



A HISTORICAL OVERVIEW OF COMMERCIAL PILOT SELECTION

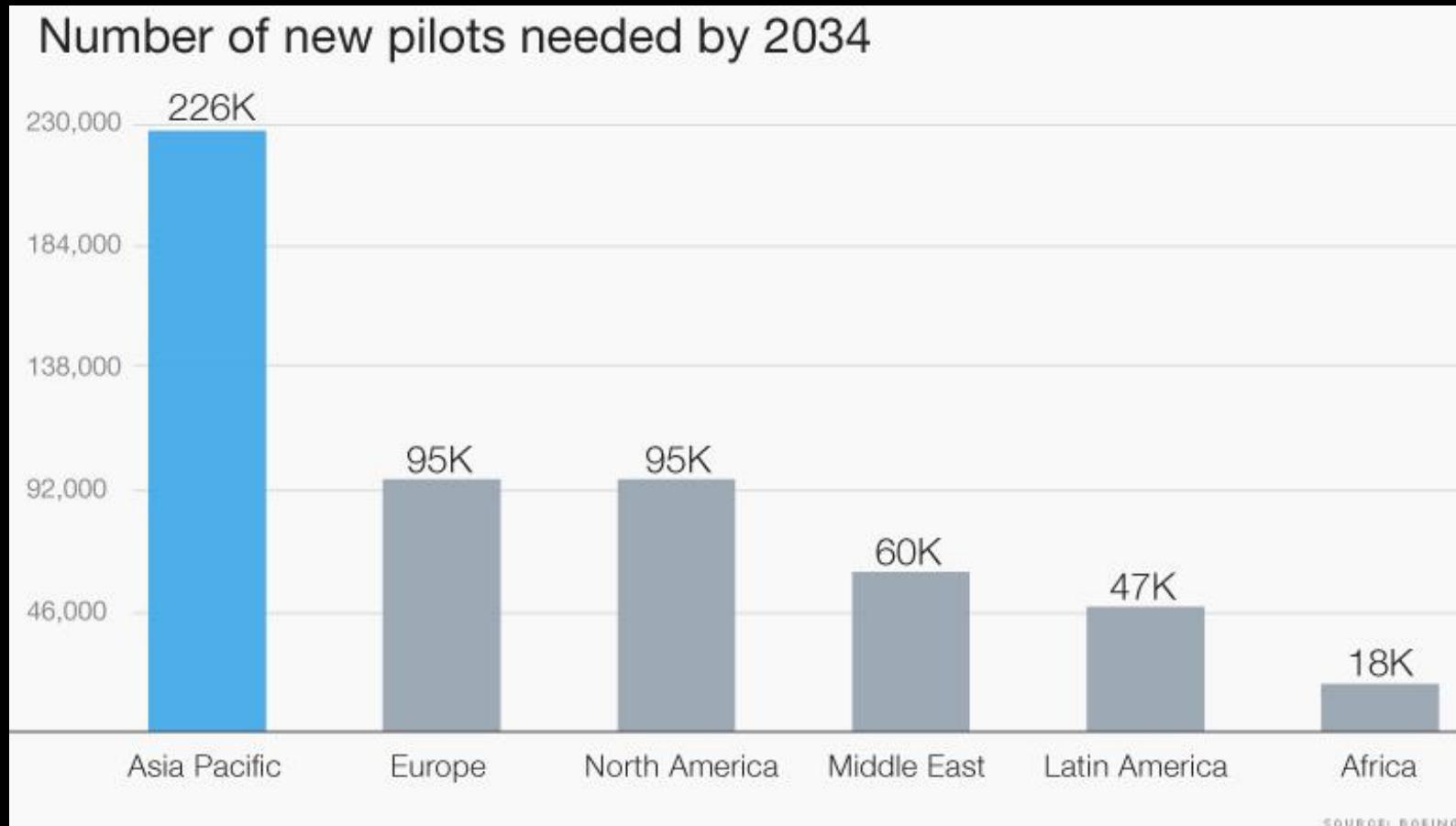
David J. Schroeder, Ph.D.

