

White Paper

Response to IATA's Guidance Material &
Best Practices for Pilot Aptitude Testing

Symbiotics Ltd

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Executive Summary

IATA has produced the first edition of the IATA – Guidance Material and Best Practice for Pilot Aptitude Testing. This work has formed part of the IATA Training and Qualification Initiative (ITQI). This work is designed to enhance the standards of pilot training and increase the safety culture within the aviation industry. Prior to producing this document, IATA conducted a survey of its members to produce data, upon which they could act. Based on the survey feedback they received, IATA indicated that only a minority of airlines has a specific selection system or process in place that is scientifically based. IATA states that they support any investment in human performance, due to these accounting for the majority of the industry's accidents. The work conducted by the ITQI is designed to increase the professional standards, standardise training processes and enhance the safety culture of the industry.

IATA suggests that the purpose of the IATA guide is to “...*provide basic knowledge to aviation managers on the subject of aptitude testing to aid them in their decision making and implementation of a practical pilot aptitude testing system...*” As a result, aviation managers and Human Resource professionals within the industry will be better informed on the questions to ask aptitude test providers. This response document is designed to answer some of these questions on behalf of ADAPT and stimulate thought regarding future enhancements to the product. This IATA guide is, as the name suggests, the first step toward regulated selections processes.

ADAPT Overview

ADAPT is a selection, assessment and enhanced training tool, which uses a multi-disciplinary approach. ADAPT can be adjusted to suit any output standard required from the organisation, be it an assessment against the final output standard or the next phase of training. The methods used by ADAPT ensure accurate, objective measurement of an individual's personality, behaviour and ability. ADAPT combines self report and interview with impartial scores of actual performance. Candidates are expected to perform dual activities that involve concurrent thinking and doing, similar to those expected in an operational environment.

ADAPT is unique in that it takes the personality profile generated and combines it with the skill orientation and abilities of the individual to provide a predictive output of how the candidate may perform when tasked with a specific syllabus in a specific organisational or training culture.

ADAPT is a five staged tool that builds up to create a well rounded and naturalistic view of the candidate. This produces measurements of candidates' performances at four levels:

1. Physical skills
2. Cognitive skills
3. Impact of personality and behaviour on performance
4. Effect of environment and situation on performance

ADAPT uses a mixture of objective data taken from telemetry outputs from a simulator, reaction times and responses to a set of aptitude tests and four-way observations ranging from self report to observed behaviour under four different environmental conditions.

ADAPT has shown that it can elicit behaviour that better informs the organisation about how the candidate will react when exposed to the entire training pipeline. It has been able to predict where candidates may excel and also where they may struggle and are at risk of failing, not through lack of overall ability but through personality and self management causations.

ADAPT does not fail or pass candidates; this is the responsibility of the organisation. ADAPT is able to offer a detailed breakdown of candidates, who are not clear cut on selection, and their suitability for the training pipeline. Often candidates, who perform well on the physical skill tests due to experience, may appear to be better suited than an individual who is less experienced. However, the less experienced candidate may prove to have a higher trainability score and will respond well to the training experience to which they are about to be subjected. ADAPT is able to identify and select out prior experience bias, educational bias and learning style bias.

ADAPT can be adjusted to meet any selection requirements, from Ab-Initio selection through TRI/TRE positions and streaming to role disposal in military pilot selection. It has been shown to produce mentally tough and robust individuals, whilst at the same time providing enhancements to instructing personnel performance. ADAPT can be administered by non-psychologists and, if required, non-pilot instructors. Symbiotics Ltd provides training to customer personnel for collection of the data which is completed in a manner that removes subjectivity and assessor biases.

Introduction

Air transportation is a dynamic industry, which spans the globe. The International Air Transport Association (IATA) is this industry's trade organisation. IATA has been working to build the commercial standards of this industry for over 60 years. IATA has a membership representing 93 percent of the scheduled international air traffic and some 230 airlines. IATA's mission is to work with the regulators and governments as they strive for sensible regulation, whilst ensuring that the interests of the airlines are heard. Also, IATA strives to ensure that airlines help themselves by simplifying processes to increase passenger convenience. However, IATA's first priority and continual goal is to improve safety standards across the industry. This includes conducting safety audits for safety and fatigue management. Running alongside initiatives such as this, IATA launched their Training and Qualification Initiative (ITQI) in 2007. This has included collaboration with the International Civil Aviation Organisation (ICAO), on projects like the next generation of aviation professionals. These types of programmes are focused on revolutionising training and qualification schemes, with a focus on competency based training. Clearly, the next logical step in this revolution would be to look at improving the selection and assessment processes. This should include predicting future performance during the training pipeline or line operations, based on a onetime assessment. IATA indicates that this should be possible through the newly released Guidance Material and Best Practice for Pilot Aptitude Testing (Effective 1 June 2010, 1st Edition).

ADAPT recognises that people are affected differently by situations. Existing selection systems do not take into account the effect of the selection process itself or the impact that this may have on any individual, nor do they take into account how they may behave when not in the assessment environment. ADAPT takes these into account and determines their relevance to the ability of the individual to complete training or be an effective operator. Some behaviours and beliefs are responsive to change. Some candidates may be rejected when they could in fact be taught to manage their anxiety and become competent operators, whilst others are good at tests but less well suited to the environment created by the training pipeline and will be recruited possibly erroneously. ADAPT gives greater assurance that candidates recruited are the right ones.

The second role of the ADAPT system is to offer mitigation strategies for individuals so that they may respond better to the challenges presented in training. By taking responsibility for their own actions and responses based on constructive guidance. These interventions are based on proven methods taken from sports and performance psychology. They improve performance levels when the individual feels the effects of pressure or experiences loss of confidence. The predictive assessment provided by ADAPT enables the process to be initiated early, which prevents performance loss due to personality issues and improves candidates' overall self-management as a life skill.

