THE EVOLUTION OF FLIGHT TRAINING

Jarosław KOZUBA[1]
Vice-Rector for Education, Air Force Academy, j.kozuba@wsosp.pl
Adam RURAK[2]
Head of Safety of Air Transport Department, Air Force Academy, a.rurak@wsosp.pl

   Summary. The article refers to issues related to the development of the approach to pilot training over the time of aviation advance. Based on literature, experts' opinions and personal experience, the author has analysed and specified basic factors that shaped the approach to methods, techniques and tools applied to training civilian and military pilots within four major periods, characterized by the changes in the approach to the training.

   Keywords: aviation, flight training, simulator training.

1. INTRODUCTION

   The history of aviation training, which dates back over a hundred years, indicates that the principles, methods, techniques and tools used in the preparation of candidates for pilots have developed simultaneously with progress in aviation technologies. The changes in area related to aviation technology as well as higher and higher degree of complexity of air tasks executed in a dynamically changing environment require constant changes in aviation training methodologies and professional development of pilots. Another factor which exerts a significant impact on the professional development of pilots is the need to optimize the cost of flight training, the use of means at the disposal of aviation organizations.

   With regard to the changes in the approach to flight training of pilots, E. Z. has identified four basic stages of flight training[3]:
1. The period of learning the job - I know how to do it.
2. The period of simulators - simulator as a training tool.
3. The period of flight safety – the issues of aviation safety as an important element of basic and advanced training of air personnel.
4. The period of dedicated training - training content focused on individual abilities and needs of the trainee in order to achieve supreme professional development - specialist competence in the shortest possible time.

   It should be noted that each of these periods exerts an impact on the current picture of flight training. Obviously, both the presented the division as well as the meritorical content included in them do not cover all the issues related to the training of air pilots. They indicate only the essential changes and factors determining such and no other approach to air training.

   In the following chapters the author refers more widely to different periods of flight training, as well as indicating their advantages and disadvantages, taking into account subject literature, experts' opinions and personal experience.

---

[1] Prof. KOZUBA Jarosław – Vice-Rector for Education, Air Force Academy, j.kozuba@wsosp.pl

[2] Dr of Science RURAK Adam – Head of Safety of Air Transport Department, Air Force Academy, a.rurak@wsosp.pl

[3] S.Z. Kerns, *E-learning In aviation*, ASHGATE, Farnham 2010, pp. 3-10 as well as opinions of aviation experts.

2. THE PERIOD OF LEARNING THE JOB - FROM 1903

Flight training was brought down to acquiring basic skills of performing basic activities related to flying an aircraft – I know how to do it (know-how) and I am able to use it practically during a flight, without the necessity to understand the activities which are part of the process of piloting an aircraft - e.g. making a turn, maintaining specified parameters: altitude +/-100 m, speed +/-10 km/h and bank +/-5 °. The fundamentals of flight training were created by the Wright brothers after the first flight in an aircraft heavier than air on 17 December 1903. In the initial period, the training consisted of two main parts – theoretical and practical training on the aircraft, which was conducted in accordance with the constantly developed model. In practice, the science was restricted to passing knowledge and skills by experienced instructor pilots, until the student achieved a required level of piloting the aircraft. This approach to training was imperfect, which is justified by the causes of death of pilots from the British Air Corps (Royal Flying Corps): During the First World War, two pilots were killed by the enemy during the execution of an air task, eight were killed due to the mechanical or structural defect of the aircraft and the remaining ninety pilots died due to individual shortcomings in air training[4].

Today the main purpose of flight training is to prepare the student to perform air manoeuvres while retaining the permissible flight parameters, specified in the flight training methodology or the flight manual of a specific type of an aircraft. However, modern understanding of this method is much wider. The pilot who undergoes training not only needs to know how to perform a specified manoeuvre and have an appropriate level of skills to execute it during a flight, but also to answer the question why he applied this and not a different manoeuvre. In other words, any activity carried out by the pilot on board the aircraft should be supported by a wide specialist knowledge and skills allowing the full understanding of the rights, procedures, standards, principles and phenomena accompanying control of the aircraft during an execution of the tasks. Talking about specialist knowledge, it is necessary to understand the type of knowledge resulting from specialist subjects, which in the case of flight training are as follows: General knowledge of the aircraft; Flight performance and flight planning, Mass and balance of the aircraft, Man, capabilities and limitations; Meteorology; Navigation; Radio navigation; Operating procedures; Aerodynamics, Flight principles, communications – including aviation phraseology in English, etc.[5]

From the onset of aviation, there has been a debate whether it is possible to create a tool/device allowing, on the one hand, more efficient preparation of the trained pilot to implement practical flight training, and on the other hand, allowing the optimization of training costs. Quite soon it turned out that the simulator is the type of device which meets the expectations mentioned above.

