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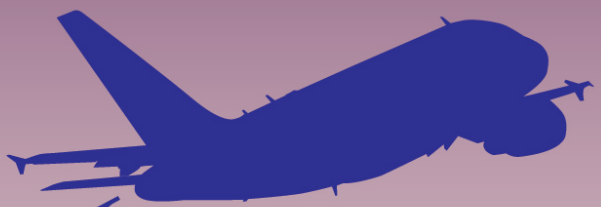


IPTS

IFALPA Pilot Training Standards

Please note that the information contained in this document represents a first edition of the ideas contained herein, as laid out and agreed upon by the IPTS Drafting Group. Future editions of this document may be released which will elaborate further on each of these topics. Any future work will be conducted by IFALPA's Human Performance Committee/IPTS Drafting Group.

INTRODUCTION

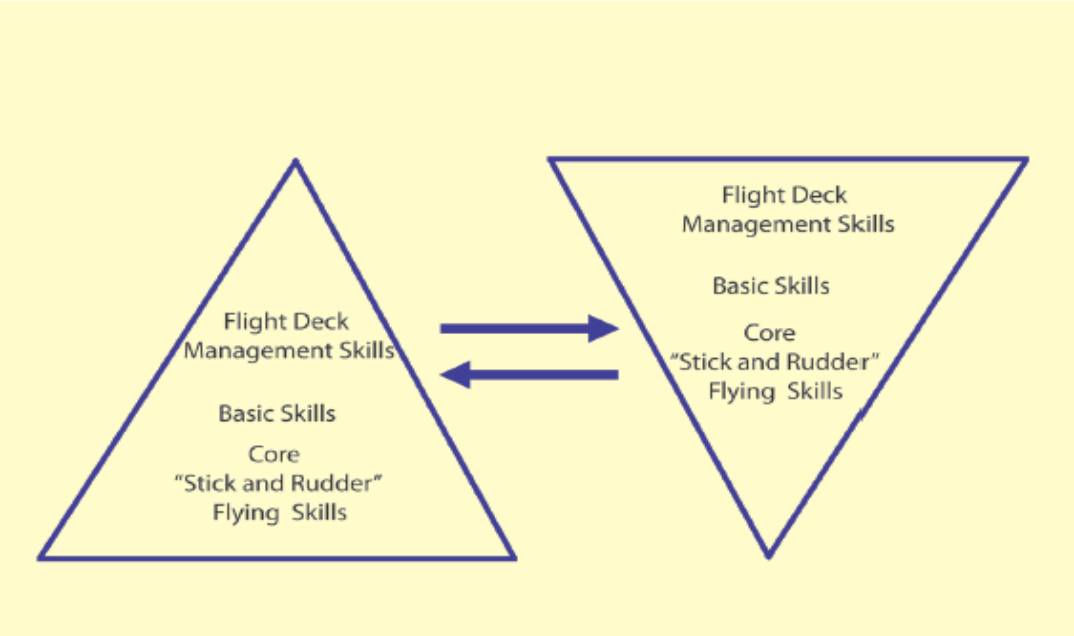
The intent of this document is to present, in a comprehensive and structured way, the best practises and outcomes derived from the IFALPA Pilot Training Standards (IPTS) Workshop that was held in Paris in October 2010. Operational pilots from 23 countries and 5 continents, with a wealth of expertise in pilot training, committed to establish IPTS as a pure pilot perspective on best practises in the development of a professional pilot.

The first result was published in March 2010 in IFALPA position paper **11POS04**, The Future of Flight Training, which outlined the factors that are fundamental for pilot training starting from the initial selection process, initial training, airline specific training, recurrent training, and professional development. This paper can be found in Appendix A.

In the workshop, there were two key themes that permeated each aspect of pilot training. The first was the need to focus on basic flying skills from the beginning and continue to practise these throughout a professional pilot's career. The second was the need to enhance training programmes to account for added demands on pilots brought about by increased automation, emerging technology, high-density airspace, and globalization. In a world of growing competition, we need to improve and increase the amount of training a professional pilot receives, not diminish it. The gradual erosion of training time will have a delayed effect as the older generation of pilots leave the left seat and take their experience with them.

The latter theme is best illustrated by figure 1 below:

Figure 1: The importance of the different skill-sets varies with current circumstance and, accordingly, an effective training programme must be aimed at first reconciling these skills and then optimising the interplay between them.



A key theme to the ideas contained within this document is that of a Paradigm Shift in the demands associated with today's professional pilot vs. the demands of previous pilot generations. A pilot needs to be able to develop skill-sets that include core, basic, and management skills. The triangle on the left demonstrates a skill-set that requires more core and basic skills (e.g. flying a hand-flown

approach), while the triangle on the right reflects a skill-set that requires more management skills (e.g. flying a coupled RNP approach). The paradigm shift in pilot training would join these skill-sets to enable the pilot to seamlessly shift between the two. While much of a pilot's responsibility is procedural in nature, pilots must be trained to depart from linear thinking and "think outside the box" in order to deal with unexpected and undefined events.

CHAPTER 1

PHILOSOPHY OF PILOT EDUCATION

Professionalism requires combining a thorough education and training throughout a professional pilot's entire career. In order to create a programme that maximises the pilot's potential, it is important to acknowledge the difference between training (developing response structures) and education (developing airmanship).

Creating a professional pilot requires not only training competency in certain technical and non-technical skills, but also an ongoing education to aid pilots to develop and maintain airmanship skills. This requires formal initial and recurrent education in airmanship skills as well as ongoing airline mentoring by well-qualified pilots. Training and acquiring certain flying skills alone (e.g. manual handling) does not make a professional pilot.

The key point is that there is a need for ongoing pilot improvement that spans a career. Individual Programmes/Courses/Professional Development, etc., are components of a quality continuous improvement programme for pilots that is constantly monitored and improved. This programme will be explained in greater detail in Chapter 4, Effective Training Systems. Each pilot will have developed a set of non-technical skills acquired through their life experiences that can be broadened within the aviation environment through training and experience. A new approach to acquiring skills and training pilots is needed, based on the following Competency-Based Training (CBT) principles:

- Knowledge
- Application of procedures and knowledge
- Interpersonal Skills

Remember, while proficiency can be described as the completion of the competency requirements, the aim of training professional pilots should extend well beyond this benchmark. The final objective for developing a professional pilot is a "safe, sustainable lifetime performance."

Proficiency

As discussed above, the most important education/training objective for developing a professional pilot is to ensure the industry provides airline pilots with the opportunity to develop and maintain the necessary pilot competencies and proficiency so they can safely operate an airplane in a complex, high-threat environment.