Section 2 - Pilot Aptitude Testing

This section of the IATA document highlights the issue of safety as the industry's number one priority, due to the nature of the business and accident prevention being essential. During the introduction, this section discusses the increasing demands of the role due to the sophistication of equipment, resourcing issues of the operators and human performance accounting for the majority of incidents and accidents. The section then goes on to discuss the efficiency of testing, the process of providing fair testing, the risk of omitting aptitude testing and quality assurance. This is a short section, which provides the stimulus for discussion in later sections.

Points to note:

1. IATA suggests that aptitude testing has proven to be highly effective and efficient.
2. Effective aptitude testing can contribute to significant cost savings to airlines.
3. Training can be tailored to meet the requirements of correctly selected individuals.
4. The stabilisation of the performance of selected individuals, increased productivity in these individuals and the enhanced reputation to flight operations as a result.
5. Increased potential for the airlines' safety culture to be enhanced as a result of a robust and valid testing regime.

Section 3 IATA – ITQI Online Pilot Selection Survey

The section of the IATA document discusses the survey, which was issued to the IATA's member airlines and associated operators; this totalled 327 organisations. The section goes on to provide a summation of the survey questions. Finally, there is a short section providing some of the lessons learnt from the industry.

The following provides an ADAPT sample response to the summarised questions and lessons learnt:

IATA Part 1 – Organisation-Training-Hiring

1. Question: Which kind of personnel are you employing/recruiting?

Answer: ADAPT provides services to a number of organisations, which either provide students into academies for Ab-Initio training or assess Pilots for selection into an airline.
2. Question: How many candidates have been tested in total during the recent three years?

Answer: 500 candidates across a range of levels, roles and organisations.
3. Question: How many candidates passed the selection process successfully in the last year?

Answer: ADAPT does not have a pass/fail criterion. However, it provides an in depth report to inform the organisations selection board or HR department of the selection risk connected to the candidate.
4. Question: Are there any preconditions for the candidates to be accepted in your selection process?

Answer: ADAPT does not apply any preconditions. However, these can be applied by the organisation and often include a predetermined level in English language, Maths and Physics.

IATA Part 2 – Financial Aspects

1. Question: What are the costs of your selection per candidate and group?

Answer: Currently the costs range between £80 and £150 dependent on the level of the candidate being assessed.
2. Questions: How much does the candidate contribute towards the costs of selection?

Answer: ADAPT does not apply charges directly to the candidate. However, the organisation to which the candidate is applying may do so.

IATA Part 3 – Psychology and Methodology

1. Question: For which of the defined groups do you have a selection concept in place?
Answer: ADAPT has concepts in place to deal with the complete range of levels from Ab-Initio to TRI/TRE Captains.
2. Question: Do you address cultural diversity in your selection system?
Answer: ADAPT is sensitive to cultural diversity, both within the organisation and the country of origin of the organisation.
3. Question: Do you accept test results of other institutions?
Answer: ADAPT is able to incorporate the results of the organisations' other requirements; these include: simulator check ride results, group tasks or leadership tasks.
4. Question: Which method for empirical evaluation did you apply to your selection system?
Answer: ADAPT has applied rigorous reliability and validity measures during the validation of the system.

IATA – Lessons Learned from the Industry

This short section is split into five separate elements, with the aim of generating discussion and providing suggested areas for further study or work. This section suggests that the survey, which IATA conducted, was relevant and will be used to optimise a standardised approach to selection.

1. Selection Systems might display a lack of conceptual basis.

IATA has shown from their survey results that very few organisations have a selection concept. Also, it appears that those institutions, who conduct selection, are not basing their methods on recognised concepts, which suggest they are adhoc at best.

ADAPT was developed to address the need for a selection system that could better predict a candidate's performance in a specific training pipeline and for any given role that required concurrent and sustained levels of performance involving both thinking and acting.

Many existing selection systems have a natural bias towards a particular type of educational background or learning style. Such systems reject candidates not because of their inability to do the job but because they are not yet trained to respond in a manner that meets the selection requirements. ADAPT has been developed to identify all candidates who could, with appropriate training, meet the operational standards of the role for which they are being assessed. This approach allows candidates to be drawn from a wider recruiting pool that includes a variety of educational backgrounds, cultures, and personality types.

Unlike existing tests, ADAPT has been developed to recognise the strengths and weaknesses of individual candidates when they are required to think and act in dynamic environments and when pressure is present. Most people are able to apply themselves to discrete tasks

reasonably well, but when they are required to multi-task their more natural behaviours and likely real levels of performance manifest themselves. Everybody responds slightly differently when subjected to a range of situations and environmental conditions. ADAPT is designed to take account of this and build a profile of the candidate against the training they are going to experience. This includes the syllabus and the culture of the organisation in which it is going to be conducted.

Many people could be taught to fly given enough time with the right instructor and training methods. These candidates could readily pass many of the selection tests currently being used. However, when they are subjected to fixed pipelines and inflexible training events and methods, they may not be able to sustain the desired levels of performance. Conversely, many people may struggle to pass the biased selection test, but could readily adapt to meet the course demands if they were given the chance. ADAPT has been developed to address this problem by eliminating bias in selection and providing the means to optimise progress through the training pipeline.

2. Strengths and Weaknesses – methodologies are being improved.

This section describes the need for greater evaluation of selection methods and the impacts of data collection. IATA suggests that measurement of reliability, validity and evaluation needs to be enhanced. They also suggest that these should be more important factors than the benefits of time, cost and automation to an organisation. However, using the survey results, the responses suggest that those organisations using a stable selection system consider high reliability, validity and quality of the evaluation as strengths. The weaknesses include the requirements of test-operator qualification, the low degree of automation and the economy of time.

ADAPT is grounded on well recognised psychological and physical performance science, robust measurement, collation and analysis of data. A series of traditional assessment methods are used in combination and have been enhanced by the automation of the test, data collection and analysis. The raw data is then passed through a series of algorithms designed to measure the candidate against a series of constructs dependent on the level at which they are being assessed.