3. THE PERIOD OF SIMULATORS - FROM 1929

It is restricted to learning basic exercises in the cockpit by the pilot and the acquisition of certain habits by means of simulation techniques (flight trainers and simulators). The construction of the Link Rainer - first "professional" - flight simulator in 1929 gave rise to the era of applying simulation in air training[6]. The introduction of air simulators launched learning basic operations related to flying and handling devices and instruments in the cockpit before the beginning of practical training in the air. Initially, flight training was continuously carried out by means of the model of activities in the classroom and practical training in the aircraft. It was enriched with training on a simulator. Over a long period of time, the aim of simulator training was to teach pilotage techniques and to prepare a pilot to perform basic activities in the cockpit. This training was so important, that often training centres did not have training aircraft with a dual control system. The oil crisis in the 70s of the last

---

[4] US Army Technical Manual (1941) – source – P. Renshaw , ATSB Materiały z Kursu Czynnik ludzki, Cambera, Australian Transport Safety (2006).

[5] The meritorical scope of the content of the individual modules of theoretical training depends on the level and type of the license.

[6] It is a fact that the first, so-called "primitive", flight simulator was created by the Wright brothers. However, in the subject literature, the beginning of the era of aviation simulation is assumed to be the date of creation of the Link Rainer simulator .

century led to a situation that the simulator was treated as a tool for the preparation of trained pilots for a full spectrum of activities resulting from a specific air task, and thus significantly affecting the optimization of the costs of basic training and the development of air personnel. In the development of aeronautics, simulators underwent constant enhancement so as to reflect the pilot's working environment as closely as possible. Currently, the simulator is not only a training tool, but also a valuable device which is used in the process of developing and implementation of new aircraft into service. Is also widely used in the process of investigation of aviation events and training other air personnel - air traffic controllers, flight mechanics, etc.

The introduction of air-cooled engines and elements of wings mechanization in the late 1940s and 1950s, the first jet engines and precise approach to landing systems at the turn of the 50s and 60s and ground and air collision avoidance systems, as well as the use of increasingly complex automation systems of the aircraft in the seventies of the last century underlined significant changes in the approach to training and investigating air events. Contrary to common expectations, using new aviation technologies on a large scale did not significantly affect the number of air accidents caused by the so-called human factor. In addition, the role of aviation organizations in the formation of the desired level of security tasks became more and more evident. The identification of procedures to raise the security of executing air tasks marked the beginning of the next era in air training.

4. THE PERIOD OF FLIGHT SAFETY - FROM 1979

This period brought new elements in the process of flight training, giving the students an opportunity to gain/improve knowledge and skills in aviation safety, which form the basis for the preparation and the execution of air tasks at an acceptable level of safety. The date of organizing the NASA Conference in 1979 is considered to be the beginning of the third era of aviation training, when the representatives of the largest airlines of the world started a discussion about an alarming increase in the number of air accidents caused by human factor. The natural consequence of this meeting was to develop the Cockpit Resource Management concept of training, whose primary objective was to teach an effectively use the means at the disposal of the crew (aircraft- non-technical aspects of the application of the devices and on-board systems, procedures, standards and principles and elements related to human factor – management, communication, situational awareness, decision making, following emergency procedures) in order to achieve the desired level of safety and effectiveness of the execution of air tasks. The ingenious nature of CRM training is that it is geared towards the improvement of non-technical skills of aircraft crews, using the knowledge and skills possessed by the crew. In addition, this training from the beginning was focused on the use of experience gained during the events which took place on the particular type of aircraft used in training. The training is carried out on a model - trained pilot and flight simulator, less frequently with practical training on the plane. Along with the introduction of CRM, as a form of pilot training, its certain elements were extended with flight safety training in the framework of individual modules of the training, specified in Part-FCL. The era of security is addressed at adjusting the operator – pilot for dynamic changes with respect to the construction, equipment, systems used on modern aircraft and optimizing the use of personal resources that are at its disposal, taking into account human capabilities and limitations. On the other hand, the work over the issues related to the adjustment of the aircraft to Man are still continued.

Currently, flight training, including the type of training which is conducted at the stage of basic training, is more focused on mastering successive procedures applicable during the execution of an air task rather than the problem-solving and decision making skills by the trainees at the stage of preparation and execution of an air task. The requirements of widely understood aerospace industry with regard to the training of air staff are now much higher. Increasing congestion of air space, more and more complex and demanding technology aviation technologies for pilots-operators, including those used in the aircraft cockpit – automation and an increasing numbers of pilots with "not enough flying hours" employed by airlines, resulted in unprecedented challenges with respect to the training of

this group of air personnel. The question whether it is possible to train "better" pilots in a shorter period of time was asked more and more frequently. The results of abundant studies in this area as well as past experience led to a conclusion that it is not a good idea to limit the hours of training in order to train better pilots in a shorter period of time. It is necessary to reconsider and find new methods of conducting flight training, which will allow increasing its efficiency. Consequently, a new era of aviation training was initiated, the period of the so-called dedicated training.