Oklahoma City, OK

COMMERCIAL PILOT SELECTION – WHY IS IT IMPORTANT?

- Projections of growth in number of passengers (IATA)
 - By 2034 the five fastest-increasing markets in terms of additional passengers per year will be China (856 million new passengers), the US (559 million), India (266 million), Indonesia (183 million) and Brazil (170 million).
 - Boeing projected (2015) close to 38,000 passenger planes -- worth \$5.6 trillion - - will be needed over the next 20 years to meet surging travel demand.
 - Rival Airbus' (EADS) recent forecast was 32,600 new aircraft by 2034.

BOEING DATA - CNN MONEY (JULY 21, 2015)



THE EARLY YEARS

- One of the early reports on aviation and psychological research (Dockeray & Isaacs, 1921)
 - Italy – Dr. Herlitzka (Turin) Reaction time, Ergoesthesiograph, swivel chair, hypobaric chamber, spatial disorientators (Galloni, 2017)
 - Italy - Dr. Gradenigo in 1919 focused on tests to assess psycho-motor activity, muscular effort, attention, and resistance to emotional stimuli. Later work involved both simple and choice reaction time. Also looked at equilibrium using the Barany chair.
 - France – Camus and Nepper in 1917 explored the importance of simple reaction times and emotional stability
 - British Research – Most of the research by the Air Medical Investigation Committee was focused on physiological data (pulse, blood pressure, vital capacity, etc.). Attention was also focused on the effects of altitude and simple motor coordination (vestibular stability – heel toe walking, standing on one foot. Birley (1918) explored pilot temperament.

THE EARLY YEARS

- Around WWI the primary focus was on self selection and physicals
- Early efforts in the U.S. were focused on emotional stability, alertness, reaction time, equilibrium, and intelligence
 - Assessment of respiration changes following discharge of a pistol
 - Use of the Thorndike intelligence tests
- CAA and Navy Bureau of Aeronautics – pilot training and research program on pilot selection in 1940

SELECTION OF MILITARY PILOTS

- There is an extensive research background for military pilot selection
- Caretta & Ree (2000) provide an overview of issues in pilot selection
 - Job task analysis
 - Identification of important job performance constructs
 - Identification of set of predictors and criteria variables
 - Examine predictive validity
- Results from several studies involving pilot selection for the US Air Force stress the importance of a higher order factor (general cognitive ability g)
- All 16 subtests of the Air Force Officer Qualifying Test (AFOQT) contribute to g

META-ANALYSIS RESULTS FOR TESTS USED FOR PREDICTING A GLOBAL CRITERION OF PILOT PERFORMANCE (BASED ON MARTINUSSEN, 1996)

Test/Predictors	N	K	Mean r (uncorrected)	Mean r (corrected)	90% CV
General Intelligence	15,403	26	.13	.16	.03
Cognitive Ability Tests	17,900	35	.22	.24	.07
Psychomotor/Information Process	8,522	29	.20	.24	.10
Combined index (several sub-tests)	5,362	14	.31	.37	.19
Aviation Information	3,736	16	.22	.24	.14
Academic Grades	4,267	9	.15	.15	.11
Training experience (flying)	5,806	10	.25	.30	.07
Personality Measures	6,304	21	.13	.14	.00
Biographical Inventory	11,347	13	.21	.23	.00

COMMERCIAL AIRLINE PILOT SELECTION

- High failure rates during training and high turnover led to research to improve pilot selection
- McFarland (1953) reports on a study of a large airline (1,000 pilots) where there was a loss of 475 pilots from 1941-1947 (10% per yr)
- McFarland (1953) conducted a job task analysis to identify duties and basic requirements for airline captains
 - Mental ability, mechanical comprehension, and judgment
 - Alertness, observational ability, motor skill, and technique
 - Emotional control, presence of mind, and perseverance
 - Interest and attitude, character, and leadership