3. Ready Entry Pilots (low experience) are a diverse group.

The IATA survey grouped applicants into four categories; Captains, First Officers, Ready Entry (low experience) and Ab-Initio. The survey was then used to try to define the group called Ready Entry in greater detail. The results showed that the term 'low experience' produced a wide range of hours, experience and licence types. Often further requirement is provided by the regulatory body for the country in which the licence is issued. IATA further suggests that a structured selection system concept would remove any ambiguity.

ADAPT recognises that candidates at this level range in qualification, licence type and number of flying hours completed. Further, it recognises that the standard of training and assessment for this group is wide ranging too. To overcome this issue, ADAPT measures candidates' performance in psychometric and psychomotor aptitude then measures the impact of personality, behaviour, learning and coping mechanisms on their aptitude. Finally, it measures these outcomes against known Knowledge, Skill and Attitude (KSA) constructs or requirements to be successful within the role, training and organisation.

4. Selection for Captains and First Officers Undervalued.

IATA suggests that most selection systems have been established for Ab-Initio level assessment and they display a high degree of sophistication. However, they also suggest the selection of First Officers and Captains is less methodical, mature or robust. Further, IATA suggests that pilots are becoming increasingly transient in their approach to organisations and work patterns, which has the potential to have a destabilising effect on organisations and personnel development. As a result, organisations have limited ability or opportunity to make long-term predictions about the performance of their pilots over time.

ADAPT uses the same level of sophistication across the assessment levels but understands that the level of KSA for each level will be different. Also, ADAPT recognises that these roles have different responsibilities, workloads and often incorporates multi-tasking and crew cooperation. A variety of cognitive and individual difference variables have been shown to influence performance in multi-tasking and crew environments, their relative importance probably depends on the particular environment being considered. It is likely that some variables, such as the ability to prioritise effectively, are much more critical to successful performance in some environments than in others; for example A320 compared with ATR. This is simply because multi-tasking environments undoubtedly vary in the kind of demands they make on a pilot's ability. ADAPT creates a better understanding of the relationships among individual variables and environmental variables, which enables an understanding of why some people perform better than others in multi-tasking settings. ADAPT measures the individual differences in cognitive abilities and personality that play an important role in determining multi-tasking performance.

Summary

This section of the IATA document reviews the current state of Pilot Aptitude Testing within its member organisations, based on the results of the survey they conducted. Using these results IATA then makes some observations regarding future directions.

ADAPT has a wide ranging conceptual design based on a multidiscipline approach and review of the current literature. ADAPT continues to collect and analyse data with the purpose of improving reliability and validity.

Section 4 - Legal Provisions for Aptitude Testing

This section provides an overview and discussion concerning current regulatory requirements as imposed by the National Aviation Authorities (NAAs). Also, it discusses some of the wider implications, for example civil rights and equal opportunities. Finally, it gives some examples of the current regulations and opens them to further discussion. Surprisingly, IATA's survey results found that the only involvement from an NAA in Aptitude Testing was in dealing with language proficiency testing.

Legal Provisions for Aptitude Testing – General

This section discusses some of the wider implications, for example medical categories, psychological aptitude and language proficiency. It suggests that a lack of guidance material creates disparity between the Air Transport Organisations (ATOs) and this in turn impacts on assessment regimes. Further, the section suggests that ATOs should make every effort to ensure future pilots are equipped with the KSA required to fulfil the role requirements and give examples of routes to achieve this; Human Factors (HF) and Evidence Based Training. Finally, the section discusses some of the current issues regarding equal opportunities and discrimination.

ADAPT recognises that there is disparity between organisations and is able to moderate for these. Also, ADAPT uses a measure of organisational culture, which ensures a better understanding of the candidates' 'fit' to the organisation in question. ADAPT uses the KSA process during its measurement and comparison of the candidate to predict future levels of performance. This prediction forms part of a mitigation strategy which could be employed by the ATO, whilst monitoring and enhancing performance. Finally, ADAPT is bound by the legislative framework of the British Psychological Society (BPS) for Data Protection and Privacy Issues Relating to Psychological Testing in Employment-Related Settings. ADAPT also operates within the legislation of the Data Protection Act 1998.

Legal Provisions for Aptitude Testing – Existing Regulations

This section provides extracts from some of the regulatory body legislative documentation. These are wide ranging in their approach and often hidden within large documents, for example:

1. ICAO PANS – Training Document 9868 Attachment A to Chapter 3 No 3.4, which refers to MPL only:

“Contracting States should define the qualifications, in terms of skills knowledge and attitudes, required for meeting the entry levels for the course and should ensure that an appropriate corresponding selection method is in place”.

2. EASA Annex III 1.a.1. to regulation (EC) No. 216/2008 (Basic regulations) refers to pre-selection of pilots as follows:

“A person undertaking training to fly an aircraft must be sufficiently mature educationally, physically and mentally to acquire and demonstrate the relevant theoretical knowledge and practical skill”.

3. FAA – 14 CFR Part 61 requires commercial pilots to have the relevant medical examination and to read, speak, write and understanding the English language and:
“61.153(c) Be of good moral character”.
4. DGCA – India – Civil aviation requirements (CAR) Section 7 Series B Flight Crew Standards, Training and Licensing:
“1. Introduction: In general, an applicant for issue of a license should “meet the requirements in respect age, basic educational qualification, medical fitness.....”
“7.3. Commercial Pilot: The applicant should have passed 10 + 2 standard examination in physics and mathematics, subjects from a recognised board/university or an equivalent examination”.

Symbiotics Ltd recognises that these requirements should be the responsibility of the international bodies and the NAAs. ADAPT is equipped to capture data, which would inform the existing NAA requirements. Interestingly there appears to be a move towards applicants proving ability to an acceptable start standard, prior to being enrolled. In particular these requirements appear more prevalent for integrated courses, where the individual qualifies up to MCC at the same school. ADAPT is equipped to predict the individuals’ performances through these training pipelines and these are reflected in the report output when measuring the candidate against the syllabi of the course.

Legal Provisions for Aptitude Testing – Data Protection and Professional Standards

The section discusses international standards regarding the collection, analysis, storage and reporting using an applicant’s data. The main example of the procedures being applied is the European Union Council Directive 95/46/EC, which defines the requirements for processing personal data. Also, this section gives a brief description of additional legal requirements applied to psychologists in the development, application and validation of aptitude tests.