Proficiency And Fluency

A good training program will embrace the concept of competency (demonstrated ability) and fluency (ability to use skills in the "heat of battle"). Instead of settling for a pilot being "proficient" in certain critical manoeuvres, we must maintain a level of fluency. The difference is explained below:

Proficiency may be attained after several repeats of several different events. Fluency is only attained once a manoeuvre can be properly completed after numerous repetitions, without error, over time. However, fluency is not attained until it can be determined that the manoeuvre can be performed

properly after some interval of time. If the manoeuvre cannot be done properly after the passage of time, the pilot by definition is not "fluent" although he may be proficient after one or more repeats.

This concept may seem cumbersome and an additional burden to training, but not necessarily. Fluency should only be applied to truly "critical" manoeuvres. This can enhance the pilot's experience level, and prepare him to handle non-published situations that may require thinking "outside the box". All non-critical manoeuvres may continue to be trained to proficiency.

The fluency agenda determines which manoeuvres are "critical"− those that should be trained every year– and which are non-critical manoeuvres– those that can be reviewed less frequently. Safety and training feedback can provide data that will show which tasks are critical and which are not. Endorsing de-identified data collection on performance will aid the Training Management System process discussed in Chapter 4.

Fluency can and should be the training/evaluation standard for airline pilots for the small subset of "critical events" which can lead to catastrophic loss of control if unrecognised and not recovered appropriately. Fluency can be achieved by exposing pilots to realistic training of critical scenarios in established training cycles, then offering enough repetitions for each pilot to allow them to demonstrate adequate recognition and recovery skills. Fluency is demonstrated by evaluation of the crew performance when given a "surprise" unannounced critical event in the course of realistic operationally oriented simulator training.

No one-size-fits-all approach – Tailored Training

It is important for any training programme to provide:

- A standard training for every student (i.e. goal to train to), and
- Tailored training that is student-specific.

A tailored, student-specific training curriculum will allow each individual to achieve a common standard. Different training tools are necessary to enable each student to identify those tools that best suit their needs. In addition, the instructor must have the ability and guidance to personalize the training to meet each student's needs.

No two students are the same. Their initial experience and skill levels may be different and the rate at which they learn certain concepts and skills may vary. An effective training programme will provide the required flexibility to ensure each pilot's skill-sets meet or exceed the required proficiency and fluency required to safely operate in today's complex airspace environment.

Flexible curriculum – The curriculum should avoid the "one size fits all" approach by being flexible enough to allow a continuous evaluation of the training process while enabling students and instructors to adapt the content to ensure the goal of a high quality, professional airline pilot is reached.

Training intervals – Using a one-size-fits-all approach to define intervals for recurrent training is not flexible enough to account for variables in specific operation. Accordingly, these should be tailored in conjunction with the national regulator to the specific requirement of an airline's operations.

Levelling (Have A Base Level To Start From)

The knowledge and experience level of pilots, including *ab initio* pilots, varies widely on many subjects. The most current training programmes assume entering pilots have some minimum level of existing knowledge on which the training syllabus is based, which may not always be true.

In order for an operator to ensure that all pilots have the minimum level of knowledge and skill required for company type-specific training, operators should define and identify what they consider to be the minimum acceptable level of knowledge required prior to entering any category of training. Each operator should then verify that all pilots have the required minimum knowledge and skills to enter their next training course, or provide refresher training to guarantee that pilots meet the minimum standards.

Evaluate the student's knowledge when they start:

- Recognition of prior learning should be taken into account
- Can give economic benefit
- Relate start level to end goal

Training Vs. Checking Vs. Assessment Balance

During recurrent training, less checking and more training is desired. The emphasis must shift from checking pilot skills to training pilot skills. Proficiency and Fluency are maintained by practise and repetition over time, not by checking. Pilots are also aware of the skills they need to practise and should be allowed to have input into the use of free time of a simulator period during recurrent training to practise these skills. The concept of de-identified data collection on performance must be endorsed to aid in the Training Management System process.

Scenario-Based Training

The purpose of Scenario-Based Training is to emphasize the development of critical thinking, flight management, and flying skills during normal line operations rather than focusing solely on traditional part-task manoeuvre-based skill training. The term "Scenario-Based Training" should not be confused with "using realistic scenarios for Manoeuvres-Based Training." These are two different types of training, both of which use "realistic scenarios" during training.

The goal of Scenario-Based Training in a full motion simulator is to accelerate the acquisition of higher level decision-making skills and airmanship by requiring pilots to apply their entire acquired training knowledge and skill-sets during line-oriented flight training. Scenario-Based Training would normally be used during later stages of a type-training course and during recurrent training. This would be an excellent way to also evaluate fluency of critical manoeuvres.

Elements of Scenario-Based Training should include the following:

- When possible, training scenarios should include scenarios from accident, incident, and safety data to provide realistic opportunities for pilots to see how threat situations may develop and how they should be managed during line operations. This facilitates a pilot's

evaluation of real-world events and teaches appropriate pilot responses to line-oriented situations.

- Prevention (Avoidance and Recognition) stresses proper aeronautical decision-making, CRM skills, enhancing a pilot's situational awareness of operational and environmental conditions that could increase the likelihood of a critical event occurring. Prevention increases a pilot's automation competence and knowledge, and emphasises his proportional control input to avoid or manage the event.

- Pilots would not normally be briefed ahead of time on events that will occur during Scenario-Based Training. The concept is to put the pilots into line-oriented flying, which presents unexpected threats or events, and allow them to recognise and manage the threats or critical events as they develop during normal operations.

- Scenario-Based Training is also a good training tool to introduce a Startle event during realistic line-oriented flight training in the simulator.

Immersion Environment

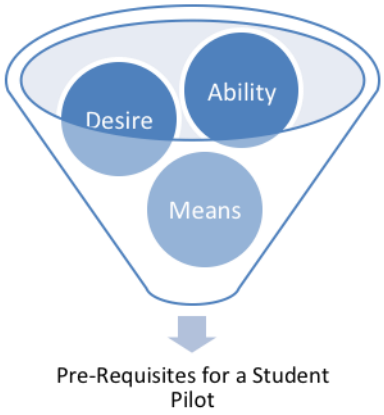
We should always consider how the training environment, can be optimised to maximise pilot education. It is clear that a high quality, distraction-free environment for learning (in terms of facilities and academic environment) yields more effective training. For *ab initio* training, a flight academy with an immersion training environment allows students to live, eat, sleep, and dream flying. In this type of environment a student is not only free of distractions but also able to profit from a peer support network. "Hangar flying" brings tangible training benefits.