5. PERIOD OF DEDICATED TRAINING - UNTIL 1990

In accordance with experts' provisions, flight training should be geared towards individual needs and needs for the trained pilot so as to make them achieve excellent specialist development - specialist competence. The method to achieve this is to use an individual approach to the trained pilot. This type of training should be based on individual training schemes, taking into account the pace of mastering "packets" of knowledge and skills, while maintaining time-oriented training standards which relate to different subjects of theoretical training, simulator training and practical training in the air. It means that the most talented trainees should achieve a higher level of expertise, skills and aviation experience in relation to the other course participants while keeping the requirements set by applicable standards. This training is based on three previously described types of flight trainings with one crucial difference. Instead of focusing on implementing strictly defined subjects of theoretical training or the stage of practical training within a certain timeframe, as it is specified in contemporary normative documents, this type of training allows providing the trainees with a broader range of knowledge and new skills in accordance with the presented level of expanded knowledge and air skills on successive stages of training. The students improve their practical skills in areas which are poorly mastered, and do not "waste time" on the execution of the tasks which they perform in a proper manner. The dedicated training resulted in a radical change of approach to aviation training - it is aimed at training in accordance with the requirements, and not on the standardization of training which was previously considered the right one. It should be emphasized that this does not mean a departure from the current procedures, standards or training principles which are described in the relevant regulations. The binding principle therefore is that the organizers of this type of training should regard it as a form which enables the particularly talented trainees to acquire excellent skills, which go beyond the standards set in relation to specific licenses. In relation to the other trainees, the training is limited to the realisation of objectives that are specified in the standards.

Dedicated training confronts the organizers of additional challenges resulting from the transition from the standard, highly clarified training process which takes into account individual achievements in particular stages. It appears that the pattern of modern training was not developed for the sake of training. It was developed for the needs of the division of students into those who master certain skills faster or slower during the training programme. The key question for the organizers at every stage of flight training concerns the level of acquisition and retention of the skills when dividing the students further into smaller groups. In the case of those students who quickly grasp successive elements of training, this method appears to be correct, however, the situation seems less favourable for those who require systematic consolidation of the acquired skills and habits. This dilemma should be resolved by training center instructors, who should take this fact into account in the individual student training program . On the other hand, it is necessary to ask a question whether this way of training, oriented at results achieved by the trainee, should be applied to the basic training, or only at the stage of advanced training. In the available subject literature, there is no answer to this question. Overall, expert opinions and experience of the authors point to the fact that it is extremely difficult to determine the retention of specific habits by the students. Therefore, at the stage of basic training, at least to the Private Pilot Licence (approximately 50 hours of flying), this method should not be applied. It seems advisable to gradually begin its implementation, in particular with regard to the later stages of practical training. This assumption does not apply in relation to the theoretical and simulator training.

Summing up the periods of flight training mentioned above, it should be emphasized that each of the specific areas should not be treated as a form of enrichment of those which are already existing. Thus, when speaking of flight training in the process approach, none of them should be treated as an independent area of training or replacing those which had been defined previously. It seems justified therefore that these areas should complement each other to a greater or lesser extent.

Regardless of the level of training of the pilot, flight training programs ought to take into account the fact that the pilot should be ready to make their own decisions, including emergency situations. The situation in which aircraft are equipped with more and more sophisticated systems and equipment confront the pilot with a necessity to execute increasingly complex tasks. In the light of the above, the pilot who executes an air task needs more and accurately selected information about the status of the aircraft and the task environment. The time required for the perception and analysis of the data provided and to create mental images of the aircraft - situational awareness, has significantly decreased.

Until now, it seemed that the answer to these challenges are the operational procedures, aircraft equipment automation, but the question remains whether they are sufficient. The experience resulting from the analysis of aviation accidents clearly demonstrates that the master command of standard operating procedures (SOPs) is a key condition, although insufficient, for the proper preparation of the pilot to carry out tasks in the air burdened with a high level of risk and unpredictability of the task environment. Also a high level of aircraft automation, which apart from the unmistakable reduction in the pilot's workload brought a series of unprecedented threats, has not proved a sufficient antidote to air events. The high technological level of aircraft and a high degree of difficulty of performed tasks mean that pilots must present creative thinking skills needed to solve new, increasingly complex problems during the execution of flight tasks. Due to the fact that training focused on the preparation of the pilot to carry out predetermined procedures, with the assumption that they can be used only in specific situations results in a situation that quite frequently it becomes a "programmed machine" incapable of creating effective solutions which are related to extreme situations, including the unprecedented ones.

