when job performance data is shared.

## 11.1 Cost Effectiveness of Aptitude Testing Systems

This section discusses the process for determining the cost effectiveness of the PAT system; a cost-benefit analysis should include a comparison between the cost of the PAT and the possible cost of consequences that could result if PAT is not implemented. As IATA identify earlier in the guidelines, the costs of implementing a successful selection system are low in comparison to those associated with failure during training, poor performance in the role and the wider impact this can have on an organisation.

Additionally, IATA go on to discuss the effect of the recruitment population on the efficacy of the selection system; the more candidates that are tested, the better the conditions for PAT as more stringent criteria can be implemented. Symbiotics are in full agreement that the selection criteria should never be lowered due to insufficient applicants; we ensure the standards maintained are consistent and all candidates must meet the necessary outlined competencies, regardless of current recruitment need.

## 12. Conclusion

The 3<sup>rd</sup> edition of the IATA Pilot Aptitude Testing guide further adds to existing recommendations of best practice regarding aptitude testing, to support organisations in implementing suitable and robust testing solutions. Effectively managed PAT can reduce costs for operators significantly through improved training outcomes, while enhancing safety. There is an emphasis on competency-based assessment, using the ICAO pilot competency framework, which establishes the knowledge, skills and abilities required by all pilots across different operators, roles, and environments; the ADAPT system is designed to measure the full spectrum of competencies at each level of candidate. Symbiotics' expertise in developing and managing effective selection systems, and the high standards we adhere to, helps us support our Clients through tailored PAT systems that maximise return on investment.

## 13. Questions

If you have any questions regarding any of our products or services, or anything discussed in this document, please don't hesitate to get in touch with Symbiotics, who will be happy to assist in answering any queries you may have.

Enquiries can be directed to: [admin@symbioticsltd.co.uk](mailto:admin@symbioticsltd.co.uk)

## References

- Aberdeen, (2015). *The Pros and Cons of Pre-Employment Screenings* [Online]. [Accessed 2<sup>nd</sup> April 2019]  
Available from: <https://www.aberdeen.com/hcm-essentials/the-pros-and-cons-of-pre-employment-screenings/>
- Amabile, T. M., Hill, K. G., Hennessey, B. A. and Tighe, E. M., (1994). The Work Preference Inventory: Assessing Intrinsic and Extrinsic Motivational Orientations. *Journal of Personality and Social Psychology*, 66(5), pp. 950–967.
- Anastasi, A. (1990). *Psychological Testing* (6<sup>th</sup> ed.). New York: Macmillan
- Bor, R., and Hubbard, T., (2006). *Aviation mental health: Psychological implications for air transportation*. Farnham, Surrey: Ashgate Publishing
- British Psychological Society, (2015). *The Design and delivery of assessment centres* [Online]. [Accessed 1<sup>st</sup> August 2019]. Available from:  
<https://www.bps.org.uk/sites/bps.org.uk/files/Member%20Networks/Divisions/DOP/DOP%20The%20Design%20and%20Delivery%20of%20Assessment%20Centres.pdf>
- European Council, (2016). *Regulation 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)* [Online]. [Accessed 6<sup>th</sup> August 2019]. Available from: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679>
- European Commission, (2018). *Regulation 2018/1042 amending Regulation (EU) No 965/2012, as regards technical requirements and administrative procedures related to introducing support programmes, psychological assessment of flight crew, as well as systematic and random testing of psychoactive substances to ensure medical fitness of flight and cabin crew members, and as regards equipping newly manufactured turbine-powered aeroplanes with a maximum certified take-off mass of 5 700 kg or less*

*and approved to carry six to nine passengers with a terrain awareness warning system* [Online].

[Accessed 6<sup>th</sup> August 2019]. Available from: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A32018R1042&from=EN>

Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. In Mervielde, I., Deary, I., De Fruyt, F. and Ostendorf, F.

(Eds.), *Personality Psychology in Europe*, 7, pp. 7-28. Tilburg, The Netherlands: Tilburg University Press.

Hofstede, G. (2001). *Culture's Consequences: comparing values, behaviors, institutions, and organizations across nations* (2nd ed.). Thousand Oaks, CA.

Hunter, D.R. (2005). Measurement of hazardous attitudes among pilots. *International Journal of Aviation Psychology*, 15, pp. 23-43.

International Air Transport Association, (2019). *Pilot aptitude testing: Guidance material and best practices, 3<sup>rd</sup> Edition* [Online]. [Accessed 6<sup>th</sup> August 2019]. Available from:

<https://www.iata.org/publications/Documents/pilot-aptitude-testing-guide.pdf>

International Civil Aviation Organization, (2013). *ICAO/IATA formalize Global Training Alliance, launch new I-TRAIN programme* [Online]. [Accessed 15<sup>th</sup> August 2019]. Available from:

<https://www.icao.int/Newsroom/Pages/ICAO-IATA-formalize-Global-Training-Alliance.aspx>

International Organization for Standardization (2011). *ISO 10667-1:2011: Assessment service delivery — Procedures and methods to assess people in work and organizational settings* [Online]. [Accessed 6<sup>th</sup>

August 2019]. Available from: <https://www.iso.org/standard/56441.html>

Kearns, S.K., Mavin, T.J. and Hodge, S. (2016). *Competency-Based Education in Aviation*. Farnham, Surrey: Ashgate Publishing

Levashina, J., Hartwell, C.J., Morgeson, F.P. and Campion, M.A. (2014). The structured employment interview:

Narrative and quantitative review of the research literature, *Personnel Psychology*, 67(1), pp. 241-293.



Levenson, H. (1973). *Reliability and validity of the I, P, and C scales- A multidimensional view of Locus of*

*Control*. Proceedings from the American Psychological Association Convention: Montreal, Canada

McDaniel, M., Whetzel, D, Schmidt, F. and Maurer, S. (1994). The validity of employment interviews: A comprehensive review and meta-analysis, *Journal of applied psychology*, 79(4), pp. 599.

Murphy, K.R. and Davidshofer, C.O. (1994). *Psychological Testing: Principles and applications* (3rd ed.).

Englewood Cliffs, NJ: Prentice Hall

Ree, M. J., MacLeod, C., French, D., and Locke, V. (2000). *The State–Trait Inventory for Cognitive and Somatic*

*Anxiety: Development and validation*. New Orleans: LA

Robinson, M.A. (2018). Using multi-item psychometric scales for research and practice in human resource management. *Human Resource Management*, 57(3), pp.739-750.