CHAPTER 2

PILOT SELECTION

Prerequisites

In order for a future professional aviation candidate to have a chance of successfully completing and thriving in the educational programme, certain prerequisites are necessary. The likelihood of a successful education increases when a candidate possesses equal proportions of the following three prerequisites:



Desire: A desire to become an aviator and an airline pilot. This is the motivational factor.

Ability: The ability to adapt and learn quickly, and develop cognitive skills.

Means: Having the financial means (cadet programmes) and the means to learn (training provider).

Additional qualifications are also necessary to ensure a candidate's ability to become a commercial aviator. He or she must possess acceptable levels of academic, social and psychomotor skills as well as medical qualifications.

Additional Qualifications

ACADEMIC QUALITIES

Pilot applicants should demonstrate basic mental abilities to learn and retain knowledge. This should include a need to have achieved an educational level that allows them to effectively learn, comprehend, and understand. In addition, this demonstrates that they have the ability to grasp complex subjects that relate to aviation. For example, they will need to learn physics, mechanics, aircraft systems, and human factors and constraints.

A pilot must have the basic ability to cognitively understand and incorporate new learning tasks in such a way that the task is repeated successfully after a reasonable learning period. These skills also must be evaluated before training.

A pilot must be able to memorise vast amounts of information including numbers, procedures, rules, and definitions. A pilot must be able to work in a 3-dimensional platform, while taking the 4^{th} dimension of time into consideration. Finally, a pilot needs to be able to observe and process vast amounts of data with accuracy and speed, and make correct decisions that result in the appropriate action.

SOCIAL SKILLS

A successful pilot is able to perform his duties under stress and solve complex situations by delegating tasks amongst crewmembers. The daily work allows the pilot to interact with a variety of people from different backgrounds, cultures, and educations, and requires a set of highly developed social skills. Only a motivated, dedicated, socially adept, balanced personality who can alternate between roles as a leader and follower as the situation requires, will have the ability to succeed in the professional pilot proffesion.

PSYCHOMOTOR SKILLS

An airplane manoeuvres in a 3-dimensional environment, and the addition of the 4^{th} dimension – time – becomes more relevant as technology and traffic volume increase. To safely operate a modern airplane in today's complex and technologically advanced cockpit, a pilot needs highly developed hand-eye coordination and the mental capacity to maintain spatial orientation under normal situations, as well as in a stressful emergency environment. Cognitive skills are harder to train and innate psychomotor skills are desirable in a pilot.

MEDICAL QUALITIES

The medical standards defined by ICAO are deemed to be an adequate level of fitness for any pilot. Obviously, an increased level of fitness helps the pilot cope with environmental factors in his job.

Selection Process

Without a doubt, there is a need to select suitable candidates for the pilot profession. It is commonly understood in any industry that selection comes before training. The pilot operates in a highly demanding, ever-changing environment that requires highly developed cognitive skills and a proper set of basic manual handling skills (that can be further developed).

A well-developed and mature selection process should identify a candidate who holds the attributes in all of the aforementioned prerequisites and qualities. Generally, academic and psychomotor skills can be trained and enhanced more easily than social and medical qualities. The objective is to identify those persons that possess the greatest chance for successful completion of training and the highest motivation to excel as a professional pilot.

It is critical that the candidate selection involve stakeholders in the training process including operational personnel, human resource/company culture personnel, and representatives from the company's pilot community. A thorough selection process will not only yield a more robust workforce, but will save the company money by focusing its training resources on those whose chance for success is the greatest. It is desirable to triage candidates as early as possible to avoid frustration and failure at a later stage of the training by properly defining the core competencies required of a commercial aviator.

CHAPTER 3

TRAINING PATHS AND METHODOLOGY

Today's pilot training can be divided into the development of two skill-sets that are paramount to master the requirements and demands put on a pilot, allowing him to become a safe and confident aviator. These skill-sets include the technical side, dealing with hard-core skills (e.g. safely manipulating and flying a modern aircraft platform) and the non-technical side that focuses on the aviator's soft skills, which are equally important to work effectively in a crew environment. The technical skills are allocated to specific phases and stages of flight training and build on each other. It is harder to put the non-technical skills in a linear development process as they tend to be more interconnected and their development stretches over the entire training curriculum.

Figure 1: Technical and Non-Technical Skills Assigned to Training Phases.

		Skill-set	
		Technical Skills (Core Skills)	***Non-Technical Skills***
Training Phase / Stage	***Basic Training***	Academics on aviation topics. Aircraft manual handling in normal and abnormal situations including upset recovery training conducted in nearly 100% visual flight conditions.	Airmanship Facilitation / Development Automation Monitoring Skills Crew Resource Management CRM Decision-making Distractions Information Management Pilot-Monitoring Skills Startle Factor Threat and Error Management TEM Time Management Workload Management
	Intermediate Training	Advance basic training to more sophisticated areas like instrument flying and more advanced aircraft systems.	
	Advanced Training	Advance intermediate training to include modern aircraft systems and operational items.	
	Additional Training	Regulatory Knowledge Safety and Security Passenger Interaction Fatigue and Stress Management	
	Airline Specific Training	Company Philosophy Cultural Scheduling Flight Operations Manual Dispatch Weather	
	Upgrade Training	Focus on leadership and management skills with enhancing flying skills and systems knowledge (aircraft systems and aviation systems).	Captain's Authority and Leadership

Application In Initial And Recurrent Training

The concepts described herein are equally applicable to initial and recurrent training. Existing regulatory framework requires successful completion of a flight standards test at the end of each training phase and when conducting recurrent training. The concept of Competency-Based Training and recurrent training is to train proficiency and fluency. Any form of recurrent training should focus on ultimately enhancing the pilot's skills through training rather than simply meeting a stereotyped set of flight standards.

Non-Technical Skills

A closer analysis of non-technical skills is required to fully understand the impact that constant training and coaching will have on the pilot's non-technical skill-set.

CREW RESOURCE MANAGEMENT (CRM)

Relying solely on a pilot's technical knowledge and skills is not sufficient to safely operate complex aircraft in today's flying environment. Crew Resource Management (CRM), including cockpit management, professionalism, and leadership, was developed to address this issue. Originally portrayed as a conflict resolution skill, CRM has evolved to define a set of skills that support a pilot's technical and decision-making flying skills by providing the pilot with the cognitive and interpersonal skills required to address human error by managing resources within the organized operational system. Some of these skills are:

- Decision-making
- Communication
- Leadership/Followership
- Conflict resolution
- Multitasking versus delegation

Industry recognises CRM as a "best practise" when fully integrated into initial licensing and recurrent training programmes. The principles of CRM are essential tools that pilots need to learn and continually improve. Pilots cannot master these skills by attending a one-time course. A high level of proficiency in CRM requires continuous training, evaluation, and feedback.