PILOT HIRING AND SELECTION IN THE 1990s

- Most common selection methods for major/regional carriers (Part 121) and all FAR Part Numbers (91/125, 121, 121/135, 135)
 - Reference checks 100% -- 93%
 - Background checks 100% -- 66%
 - Interview 94% -- 96%
 - Simulator 47% -- 17%
 - Written tests 35% -- 30%
 - Psychological Assessment 25% -- 14%
 - Flight checks 24% -- 76%

Suarez, Barborek, Nikore, & Hunter, 1994

ADDITIONAL STUDIES

- Doat (1994) Air France transition to a four stage process, also initiated a JTA
- Bartram (1989) Bartram & Baxter (1996) Cathay Pacific Airways
 - Started using MICROPAT (aptitude tests in 1989)
 - JTA
 - Cadets have a three stage process:
- Stead (1991, 1995) – Qantas pilot selection 1950's to 1990
 - Pre 1960 - prior pilot experience, job knowledge, personality, and medical
 - 1959-1960s – Differential test battery, reasoning, Values, Preference, 16PF
 - 1983-1990 – Two stage process. Stage 1 – psychological assessment, aptitude, interview, vision. Stage 2 – B747 flight simulator and light aircraft check, final interview. Psychomotor coordination and SA
 - Validation study in 1995 revealed the cost effectiveness of the psychological testing.

EARLY YEARS TO THE PRESENT

- The German Aerospace Research Establishment (DLR) provides the most extensive and documented research on commercial pilot selection
 - Hormann & Maschke (1987) a validity study of student airline pilot selection
 - Maschke (1987) Temperment structure scales
 - Manzey & Hörmann (1990) application of DLR selection system for IBERIA pilot selection
 - Hörmann & Maschke (1996) relationship between personality and job performance of airline pilots
 - Hörmann (1997, 1999a, 1999b) selection test methods of selection of Chinese ab initio student pilots
 - Hörmann, Burger, & Neb (2003) evaluation of pilot's interpersonal skills
 - Hörmann & Goerke (2014) social competence in pilot selection

IATA GUIDANCE MATERIALS AND BEST PRACTICES FOR PILOT APTITUDE TESTING (2012)

- IATA conducted an online survey of member airlines and associated operators in 2009
- The survey was designed to review industry selection practices
- While 66 institutions responded to parts of the survey only 12 completed all three parts
- Categories and questions appeared to be appropriate
- Current selection systems lack a conceptual basis
- Selection systems for ab initio candidates were fairly sophisticated, methods for first officers and captains were less mature
- Benefits – economy of time/cost, reliability, validity and quality of the evaluation

EXISTING PATHWAYS TO BECOME A COMMERCIAL PILOT

- University-based pilot training programs
- Independent flight schools/flight academies
- Former military pilot
- Multi-Crew Pilot License (MPL) (Non-US)
- “Flow-through” agreements

Broach, Schroeder & Gildea, 2017

BEST PRACTICES

- Conduct a job task analysis (The most recent JTAs for commercial pilots were conducted nearly a decade ago)
- Develop job performance measures for validation
- Develop predictor (criterion) measures
- Conduct a validation
- Establish cut scores

AIRLINE PILOT JOB REQUIREMENTS

- Maschke, Goeters, & Klamm (2000)
 - Used Fleishman's Job Analysis Survey
 - Ratings provided by 141 Lufthansa CPTs and FOs (7-point scale)
 - Very Important – 6 to 7 (Map Reading, Stress Resistance, Cooperation, Communication, Time Sharing, Decision Making, Spatial Orientation, Rate control)
 - Ratings of 5-6 (Important) Next five all interactive/social (leadership, SA, Self Awareness, Resistance to Premature judgment, Behavior Flexibility)
 - Psychomotor Control (5.71)
 - First Sensory – Auditory Attention 5.6
 - Some traditional qualities rated rather low (Mathematical Reasoning and Electrical and Mechanical Knowledge)