ADAPT is bound by the requirements of the British Psychological Society (BPS) and in particular to the Occupational division within the BPS, who are in part responsible for the development and regulation of psychological testing. ADAPT uses the following guidelines and regulatory documents from the BPS, Psychological Testing Centre (PTC):

1. Design, Implementation and Evaluation of Assessment and Development Centres – Best Practice Guidelines. PTC12/10.05
2. Psychological Testing: A User’s Guide. PTC01/12.07
3. Code of Good Practice for Psychological Testing. PTC09/11.07
4. Using online assessment tools for recruitment. PTC20/07.2006
5. Guidelines for the Development and use of Computer-Based Assessments. PTC05/10.05
6. International Guidelines on Computer-Based and Internet Delivered Testing. PTC19/01.06

7. Using online assessment tools for recruitment. PTC20/07.2006
8. International Guidelines for Test Use. PTC04/10.05
9. Data Protection and Privacy Issues Relating to Psychological Testing in Employment-Related Settings.
10. Principles for the use of published Psychological Tests in research. PTC15/10.07

Summary

ADAPT currently fulfils the legal requirements of the UK Data Protection Act 1998. Also, ADAPT meets the standards of the BPS regulations and the recommendations made within the guideline documentation as issued by the PTC. Should it become a legal requirement for ATOs to use either pre-selection screening tests or selection and assessment prior to enrolling applicants, ADAPT is well placed to meet international standards.

Section 5 - Aptitude Testing and Recruitment/Hiring

This section discusses the end-to-end process which can be used in the screening, selection and hiring decisions of flight operations departments. In addition, there is a section on cultural diversity and the effects of applying tests developed in one culture upon another culture. However, the focus appears to be mainly on ATOs rather than Flight Training Organisations (FTOs).

Aptitude Testing and Recruitment/Hiring – Testing Supports Recruitment

This section discusses the process of an effective recruitment process, which includes items such as posting an advert through to applying a probationary period. The section also proposes several questions designed to generate thought regarding the resource implications of the recruitment process.

ADAPT works in tandem with the organisation and recognises that this process is likely to differ between organisations as the requirements often differ.

Aptitude Testing and Recruitment/Hiring – Screening and Selection

This section attempts to define screening and selection and discusses the nuances of each of these definitions. IATA suggest that screening can be used to eliminate those candidates which do not meet a preset list of criteria. Further, they suggest that screening can be used to identify the “best” among a group of qualified applicants. IATA suggests some elements of the screening process, which include; questionnaires, psychometric tests, psychomotor abilities and specific operational competencies, plus reference checks depending on the level of applicant. IATA suggests that selection refers to the identification of those applicants which best meet the requirements from the group of qualified candidates. Often this element can include the ‘offer’ or invitation to join the organisation. Additionally, IATA suggests that this final element could include more elaborate testing of qualities like personality and social competencies.

ADAPT combines the elements suggested by IATA in Screening and Selection into one, dependent on the organisation utilising the tool. The process under which ADAPT operates is to provide the ATO with a detailed report of the candidate, by which the ‘final decision’ can be made. ADAPT is unique in its ability to employ the organisation’s own testing elements, in the form of the ‘5th element’. This could include anything from a simulator check ride to a group exercise, dependent on the organisation’s requirements for the level of candidate being assessed. ADAPT leaves the final selection decision to the organisation.

Aptitude Testing and Recruitment/Hiring – Mechanisms of Structured Aptitude Testing and Recruitment

In this section IATA suggests some of the processes within the aptitude test. They discuss the analysis of the requirement as key to understanding the dimensions of the role within the organisation. IATA suggests this takes three forms; the KSA required of the role, the personality traits required to meet the operators’ requirements and the nature of the operations. IATA suggests that it is crucial to separate the testing of basic, pilot-specific mental abilities and personality traits. The purpose of this section is to aid the organisation in formulating a sustainable mechanism. Finally, IATA recommends a structure for target groups and defines them as:

1. Ab-Initio Cadets – beginners who join an operator sponsored or self-sponsored, supervised approved training course in an approved training organisation (MPL or ATP integrated course)
2. Ready Entry Pilots – a varied group in experience and licence terms, but defined as CPL/IR-MPA or MPL licence holders with less than 1000 hour, or with less than 500 hours on a MPA. These are regarded as low experience pilots.
3. First Officers – type rated with more than 500 hours on MPA.
4. Captains – type rated with successful completion of an operator commander course.

ADAPT, from its very concept, was designed to have a mechanism by which it understands the personality, role and organisation requirements, which are underpinned by ability measurements and behavioural impacts. Therefore, ADAPT is currently doing more than the elements described within this section. Further, it is suggested that IATA's target groups are currently too generic. ADAPT, currently selects for Senior First Officers, TRI and TRE pilots. Also, ADAPT provides a road map for performance enhancement within these specific groups.

Aptitude Testing and Recruitment/Hiring – Cultural Diversity

This short section discusses the nature of test development and the impact of these tests being applied within cultures without testing. IATA suggests that the results from their survey show that two thirds of the organisations do not address cultural diversity in their selection systems. IATA does not discuss cultural diversity at an organisational level.

ADAPT is cognisant of cultural diversity at both national and organisational levels.

Aptitude Testing and Recruitment/Hiring – Hiring Decision

In this section IATA discusses the route that organisations take to arrive at the decision to employ the applicant or not. IATA suggests some mechanisms for 'curing deficits' during training, when accepting candidates with these during periods of high demand. Also there is some discussion regarding the route taken to provide feedback to candidates who are not successful.

ADAPT employs statistical methods in the data analysis from a combination of 'events', which produces an indication of applicants' likelihood of success; organisations then use this scale to inform their recruitment decision. The ADAPT report indicates strengths and weaknesses of each candidate and provides information for performance mitigation.