Recognising that safety depends on the coordination of key people in the entire system and not just on the actions of pilots, CRM training should be implemented by flight operations personnel employed by an air carrier who possess pertinent knowledge of the culture, policies, procedures, and training of that particular air carrier. Evidence shows that a joint CRM course for flight crews, cabin crews, and other operational team members can improve the level of understanding and cooperation within the entire team.

Air carriers develop CRM programmes that promote the integration of practical flight management skills with traditional technical skills. CRM awareness and error management training is most beneficial when the training curriculum is individualized; tailored to each airline's unique culture and includes the added realism of Line Oriented Flight Training (LOFT). The development of CRM skills

must be training oriented and if assessed, shall be non-jeopardizing towards the qualification of flight test standards.

THREAT AND ERROR MANAGEMENT (TEM)

CRM is now in its fifth generation and emphasizes Threat and Error Management (TEM). One of the underlying principles of Threat and Error management is the premise that human error is inevitable. Pilots should be taught the limitations of human performance and trained to develop skills to detect and manage error. For this error management approach to succeed in any organisation, the organisation itself must first recognise and communicate their formal understanding that errors will occur and adopt a non-punitive approach to error.

DECISION-MAKING

Effective decision-making is critical to safe operations and is used continuously throughout every flight. Operators shall provide all pilots with decision-making training in every training course. This training should cover general decision-making skills and fundamentals, including team decision-making and cognitive biases, as an important part of the content of a training curriculum. Decision-making is an integral part of CRM and recurrent training. Flight crews should also be trained to deal with unanticipated events (e.g. subsystem failures not covered by checklists) and how to use multiple checklists, especially during high-workload conditions.

CAPTAIN'S AUTHORITY AND LEADERSHIP

Operators shall provide a command and leadership course that covers non-technical skills that a captain needs to perform his/her duties. Course information should reflect company and regulator expectations and be solicited from various sources within the company, including operations, standards, and other captains. The course content should include, but is not limited to: leadership, professionalism expectations, company culture, captain's authority, captain's emergency authority, and captain's duties and responsibilities.

The command training course should expose new captains to available resources outside the cockpit that can help them make more informed decisions as they operate their aircraft. These resources could include departments within the air carrier as well as outside sources.

AIRMANSHIP FACILITATION/DEVELOPMENT

Professionalism can only be created by combining thorough pilot education and training throughout a professional pilot's entire career. Creating a professional pilot requires not only training competency in technical and non-technical skills, but also ongoing education to aid pilots in developing and maintaining airmanship skills. This requires formal initial and recurrent education in airmanship skills as well as proper ongoing airline mentoring by well-qualified pilots.

INFORMATION MANAGEMENT (MANAGING THE INFORMATION FLOW)

Systems that provide information in the cockpit have improved pilot situation awareness and increased safety. However, the same systems can also have serious negative effects on safety. The pilot may not understand how to properly use the system, have problems interpreting the information being presented, or simply get overloaded with "too" much information.

Proven and profound training programmes will be necessary to equip the pilot with the necessary skills and technical knowledge to safely utilise and operate this new equipment. A full understanding of the capability and limitations of new technology is required to benefit from these systems.

PILOT-MONITORING SKILLS

The U.S. National Transportation Safety Board (NTSB) accident statistics indicate that 84% of accidents involve a failure to properly monitor, detect, and correct errors in the operation of aircraft or the actions of crewmembers. The strict definitions of pilot flying and pilot monitoring are not only academic, but serve as an effective mitigation against error propagation and accident prevention. With this critical impact to safe aircraft operations, pilot-monitoring duties must be clearly defined and adequately trained to include incorporation into everyday flight operations.

Overall flight crew monitoring performance can be significantly improved by developing and implementing effective Standard Operating Procedures (SOPs) to support monitoring and cross-checking functions, by training crews on monitoring strategies, and by pilots following those SOPs and strategies. The development and training of Pilot Monitor (PM) skills should be an integral part of all initial and recurrent pilot training and CRM programmes.

AUTOMATION MONITORING SKILLS

As a rule, humans are not good monitors. As automated systems have become very reliable, industry data indicates that pilots may become complacent in monitoring because nothing usually happens with the data that is cross-checked and most flights are routine. Consequently, insufficient cross-checking and verification procedures are commonly cited as contributing factors to flight path management related incidents and accidents. While not a complete solution to the problem, toughening existing SOPs and providing better training in monitoring and cross-checking will help some of the underlying issues. Operators should focus on designing better user interfaces and procedures that address human factors issues and minimise error.

WORKLOAD MANAGEMENT

Proper workload management is a very important non-technical skill that needs to be mastered by all pilots, not just captains. It is important for pilots to know what to do and when to do it. The captain sets the workload pace and prioritisation of work. Although a captain controls the tempo and management of cockpit workload, it is essential that other pilots be aware of their individual workloads and advise other crewmembers if they are getting overloaded. In a good CRM environment, any crewmember should feel comfortable speaking up on any issue, especially if they see dangerous threats developing. Training on workload management should be done throughout training.

TIME MANAGEMENT

Effective time management is an important skill that every pilot has to learn. Training programmes must train pilots to manage time both in normal and non-normal operations. During student pilot training, pilots are taught to think ahead and "stay in front of the airplane." This requires good planning skills and anticipation of what will happen, including anticipating possible threats and errors that might develop.

"Time" can escape pilots and they must appreciate its importance. Time means speed and speed means acceleration. Acceleration can lead to a lack of perception. The faster one goes, the less time one has to recognise threats and errors ahead of time and prevent them. The pilot must be aware when he is losing track of time. He must then re-evaluate, take control of the situation, and handle it safely.

STARTLE FACTOR

Startle helps explain why a pilot can demonstrate proficiency in a manoeuvre during simulator training yet fail to do the manoeuvre correctly when a similar scenario is encountered during flight. During simulator training, the pilot is often expecting the manoeuvre and has discussed and/or studied the procedure shortly before practise. Later, during normal flight, if the pilot encounters the same situation and is not expecting it, he may become startled.