GUILD OF AIR PILOTS AND NAVIGATORS SURVEY (UK)

- Ranking of importance of technical / non-technical skills
 - Team working skills
 - Aircraft handling
 - Leadership
 - Personality
 - Customer awareness
 - Technical knowledge
 - Education
 - Presentation and appearance
 - Previous employment
 - Family background

SELECTION INSTRUMENTS

- Biographical Questionnaires
- Freestyle Interviews
- Semi-standardized interviews
- Paper and Pencil Psychometric Tests
- PC-based Psychometric Tests
- Work Samples
- Simulation-based testing of operational competencies
- Fixed-base simulators
- Full Flight Simulators
- Personality

EXISTING TEST BATTERIES FOR COMMERCIAL PILOT SELECTION

- ADAPT – Symbiotics Ltd.
- COMPASS - EPST
- DLR - Lufthansa
- Delta – Hoffman, Hoffman, & Kay (1998) Hoffman, Spetz, & Hoffman (2011), Hoffman (2013), Hoffman & Hoffman (2017)
- GAPF – Society for Applied Psychological Research
- GPSS – Global Pilot Selection System
- KLM – KLM Flight Academy/Institute for Aviation Psychology
- WOMBAT (Roscoe, Corl & LaRoche (1997) and Damos
- PILAPT – Burke, Kitching, & Valser (1995) Burke, Hobson, & Linsky (1997)
- SCHYHFRIED Company – SAAIR Safety Assessment Aviation
- SIAP - Scandinavian Institute of Aviation Psychology

CONSTRUCT	SAAIR	SIAP	ENAC	DLR	GAPF	ADAPT	PILAPT	GPSS	COMPASS	WOMBAT
Attention/Concentration	2	2	X	X	3	X	X			X
English			X	X	X			X		
Math			2	X	X				x	
Memory	X	X		X	X	X	X	X	X	X
Multi-Task			X	X	X		X	X	X	X
Psychomotor/Coordination	X	X		X	X		2		2	X
Spatial	X	2	X	X	X	X	X	X	X	
Reasoning	X	2	X	X	2	3		3		
Perceptual		2		X		X	X	X		
Misc.	2	2	2		2	2	X	3		X
Personality				X	X	X		X		
Interpersonal/Group		X	X	X				X		
Technical Knowledge		X		X						
Simulator				X	X	X				

Student Pilot Qualifications

- Age
- Education
- Height
- Vision
- Fluent (German, English)
- No alcohol/drug violations
- Character

DLR Test Coaching

Free computer-based at home

Phase 1: Computer Aided Testing

- Mental Arithmetic
 - Memory Function
 - Attention
 - Perception
 - Spatial comprehension
 - Reasoning
 - English Language skills
 - Technical knowledge
- (33%)**

Phase 2: Computer aided team assessment

- Interpersonal skills & work sample tests
 - Dynamic and small group tasks
 - Social competence
 - Task Orientation
 - Stress resistance/interactive skills
 - Personality Questionnaire
- (70%)**

Phase 3: Computer aided simulation

Psychomotor & Multi-tasking

(70%)

Phase 4: Interview

(60%)

Medical

SUMMARY AND CONCLUSIONS

- Job task analyses are needed to reflect current glass cockpit aircraft
 - The most recent JTA in the scientific literature (Maschke, Goeters, & Klamm, 2000)
- Existing predictors seem reasonable and fair
- Need to improve criteria
 - Most criteria are based on pass/fail during training and/or instructor evaluations
 - Need to emphasize basic airmanship skills
 - Consider use of subsequent job performance indicators
 - This is especially true for personality measures (CRM)
- Additional efforts are needed to verify the validity of many of the existing pilot selection test batteries
- Despite the need for corporate secrecy, efforts need to be devoted to documentation of the research in the open scientific literature



THANKS FOR LISTENING

- davids20@cox.net