Summary

ADAPT is able to demonstrate an aptitude testing process, far in excess of the topics discussed in this section. Interestingly, IATA recognises the issue of the robust measurement of defined concepts, which has differing criteria determined by target group and organisational requirements.

Section 6 - Predicting Performance of Pilots

This section discusses the statistical methods by which pilot performance can be predicted. These include measures of reliability, validity, norm referencing and measurement scales. ADAPT meets these criteria by the applying well regarded statistical analysis of the data collected and ever mindful of the aspiration to publish ADAPT as a recognised instrument, Symbiotics Ltd are using the European Federation of Psychologists' Associations (EFPA) guidelines, as recommended by the British Psychological Society (BPS) Psychological Testing Centre (PTC).

Statistical Methods Used

This section presents details concerning the psychometric properties of ADAPT. The aim will be to show that the tool fulfils various technical requirements in the areas of standardisation, reliability, and validity, which ensure the psychometric soundness of ADAPT.

In order to provide meaningful interpretations, ADAPT is being standardised against representative samples of professional males and females from various cultural norms. The sample is described in the Standardisation section below:

Standardisation: Normative

Normative data allows us to compare an individual's score on a standardised scale against the range of scores obtained from a clearly identifiable, homogenous group of people.

Standardisation ensures that the measurements obtained from a test can be meaningfully interpreted in the context of a relevant distribution of scores. Another important technical requirement for a psychologically sound test is that the measurements obtained from that test should be reliable.

Reliability

The reliability of a test assesses the extent to which the variation in test scores is due to true differences between people or the characteristic being measured or to random measurement error.

Reliability is generally assessed using two specific measures, one related to the stability of scale scores over time, the other concerned with the internal consistency, or homogeneity, of the constituent items that form a scale score.

Stability coefficients provide an important indicator of a test's likely usefulness. If these coefficients are low (< approx 0.6), then either the behaviours/attitudes being measured are volatile or situation-specific, or, over the duration of the retest interval, events have made the content of the scale irrelevant or obsolete. Of course, the duration of the retest interval provides some clue as to which effect may be causing the unreliability of measurement. However, the second measurement of a scale's reliability also provides valuable information as to why a scale may have a low stability coefficient.

Internal consistency is also known as scale homogeneity. An assessment is made of the ability of the items in a scale to measure the same construct or trait. This parameter can be computed that indexes how well the items in a scale contribute to the overall measurement denoted by the scale score. A scale is said to be internally consistent if all constituent items are positively associated with the scale score.

The most common measure of internal consistency is Cronbach's Alpha. Thus, a high coefficient alpha indicates that the items on the scale are measuring very much the same thing, while a low alpha would be suggestive of either scale items measuring different attributes or the presence of error.

Validity

This is the ability of a scale score to reflect what that scale is intended to measure. Kline's (1993) definition is: 'A test is said to be valid if it measures what it claims to measure'.

Reliability is generally investigated before validity as the reliability of a test places an upper limit on its validity. It can be mathematically demonstrated that a validity coefficient for a particular test cannot exceed that test's reliability coefficient.

Validation studies of a test investigate the soundness and relevance of a proposed interpretation of that test. Two key areas of validation are known as criterion validity and construct validity.

Validity: Criterion Validity

Criterion validity involves translating a score on a particular test into a prediction concerning what could be expected if another variable was observed.

The criterion validity test is provided by demonstrating that scores on the test relate in some meaningful way to an external criterion. Criterion validity comes in two forms – predictive and concurrent. Predictive validity assesses whether a test is capable of predicting an agreed criterion, which will be available at some time in the future – e.g. can a test predict the likelihood of someone successfully completing a training course. Concurrent validity assesses whether the scores on a test can be used to predict a criterion measure, which is available at the time of the test – e.g. can a test predict current job performance.

Validity: Construct Validity

Construct validity assesses whether the characteristic, which a test is actually measuring, is psychologically meaningful and consistent with the test's definition.

The construct validity of a test is assessed by demonstrating that the scores from one test are consistent with those from other major tests which measure similar constructs and are dissimilar to scores on tests which measure different constructs.

Summary

The main area of concern indicated by IATA is the surety that a selection system which operates in one culture will operate in a different culture with impunity. IATA does not discuss methods of how to achieve this. Indicated above is how ADAPT intends to overcome this issue of standardisation.

Section 7 - Measures Dimensions/Testing Instruments

IATA uses this section to give examples of the differing types of measurement or test available and then to briefly discuss the merits of each. Interestingly, IATA suggests that aptitude testing is being utilised for all phases of a pilot's career. Also, they suggest that Ab-Initio candidates generally receive the largest test programme, with Captains receiving the smallest. The rest of this section is then used to describe some of the test types and what they are designed to measure, which provides practical examples of the test IATA would recommend. Finally, this section provides two matrices, one to show the general route for screening candidates using appropriate tests across the four target groups. The second shows some additional methods which could be used.

Measuring Dimensions/Testing Instruments – Measuring Dimensions of Pilot Aptitude Testing.

This section is broken into several sub-sections or competencies, each listing a series of tests which can be conducted to measure competence. The first of these is basic mental ability. This section lists 11 types of test, designed to measure mental processing; these include: Logic abilities, Memory capacity tests, Spatial orientation, Visual processing and Auditory processing including dichotic listening and technical comprehension. The next sections references Operational competencies. IATA suggests that these competencies should be tested in addition to basic mental abilities and include; Psychomotor task, Multi-tasking, Movement anticipation, Information processing and Strategic competencies. Interestingly, in the psychomotor tasks element IATA only lists two types of tracking task (Compensatory and Pursuit). The next section discusses social competencies, in which IATA lists communication, co-operation, assertiveness and leadership as requirements. The next section lists personality traits, including; self-discipline, self-critical attitudes, stress management, self organisation and professional aspiration level. Interestingly, IATA does not discuss personality traits, the use of well regarded personality measures or distinguish the differing types of stress anxiety impacts. The final element of this section lists the professional competency requirements, including; regulations, procedures and technical knowledge. Interestingly, IATA suggests that they and ICAO have projects which have identified a consolidated list of operational competencies, which is still under development. However, they have listed the categories of these, including; communication, situational awareness, leadership & team working, workload management, problem solving & decision making, knowledge, application of procedures & knowledge, flight management guidance & automation and manual aircraft control.