An unexpected emergency or situation in the aircraft can create confusion and other psycho/physiological effects resulting in reduced crew effectiveness. The response of a startled pilot might include confusion, wrong identification of the situation, or possible over-aggressive flight control inputs that could further complicate the situation (such as a stall), or result in an unrecoverable aircraft state. Confusion may also occur between pilots if they have never encountered the situation before, have not been properly trained in CRM skills to handle unknown situations, or do not have procedures in place for handling the situation.

All training programmes should include and address startle/surprise factor. The crew must be trained to suppress the startle response, confirm the situation, then apply measured and proportional corrective inputs during realistic training scenarios to help create an appropriate response to unexpected aircraft states encountered during flight. **The ultimate goal should be to train the crew to manage startle and surprise while effectively recovering the airplane.** Startle training and fluency can be validated simultaneously in one of the critical manoeuvres in an "un-announced" or "surprise" delivery. Rote checklist procedures don't prep for the startle effect – but effective training does!

DISTRACTIONS

Interruptions and distractions usually result from the following factors:

- Pilot/controller or intra-cockpit communications (i.e. including flight crew/cabin crew communications);
- Head-down activity;
- Responding to an abnormal condition or an unanticipated situation; or
- Searching for traffic.

Prevention strategies and lines-of-defense should be developed and trained to minimise interruptions and distractions and lessen their effects. The foundations for an effective line of communication and interaction between all flight crewmembers and cabin crewmembers should be embedded in company policies, SOPs, CRM training and the leadership role of the captain. Strict adherence to the following standards is the most effective company prevention strategy and personal line-of-defense:

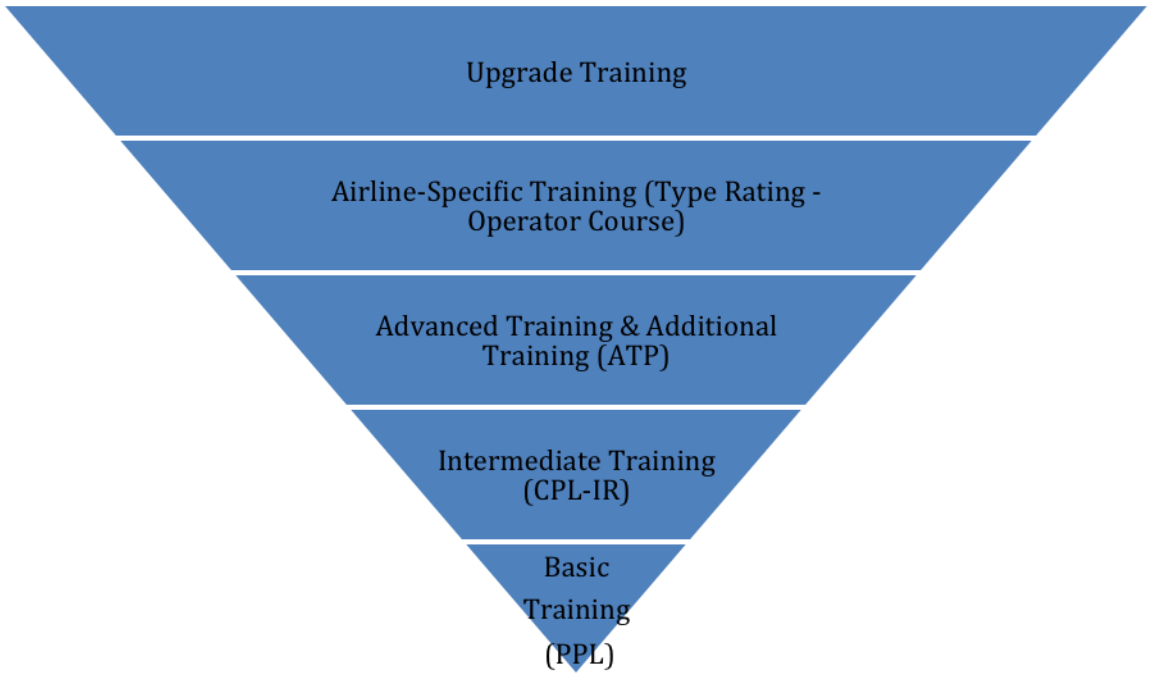
- SOPs;
- Standard calls;
- Sterile Cockpit Rule;
- Recovery techniques such as:
    - Identify – ask – decide – act, or
    - Prioritize – plan – verify.

Training Methodologies

THE TRADITIONAL *AB INITIO* PILOT TRAINING

Traditionally, pilot training has been built on the concept of clearly defined training phases with specific contents and measurable standards that a pilot needs to meet before progressing to the next level. Each step was meant to broaden the pilot's knowledge and enhance his competency to enable him to act as a captain in commercial air transportation. This concept is illustrated in Figure 2:

Figure 2: The traditional pilot training.



The traditional method requires a pilot to successfully complete each phase before progressing to the next one by meeting the flight and license standards at the respective level. The regulatory framework allows the pilot candidate to select each module from a different training provider, at the risk of losing continuity and quality. By meeting the piloting skills and knowledge level for a particular license, a pilot is qualified for the next level. By "training to checking" standards, the

emphasis has not been to assess the individual pilot's overall competence to master the tasks that make up a competent, safe and professional aviator.

A new training concept was conceived that focuses on the global pilot competencies rather than separate training phases. Competency-Based Training is a training methodology that can be a valuable tool to enhance training effectiveness and efficiency, and does not presume the quality of the final product, which relies only on its correct definition.

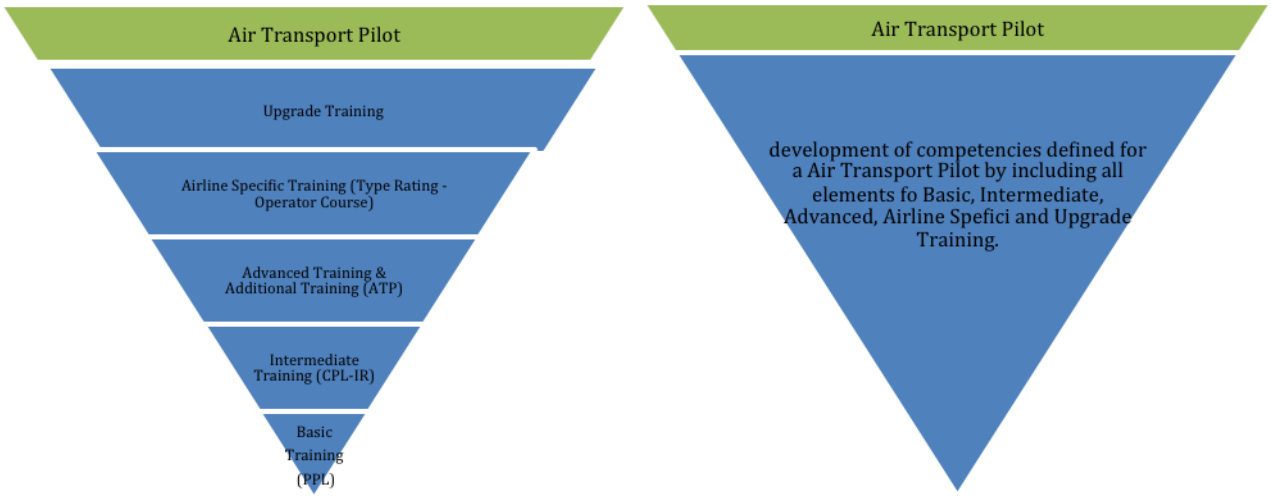
"Whatever the desired product is, competency based training will help produce it efficiently."

In this case, the desired product is a highly professional pilot who is trained to proficiency and equipped with the academic and practical knowledge and pilot skills to successfully exercise the privileges of his license and position. Each phase of training is meant to broaden the pilot's knowledge and enhance his competency to enable him to act as a captain in commercial air transportation.

COMPETENCY-BASED TRAINING

Before considering Competency-Based Training in detail, this alternative training methodology should be evaluated alongside the traditional pilot training pyramid to illustrate the interwoven content of the training programmes.

Figure 3: Traditional Pilot Training vs. Competency-Based Training.



While traditional, time-based approaches to education have met with varying levels of success over the years, it may be a less effective system when the goal is to train individuals to perform specific, job-related tasks. For example: if an active, certified airline pilot attends a 3-week training course to learn to fly a new type of aircraft, will attending all sessions during the course ensure the pilot can fly the plane? Of course not! If the pilot is unable to attend 2 days of the course, does this mean the pilot cannot fly the plane? Probably not. If, after 4 days, the pilot does poorly on a written test, should he immediately fail the course or should the pilot continue with assistance and be given the opportunity to be tested again? If the pilot passes all written tests does it mean he can fly the plane? No! In addition to assessing knowledge, an evaluation of the pilot's skills is also required.

In a traditional educational system, the unit of progression is time, and is teacher-centered. In a CBT system, the unit of progression is mastery of specific knowledge and skills, and is learner- or participant-centered. Two key terms in Competency-Based Training are:

Skill—A task or group of tasks performed to a specific level of competency or proficiency which often use motor functions and typically require the manipulation of instruments and equipment. However, some skills (such as counselling) are knowledge- and attitude-based.

Competency—A skill performed to a specific standard under specific conditions.

Figure 4: Competency-Based Programme Characteristics

Characteristics of Competency-Based Training Programmes

- ⇒ Competencies are carefully selected.
- ⇒ Supporting theory is integrated with skill practise. Essential knowledge is learned to support the performance of skills.
- ⇒ Detailed training materials are keyed to the competencies to be achieved and are designed to support the acquisition of knowledge and skills.
- ⇒ Methods of instruction involve mastery learning, the premise that all participants can master the required knowledge or skill, provided sufficient time and appropriate training methods are used.
- ⇒ Participants' knowledge and skills are assessed as they enter the programme and those with satisfactory knowledge and skills may bypass training or competencies already attained.
- ⇒ Learning should be self-paced.
- ⇒ Flexible training approaches including large group methods, small group activities, and individual study, are essential components.
- ⇒ A variety of support materials are used including print, audio-visual, and simulations (models) keyed to the skills being mastered.
- ⇒ Satisfactory completion of training is based on achievement of all specified competencies.

EVALUATION AND ASSESSMENT IN CBT

Evaluation in traditional courses typically involves administering knowledge-based tests. While knowledge-based assessments can be used in CBT to measure mastery of information, the primary focus is on measuring mastery of skills. In keeping with this, Thomson (1991) reports that the decision to recognise a performance as satisfactory and determine competence should be the basis for success of a competency-based programme. Moreover, Foyster (1990) argues that assessment in competency-based programmes must be criterion-referenced with the criterion being the

competencies upon which the programme is based. Finally, Richards (1985) indicates that simulation and work sample performance tests should include a checklist or some type of rating scale[1].

Training Delivery Methods

There are many training delivery methods available to prepare today's flight crews to perform their jobs safely and professionally. For some elements of training, it is beneficial to have more than one training media to account for differences in learning capabilities between pilots and to further enhance other methods of training. However, there are some elements of training that must be undertaken in the proper training device to produce the most optimal outcome and which are mandated by regulatory requirements.

IMMERSION ENVIRONMENT

Of all the environments that are available to learn how to fly, the immersion environment (flight academy style) is optimal. The advantages of being surrounded by other airmen going through the same experience are invaluable. Without the external distractions of the outside world, the immersion environment allows the developing pilot to live, eat, and breathe flying. Interaction with fellow trainees in a squadron- or hangar-type environment outside the classroom is extremely helpful for a pilot in training to impart or absorb information and share experiences with his peers. It helps accelerate the learning process and allows the training pilot with the most resources to compliment his learning. This environment applies to all phases of training including initial/*ab initio*, type rating, and recurrent training.

CHAIR FLYING TECHNIQUE

This technique allows the training pilot to practise his thought processes, develop cockpit flows, mentally review different manoeuvres, and is a very inexpensive and rewarding method of self-teaching. The best environment for "chair flying" is to have a poster or picture of the cockpit, a quiet room with walls for the visual aids, and a chair at minimum. Some training facilities provide mock cockpits for their trainees to use for this purpose. Mentally preparing for the next day's flying or simulator session using this method is invaluable. It is also an excellent way to mentally review the previous lesson.

BRIEFING/DEBRIEFING (ADEQUATE TIME)

The benefits of a proper pre-briefing and debriefing cannot be emphasised enough. The training pilot must know what is to be expected of his performance and be able to ask pertinent questions prior to each training event. After the training event has concluded, a concise debrief on the training pilot's performance, both the positive and negative aspects, with explanations of ways to improve, is essential. An instructor must also be a good observer and a good listener to provide proper feedback to the student.