ADAPT currently measures all the main sections listed in this section and arguably all the elements of each section. However, to greater clarify, ADAPT is designed to measure to the bespoke requirements of each of the target groups, as it is recognised that these groups will have potentially vastly different requirements and abilities. Therefore, whilst the overall process of ADAPT remains the same across the groups, the individual elements of ADAPT are adjusted to meet the very bespoke requirements of each group. It would be entirely inappropriate, for example, to test an Ab-Initio on the situational awareness skills required of a Captain.

Measuring Dimensions/Testing Instruments – Testing Instruments

The section is broken into sub-sections, which contain a limited discussion and provide examples of specific instrument types. Examples of these sections pertinent to ADAPT include; Questionnaires, Targeted Selection, Semi-Standardised Interviews, PC-based psychometric tests and Simulation-based testing of Operational Competencies.

Interestingly, IATA discuss Work Sample, Fixed Based Simulators and Full-Flight Simulators as options for testing instruments, but point out some of the pitfalls of using these types of tests. Also of note is that none of the instruments listed is a test of personality.

Testing Instruments – Questionnaires

IATA suggests that questionnaires are the most widely used tool, suitable for collecting some data but not very suitable psychological criterion. Also, they suggest that by collecting biographical data (education grades, English language proficiency, maths and physics, general education ability); it becomes a cost effective way of screening. Thus, successful candidates at this stage qualify for professions which have a defined set of intellectual prerequisites.

IATA's advice appears quite limited here, but does indicate that pre-screening is potentially cost effective. The lack of guidance regarding personality profiling is potentially damaging. The weight of the meta-analytic evidence clearly leads to the conclusion that personality measures may be an important contributor to the prediction of job performance. Whilst ADAPT does not weight this self-report data as highly as some of the other data streams, it is clearly impactful. The pre-screening element of ADAPT is currently more than equipped to meet the recommendations made in this section. One flaw in IATA's discussion of biographical data being used to pre-screen, is that this excludes many able candidates.

Testing Instruments – Free-Style Interview, Semi-Standardised Interview and Targeted Selection.

This sub-section discusses a range of differing styles of interview techniques. IATA suggests that free style interviews are "...*very subjective and methodically weak*..." Semi-standardised interviews appear equivalent to the semi-structured interviews, whereby the interview follows a pre-defined set of questions and evaluation criteria. The targeted selection system relates to an interview structured to collect job-related behaviour. IATA suggests that the skills required by the interviewer get more complex as you progress across the range. However, of interest, IATA suggests that the targeted selection interview requires a series of dimensions, which can be developed through an empirical process.

ADAPT's Structured Interview process appears outwardly informal and relaxed to the candidate, which engages them in a two way exchange of information and views. However, the interviewer is trained to question the candidate around a series of subject matter to elicit behavioural information. This process can become more complex and demanding the more senior or experienced the candidate is. Research suggests that humans interpret their behaviour and develop coping strategies to overcome perceived issues. ADAPT's interview topics are standard within groups and measure the same behaviour between candidates in those groups. To aid this process, interviewers are trained in question technique, listening skills and also the psychological model of Observe, Compare, Record and Evaluate (OCRE), when observing behaviour. Finally, and uniquely, ADAPT has a second interview process during which the candidate is expected to debrief the interviewer on their performance during the physical task. This is not a standard or arbitrary debrief process, but an excellent opportunity to capture real performance data from the candidate's observations.

Testing Instruments – Psychometrics.

IATA provides very scant information regarding psychometric testing in this section. They only suggest the different styles of administration i.e. paper and pencil vs pc-based. Also, there is no discussion regarding empirical evidence or the relevance of these types of test.

ADAPT uses psychometrics in a blended approach to capture objective data from each candidate. Psychometrics is the field of psychological study concerning the measurement of knowledge, ability, attitudes, aptitude, intelligence, personality and memory. Psychometrics is a standardised procedure for conducting tests designed to measure three main areas; ability, aptitude and personality and can be conducted either by paper and pencil or electronically. Both aptitude and ability tests are designed to give a measurement or numerical score of a specific characteristic and how the candidate compares to other candidates. Aptitude tests specifically measure individuals' potential to learn a new task. Ability tests measure specific levels of ability in a defined construct, for example numerical or verbal reasoning. Personality tests are designed to measure information regarding candidates' styles of behaviour.

ADAPT uses psychometric data in an ipsative, normative and criterion referencing to measuring candidates' performance. Ipsative referencing is the practice of assessing present performance against prior performance of individuals and defines learning ability. Normative referencing is the process of assessing a candidate's performance in relation to other candidates. Criterion referencing is the process of assessing a candidate's performance in relation to the achievement of a certain standard, which produces a pass/fail result.

Testing Instruments – Work Samples and Simulation.

IATA discusses this next section as four distinct sub-sections; work samples, simulation based testing of operational competence, fixed based simulators and full flight simulators. Work sample tasks are designed to measure bespoke tasks, which have been created in relation to the job to be performed. Interestingly, IATA suggests that these instruments are "...highly dependent on the standardisation of the exercises and the quality of the observation personnel..." but they can provide "...good value because of their realistic content..." IATA discusses simulation-based testing from a more detailed perspective. It points out that this form of testing can measure a candidate's ability to solve tasks in dynamic situations, which involve more realistic scenarios, require multiple interactions and involve cognitive, physical, emotional and motivational performance aspects. Worthy of note, they indicate that testing of operational competencies can be conducted on specifically programmed PCs with low fidelity but they have high predictive validity. The discussion regarding fixed base and full flight simulators is more limited. IATA indicates that these tests are primarily used in conjunction with work sample scenarios and are most commonly used when handling candidates above the Ab-Initio level. Interestingly, IATA suggests that standardisation in full flight simulators is difficult, which tends to produce simplified tests. These simplified tests generally do not produce the quality of data for valid aptitude testing. In short IATA states that full flight simulators and simplified non-standardised work scenarios "*should not be used to replace classic means of aptitude testing [sic]*".