[1] Rick Sullivan, Ph.D. – Director, Training Office, JHPIEGO Operation – JHPIEGO Strategy Paper, September 1995

MEDIA-BASED INSTRUCTION

There are several methods of training and it is important to choose the one that best fits the task. New media technology does have its place in certain aspects of pilot training. Presenting pure information is often best done through media where it can then be repeated or stopped as many times as necessary to maximise comprehension. It can present visual and/or aural cues that could not be duplicated elsewhere. It can be used at the discretion of the trainee, in almost any location, and relatively inexpensively. However, it is equally important to understand the limitations of training with media. Providing the opportunity to ask questions or clear up misunderstandings with an instructor is complementary to the use of Media-Based Training.

Electronic Bulletins are one method for distributing an easily succinct message regarding a particular issue with regards to training. For example, checking tire wear on an external inspection with a description of exactly what to look for in an acceptable tire condition. This type of media is used for issues that arise suddenly and need to be rapidly distributed to the pilot group.

Computer-Based Training/Distance Learning education can be accessed in different formats from a pilot's home, company mailbox, email account, or directly downloaded from a company website. It can be used as an interactive tool to download or refresh the pilot's knowledge prior to or between cycles of training. Generally, it should be clear information that will not generate unanswered questions, which can otherwise result in negative training. This method can save classroom time, however, adequate time to address questions must be allocated during a training cycle.

CLASSROOM

Many operators have severely curtailed or eliminated classroom time and have replaced it with Computer-Based Training /Distance Learning. Early in a pilot's training programme, the classroom environment is an integral part of the education process. As a pilot's career progresses and he becomes more familiar with aircraft systems as well as operating environment experience, the balance between classroom and media-based training changes.

In the *ab initio* phase, the classroom environment is crucial to answering questions and imparting knowledge and techniques from instructor to student. Ideally, different training media, including the classroom environment, are optimal. While computer-based and/or distance learning is important to help the early pilot prepare for his training along with written media (aircraft-specific operating manuals, Flight Operations Manual, Airway Manuals, etc.), the classroom is where questions get answered and instructor knowledge is best transferred. As training progresses, pilots find computer-based learning helps refresh and solidify the knowledge that has been learned in the classroom.

In Type Training, the mix of classroom time and Media-Based Training changes as the pilot has now developed the necessary background level of knowledge to have more targeted and specific questions for instructors. A pilot must be allotted sufficient time to prepare prior to arriving to class (such as distributing training materials). Thus, allowing classroom time to be used more efficiently. Classroom time is still a valuable part of the overall training environment and can be tailored to a pilot's needs. Therefore, a pilot moving from one type to another within the same OEM family will need less time than a pilot moving from one type to another in a different OEM family. Some early pilot-tailored classroom training time at this phase can make the transition much smoother and make follow-up training far more effective.

Often, in recurrent training, less academic classroom time is needed and can often be substituted with extra briefing time prior to the start of simulator periods, as the Computer-Based Training is meant to refresh topics that are already familiar to the trainee. Classroom time may be necessary to impart operator-specific information and/or regulator-required information.

OBSERVATION

Observation is a very valuable, cost-efficient method of learning. It is a real-time situation in which the jumpseater can observe the performance of the crew flying and learn how they handle operational issues and work as a team. Most pilots volunteer to ride the jumpseat during training to observe, even though it is not a formal part of the syllabus. Specific information must be provided to *ab initio* pilots to ensure their presence does not detract from the operating crew's performance.

TRAINING DEVICES

It is important, before commencing a training period, that the instructor allows sufficient time for the trainee to get comfortable with the environment (i.e. "building a nest").

Ask the question: "Is this the appropriate device with which to train the task?"

There is no precise answer to this question, as it is an area that can be tailored to a pilot's needs, resource permitting. There are benefits to all the aforementioned training methods for all trainees. Some may review the computer-based media training several times, while others will only do the amount required. Some trainees may need more FSTD time than others, and the Competency-Based Training method is well suited to this purpose. Clearly, some manoeuvres that must be trained need to be practised in the aircraft to give the trainee the proper visuals and motion cues needed to fully comprehend how the aircraft performs.

MOTION VS. NON-MOTION

In some situations, motion cues are beneficial, while in others they are not. Many could be performed either way. "Switchology", or master of checklists and flows can be done without motion. Windshear, low visibility approaches, and many other situations require motion for proper cueing. Instrument approaches, especially in the early phases, to emphasise an instrument cross-check, may not require motion, but in recurrent and later type and ab initio training, motion is very important as it makes the scenario more realistic.

AIRCRAFT VS. FSTD

In *ab initio* training, the use of an actual aircraft is essential for a pilot to have an appreciation for how the aircraft handles. When operating in Visual Meteorological Conditions, a real aircraft gives real-life cues to complete the intended purpose of each scenario. An integral part of the early development of basic flying skills should include an aircraft that allows the trainee to explore the boundaries of controlled flight and how to recover the aircraft from an upset state (stalls, unusual attitudes, high and low energy states, and spins, for example). A glider has been used in some pilot training courses to effectively teach the training pilot how to efficiently manage the energy state of the aircraft. At this early stage in a pilot's training programme, an investment in this type of training will pay huge dividends in later advanced phases of a pilot's career.

For type rating and recurrent, a full motion FSTD with high quality visual fidelity will provide adequate realism for the intended training at a lower cost than an aircraft. The FSTD will also allow the professional pilot to experience many events/situations that could not be accomplished in the aircraft for training purposes.

CHAPTER 4
EFFECTIVE TRAINING SYSTEMS

Instructor Cadre

Instructors play a key role in guiding a pilot toward the successful development of skills and competencies required to pursue the pilot profession. It is essential that an instructor is aware of his responsibility to facilitate the student's development of the required skills and competencies to become an effective crewmember. In order to have the highest calibre of instructors, it is necessary to develop a robust, high-quality instructor-training programme. A well-defined instructor selection process is essential to ensure the effectiveness of a well-designed training system. Prior to the issue of a flight crew instructor/evaluator certificate, rating, or authorization, all instructors or evaluators must hold or have held a license or rating equivalent to that for which the qualification to instruct is being sought. The quality of the graduating student from any programme will largely depend on the quality of the instructor cadre and the training that they have received. Based on this, it is readily apparent that an investment of resources in this area will yield high dividends in the long term.

An outstanding instructor can be defined as one who facilitates a student's development of the required skills and airmanship needed for a pilot's stable and successful lifetime performance. The relationship between instructor and student should instil confidence in an open and direct environment. An accurate assessment of a student's motivation level will help the instructor adapt his training methods to ensure the best learning environment for each individual student. An integral part of instruction also includes teaching time management techniques so that a student can effectively manage his workload.