ADAPT combines work based sample tests dependent on the level of the candidate and PC based simulation, which is again based on the level of the candidate. Each of these tests is continually undergoing statistical analysis to ensure reliability and validity. ADAPT is able to immerse an individual in a context specific environment, which reduces the potential for self-consciousness to impact on performance. Also, it ensures that people who think and learn in different ways are not subjected to bias of a particular style of information presentation or problem solving format.

Measuring Dimensions/Testing Instruments – Motivation of applicants.

This very short section discusses briefly the 'needs' requirements of candidates. IATA suggests that whilst tests should be empirically valid they should also be easy to use. This, they claim, can be achieved through;

1. Ensuring that tests are relevant to the job.
2. Have a low degree of difficulty to minimise disappointment.
3. Be fair in respect to the framing conditions and instruction must be understandable.
4. Challenge performance adequately within the measuring dimensions.

IATA appears to be contradictory in its advice here and subjective in its reasoning of having low degrees of difficulty to minimise disappointment. In previous sections, IATA has taken great care to suggest that test construction should be empirically valid. ADAPT measures motivation through several measures, some self-report and others through observed behaviour. Whilst motivation is key to applicant preparation, ADAPT uses this as one measure to build a report on the candidate's likely commitment and resilience.

Measuring Dimensions/Testing Instruments – IATA Matrix – Pilot Aptitude Testing.

IATA uses this section to provide examples of the components which it suggests as conducive to a successful test battery. Also, IATA presents two matrices, which explore some measuring dimensions, scales and instruments. They stress that the test battery should be conducted in a specific order and confirm some of the detail discussed in the previous section. They do stress that there are other solutions available, but do not indicate what these might be. The complete battery test, IATA suggests, consists of an ordered set of components; these are: screening (formal requirements), tests of basic mental abilities, tests of operational competencies, tests of social competencies and half-standardised interview to capture relevant personality traits.

Matrix 1: This proposes a relatively detailed method of allocating test instruments to the four target groups. It lists the measuring dimension, for example basic mental abilities. Following this is the instrument type, for example psychometric paper/pencil tests. Following this, it suggests the type of tool to be used. These are linked to the four target groups, for example speed and accuracy of information processing – linked to all groups.

Matrix 2: This investigates the 5 elements IATA suggests as requirements for a test battery. The matrix indicates the phase, the measuring dimension, target group, instrument and suggested scale, for example tests of operational competencies involves, decision making, prioritising, organisation, planning, management and problem solving. The target groups should be; Ab-Initio, Ready Entry (direct entry) and First Officer, using a low fidelity simulator. The scales should include T-Values and rank rows. Interestingly, IATA fails to suggest tests of operation competence for Captains or more robust methods of statistically scaling candidates.

ADAPT operates within the structure of these guidelines, but often exceeds the IATA's proposed pilot aptitude testing matrices. For example, ADAPT is capable of conducting more robust testing of probably the most critical element of the flight deck; the Captain. Interestingly, IATA have included the requirement to measure 'assertiveness', during the social-interaction competencies dimension to be directed at all target groups. Whilst it is important to establish this competence due to its correlation to communication, IATA fails to make reference to the need for establishing perhaps the dysfunctional end of assertiveness; arrogance. This is a construct which ADAPT's clients have indicated as critical to effective

cockpit communication. Arguably, IATA has failed to incorporate a critical element, which if used appropriately, provides robust data on a candidate's personality; personality profiling a standardised psychometric method of measurement. The personality profile creates a series of hypotheses, which should be subsequently 'tested' with the candidate at interview. This is a far more reliable method of assessing a candidate's personality than the half-standardised interview. This method is generally reliant on observation and may incur subjective bias and inter-rater reliability issues.

Summary.

IATA uses this section to discuss the elements of a test battery, breaking these down into practicable test types and then defining which of their target groups should be assessed with each component. During the subsequent discussion of each sub-element of this section, ADAPT has been found to exceed the current recommendations and proved to be more statistically robust.

Section 8 - Construction of Pilot Aptitude Testing Systems

IATA uses this section to explore the design of pilot aptitude testing systems and present some of what IATA considers the crucial elements. They suggest that the starting point of any selection system should be the "...*actual needs of the organisation...*" IATA suggests that some criteria for needing an appropriate aptitude testing system might be: reduction of failure rates during type rating, cost reductions, reduced staff turnover and improvement in service. IATA suggests the next step in constructing pilot aptitude testing is to define the requirements expected of successful candidates fulfilling the role. This includes a greater understanding of the job and IATA suggests conducting 'Job Analysis', including the sub elements of the 'Job Description' and 'Job Requirements'. Finally, they indicate the requirement to establish valid definitions of the essential 'employee' qualities, which would indicate excellent job performance. IATA suggests that completing the three functions, discussed above, as a prerequisite would allow the organisation to identify the most suitable candidates for the job, deliver selected personnel at the lowest possible cost and provide a fair and legal defensible architecture.

Construction of Pilot Aptitude Testing Systems – Elements of a Pilot Aptitude Testing System.

Interestingly, IATA suggests that one of the key requirements is the goal of improving staff performance either during training or during operations. This is used to justify the requirement for testing systems to contain certain elements, which are listed as a series of questions. IATA suggests careful documentation of the process should be conducted to ensure that it is included into the organisation's quality assurance documentation, is used to implement a maintenance review process of the system and the documentation may be required to show fairness in the system against legal claims.

ADAPT has been established to address the issues raised in this section. We have been using job analyses of both the role and the syllabus to construct criteria against which we measure the candidates. The questions that IATA suggests organisations use to establish a testing system may be useful for Symbiotics to address clients' needs.

Construction of Pilot Aptitude Testing Systems – Test Criterion.

The section discusses the issue of performance measures serving as test criteria, but suggests that good performance and airmanship is not sufficient to serve as a criterion. Also, IATA suggests that any performance criterion measuring performance during training should be linked to those used in operational conditions. An indication is given of the types of items which should be measured and include theory tests, check flights, simulator sessions and hours or sectors needed to complete initial line training.

ADAPT uses multi-criteria to establish likely performance, anticipation of low performance and where mitigation may be required. Primarily, when establishing measurement criteria, ADAPT will work with organisations to build the required performance, conditions and standards in which the likely candidates will operate. When looking at performance, ADAPT will study the knowledge, skill and attitude requirements. This work establishes a series of constructs, which candidates are measured against using normative procedures.

Construction of Pilot Aptitude Testing Systems – Personal Requirements

This section discusses the issue of matching knowledge, skills, attitudes and personality traits to successful pilots. Also, IATA discusses the issue of many organisations believing that it had a unique character and operation and therefore requires a specific 'personality'

type when selecting potential candidates. However, studies have found that between organisations there are many commonalities, which negate the requirement to measure specific personality types. The section also analyses the issue of organisations struggling to create their own job analysis. There is some discussion regarding the differing requirements between flight school and routine flying duty.

ADAPT is designed to measure the knowledge, skill, attitude and personality of candidates. Also, ADAPT is able to distinguish between the differing requirements needed during operations and flight training. Using this information ADAPT creates a profile of the candidate, which predicts performance and indicates strengths and weaknesses.

Construction of Pilot Aptitude Testing Systems – Test Battery, Arrangement of Stages and Content of Stages.

IATA, having suggested that there are differing requirements between flight training and operations, have previously discussed that there are differing requirements between the target groups. IATA use these sections to suggest a means of testing applicants using a series of differing tests, which act to filter candidates. IATA argues that a robust assessment process uses a multiple stage test battery, programming the least expensive tests at the beginning with large numbers of candidates. The process IATA suggests is to screen for biographical data initially, followed by psychometric and psychomotor abilities measuring specific operational competencies. The next phase would be measures of social competency to establish personality traits. IATA suggests that a final phase might be reserved for Ready Entry Pilots and above, which would be the use of a flight simulator. However, IATA does indicate that the use of flight simulators to predict future performance is difficult as they do not produce the quality data required for such diagnostic use. Interestingly, IATA does suggest a specific selection process for screening MPL candidates, which should be combined with a continuous/progressive assessment of pilots' performance during their initial career.

ADAPT is capable of using multiple tests during selection and/or a multiple stage approach. ADAPT uses the candidate data collected across all elements to cross check performance potential. As a result, ADAPT predicts strengths and weaknesses, which may manifest over time. ADAPT is able to monitor candidates' progress through the training pipeline or initial operational experience for use to continually improve performance.

Summary

IATA uses this section to discuss the formation of the elements which make up a robust assessment process. These elements include the test elements discussed in the previous section. However, are now combined with measures and result that are important to the organisation conducting the process. IATA suggests that competency based programmes like the MPL combine multiple stage selection with continuous assessment.

Section 9 - Administration of Aptitude Testing Systems

In this short section IATA discusses the need of correct administration of any testing system. This includes how and who the selection team consists of, including in department co-operation, for example Flight Operations and Human Resources. There is a short discussion on the duration of tests. IATA suggests that each stage they have discussed in previous sections should last six to eight hours; there is some discussion of outsourcing tests. This appears aimed particularly at small operators, who may wish to outsource or share selections with other operators.

The remaining elements of this section discuss what additional factors can affect the candidate, for example whether to present the results to the applicant, candidate preparation, candidate re-application, validity period of the results and continued evaluation of the testing system. Points to note from these sections are:

1. If presenting the result to the applicant, it should be used as an opportunity to provide some constructive feedback. Generally though, most organisations surveyed only provide pass/fail information.
2. Pre-information about the organisations selection system can be available on the internet as the subject of a discussion forum. Some forums can/do inform candidates how to prepare. Therefore, considerations should be given to the information provided by the organisation and the potential impacts this can cause the on the candidates data.
3. Whether to allow the candidate to reapply and what time frame should be allowed between applications. IATA argues that the candidate changes after the first application; any second attempt may be influenced by practice effect.
4. If a candidate is successful, but for certain reasons cannot be recruited, how long should the results be valid? The results from IATA show that Ab-Initio candidates' results are often valid for the greatest period, being up to two years. Ready Entry candidates often are given no time from completion of the assessment.
5. Any validation of a selection system should be given scientific support. Two defined areas of validation need to be conducted; statistical analysis of reliability/validity data and validation by the organisation to ensure general satisfaction with candidates recruited.

ADAPT puts the needs of the organisation as a high priority and works with the organisation to understand these. However, ADAPT considers the needs of the candidates, but also includes several measures, which include measures of how the candidate has prepared and practice effect. ADAPT is capable of monitoring how successful candidates perform through the training pipeline or transition training into line operations, as this aids the validation process for organisations. ADAPT is able to use pre-selection criterion to filter candidates into airline specific preparations courses.

Section 10 - Financial Aspects

In this short section IATA attempts to stimulate thought by considering some of the financial impacts of selection systems. IATA suggests that before implementing a selection system an organisation would need to be convinced of its cost effectiveness. IATA suggests two methods of measuring this; conducting a financial analysis or cost benefit analysis and determining what testing needs to be conducted against which target group. At this stage IATA points to previous sections where types of tests required by each of these groups have been discussed.

Some of the implications discussed are:

1. The main aspects for consideration:
 - a. Ensuring sufficient candidates
 - b. Recruitment costs
 - c. Cost per test
 - d. Cost of staff training to administer the tests
 - e. Overall costs
 - f. Liability of these costs

This section has little impact on ADAPT, as its primary focus is to stimulate thought in organisations considering implementing their own testing process. However, IATA does suggest that outsourcing should be considered as this could be more cost effective to some organisations.

Summary

The IATA document provides a series of stimulating sections designed to aid organisation considering their own selection processes. The discussion is focused around enhancing the safety culture of the industry, whilst reducing cost, remaining fair but at the same time increasing the validity of aptitude testing.