Training Systems – Introduction to the Training Management System (TMS)

The rapidly changing aviation operating environment requires airlines and member associations to continuously adapt to maintain the viability and relevance of their training programmes. The traditional approach of curriculum construction, largely influenced by what operators and regulators "think" should be trained, is no longer effective. In addition, lack of pilot involvement through their representation contributes to these deficiencies. Furthermore, a decrease in resource availability has also impacted the pilot training programme development and delivery.

These issues have forced a fresh look at training strategies for the future. Businesses and governmental organisations adapt continuously to changing conditions. Modeled after the successful Safety Management System (SMS), the Training Management System (TMS) shows great promise and will deliver benefits to airlines, regulators, and pilots.

The TMS will allow airlines to use a well-defined system to identify, construct, and deliver curriculum that is relevant and fresh, without wasting resources on items that are NOT.

The TMS will allow regulatory bodies and agencies to know that a well-defined process is in place to ensure compliance and quality.

Finally, pilots will have a "seat at the table" when their training programmes and needs are discussed. Pilots will bring a "real-world" perspective to curriculum in addition to relevant data streams.

The TMS is largely based on the core principles of SMS. One way of breaking down TMS concepts is to discuss the three words that make it up: Training, Management, Systems.

The objective of a TMS is to provide a structured management system to control risk in operations. A quality training programme plays a key role in risk management by giving pilots the technical and non-technical tools to minimise risk.

Safety is a managerial process shared by regulators, operators, Authorized Flight Training Organisation, OEMs, and pilots. In order for the pilot training programme to be successful, the education, awareness, and input of all of these stakeholders are crucial. The Training Management System described in this document starts with the design and implementation of organisational processes. Every stakeholder involved in pilot training needs to understand his responsibility in the Training Management System so that each pilot receives the necessary training to be competent and confident in exercising his job.

Pilot representatives must be equal members in the TMS while recognising that airlines retain full responsibility for compliance, and that regulators retain responsibility for oversight.

A system can be described in terms of integrated networks of people and other resources that accomplish some mission or goal: in the case of TMS – quality pilot training for aviators. Management of these system's activities includes planning, organising, directing, and involving relevant parties.

The core components of a TMS include a "Training Action Group" and a "Training Review Board" (TAG and TRB). These two groups operate independently within the TMS in the common goal of ensuring the best possible training for pilots. Both the TAG and TRB are modeled after the SMS-equivalent "Safety Action Group" and a "Safety Review Board". Further information on this can be found in ICAO document 9859.

The Training Management System codifies a "system" made up of well-defined processes where the major stakeholders provide input for both priority establishment and quality control. The Training Action Group uses a data-driven approach to establish training objectives, set priorities, recommend changes, and monitor the effectiveness of changes to the training syllabus. The Training Review Board ensures compliance to stated processes and objectives through the use of anecdotal and technical data review. Regulators, airlines, and pilot representatives engage in frank and honest dialogue within the TMS.

CHAPTER 5

RECURRENT AND CAREER DEVELOPMENT TRAINING

A pilot is expected to continuously maintain and improve his skill-sets throughout his career and should therefore be offered a training environment that allows for career-long development. A description of the characteristics of a professional aviator can help one understand what a pilot must extract from recurrent and development training.

An airline pilot should possess a sense of duty, honesty, and integrity enabling him to lead by example and treat his peers with respect and fairness. Self-discipline and responsibility are driving factors for continuous self-improvement. These qualities enable a pilot to strive for perfection and the safe, secure conduct of any flight.

Besides the obvious need to refresh and enhance the pilot's knowledge of aircraft systems, procedures and operational aspects, it becomes necessary to support him in the development of soft skills that will allow him to become a proficient and professional captain. This requires training and education in leadership through the application of theoretical knowledge and practical experience.

In order to maximise proficiency when flying for an airline, one must consider the time interval between training sessions and determine how to make the best use of the time available for training. Less time checking and more time training is needed to provide for optimal training (this is part of a shift towards Competency-Based Training vs. the traditional method of "box ticking"). A data-driven approach (from multiple sources) should be used to determine what and how often various scenarios should be trained. Recurrent training should not simply be an exercise of "going through the moves". The startle factor should be introduced to represent real, unexpected, critical, high stress situations that will demand efficient workload management and crew coordination. The introduction of new technology and increased automation creates a continuous challenge throughout a pilot's career. As new generations of aircraft are introduced, pilots will need to increase their understanding of automation systems. This will increase confidence in the technology and lead to a better knowledge on where the limits are. This increased confidence will allow the pilot to use the proper skill-set, and quickly shift from one set to another in a given situation. This is a prime illustration of the paradigm shift previously mentioned flight management skills versus stick-and-rudder skills.

The result of recurrent training must be improved skills, improved knowledge, improved proficiency, fluency, and increased confidence.

Prerequisites

A confidential environment must be provided in order to offer both the pilot and the instructor an open line of communication. This open line of communication, made possible through a Flight Operational Quality Assurance System (FOQA), will provide feedback to both the pilot and the instructor on their respective performances. The system can only function under full confidentiality and in a non-jeopardy environment.

The briefing and debriefing parts of the training should be standardised and allow for sufficient time. The pilot must clearly understand what is expected during the training and given feedback on his performance at the end of the event.

Intervals

The IFALPA policy on the amount of recurrent training today states that training sessions should be provided for each pilot at least once every six months and ideally once every three months[2]. However, economic circumstances are reducing the amount of available training. As a result, many airlines are now down to providing only the legal minimum amount of training. In order to keep pilots proficient, increased training is necessary to cope with the complexity of today's air operations. Regardless of the total amount of time available for training and checking, it is clear that LESS checking and MORE training is needed.

There are various possibilities to optimise the available training hours:

- Allow manoeuvre validation checking during training and operations: If the training accomplished in recurrent satisfies an acceptable standard, then less checking is required. Validating exercises during training and operations can free up time during checking which can be used for training scenarios specific for the operator. (e.g. if a pilot has been flying in Autumn for the past months and has done many CATIII landings, he should not repeat these during training and checking as he is clearly proficient.)

- Just as "one-size-fits-all" is not possible due to each operator's specific operations, the amount of training may also be individualised in the sense that it take into account of the individual pilot's experience, pilot background, and abilities. In a confidential environment, the time gained during checking can instead be put toward practising manoeuvres/scenarios that the pilot considers beneficial to increase their confidence level. Pilots should be allowed to have input into their training during the free time of a simulator period.

[2] IFALPA Annex 1 Appendix PEL-A §7.2.6. 1997