6. ERA OF E-LEARNING TRAININGS

With regard to aviation training in accordance with Kerms, in the age of globalization, the development of the Internet and access to information, the authors also point to an important role in training and science of a currently emerging epoch of e-learning. The authors observe that despite the attractiveness of this form of training and learning, especially in the training and improvement of pilotage skills, it must co-operate and interact with the forms which are currently in use. In the subject literature, there is a similar belief that the e-learning technology alone is not a miraculous means to overcome difficulties faced by training systems. This technology should be used in conjunction with conventional forms of education (lectures, exercises, laboratories, etc.), and not as a substitute method, autonomous in relation to other methods.

The main problem with which we deal with in the process of adaptation of a modular training program into an e-learning programme is a small possibility, or its lack in relation to the learning objectives associated with the formation of practical skills of trainees. Here we deal with the basic practical skills usually mastered by trainees during exercises, laboratory activities carried out within the framework of theoretical training. Therefore, aviation e-learning training, should be complemented by the use of binding forms of training, where the participant might have contact with a specific training device, air simulator, aircraft piece of equipment or the aircraft with which it interacts while training practical skills. With such a form of aviation training, the student has also chances of support from the instructor. The emerging doubts can be resolved almost immediately during classes. With regard to the elements of professional development of pilots, e-learning can be used in a much wider range. It can also be regarded as a form of extending and consolidation of pilots' knowledge and a fundamental tool to verify their theoretical knowledge, in accordance with the requirements specified

by the rules and an aviation organization. It should be stressed that commercial aviation organizations - airline companies, in accordance with EU-OPS-1 are required to conduct periodic training of pilots on flight simulators.

Undoubtedly, the use of e-learning in relation to aviation training has got a number of advantages, including the effectiveness of expenditures on training, the ability to conduct it anywhere on the earth, its availability for 24 hours a day, the use of interactive exercises, the possibility to ensure standardized training among instructors in the whole organization, quick and easy access to information concerning the results of training, also through tests. When planning this type of training, it is necessary to remember that none of the above-mentioned advantages will function if it is designed without the creation of appropriate instructional training principles and without its adaptation to specific expectations of the trainees and the aviation organization. On the other hand, we can also find a number of drawbacks in e-learning training, i.e.: the training design and its implementation may cost far more than the expected savings, the lack of direct contact with an instructor, the success of training depends on the skills of the students and their persistence, a high degree of motivation and skills of personal management. In addition, much higher requirements are imposed on the personnel of the organization with regard to knowledge and skills connected with the creation and implementation of this type of training.

Ironically, e-learning courses, which were designed, among others, to make savings in the long run can be extremely expensive and not particularly efficient. Numerous examples show that improperly designed e-learning is a common practice in air organizations. The organizations wish to reduce the expenditures on courses, in any possible manner, undertake trainings courses using e-learning methods without full understanding of how to design a particular training program in order to achieve the expected objectives. The most common practice is simple adjusting materials from a residential course into an e-learning course. Typically these activities are narrowed down to posting presentations used in a residential course on a website and later using a special programme to check students' knowledge. Very rarely, the presentations and training materials are processed into a typical e-learning course. In view of the above, it seems likely that the course participants will reach lower levels of knowledge and skills in relation to those who have acquired this knowledge on a residential course. In addition, a poorly-designed e-learning program may discourage those undergoing training to treating it as an essential training material, and in extreme cases it can lead to the interruption of training.

To sum up, e-learning should not be a substitute for academic training just like practical training in the aircraft should not be superseded by simulators . E-learning does not guarantee conducting full training without the support of very-well experienced instructors. The organisations which select this method of training should revise the level of skills of individual instructors employed in this aviation organization, taking into account the requirements of e-learning. No modern technology is capable of replacing the instructor. Training effects will always be dependent on the skills of instructors which, quite possibly can become evaluated through the level of knowledge and skills presented by trainees on completion of the course. E-learning should not be seen as a tool that can completely replace classroom activities. It is at the disposal of an air organization and an instructor in order to raise current training effects. A well designed and implemented e-learning training programme can serve as an effective supportive tool, however, it does not replace previous classroom training.

7. CONCLUSIONS

Regardless of the above deliberations relating to flight training, it should be stressed that the undoubted downside of the applicable flight training methods is the fact that in some areas (e.g. theoretical training) they are based on adjustment and subordination to procedures which have been binding over a long period of time. Too often they are restricted to student sitting and quietly following instructor's commands. The question may be asked whether in such conditions, it is possible

to teach trainees initiative and creative thinking which are indispensible for the execution of increasingly difficult air tasks, demanding particularly high requirements with regard to the implementation of the process of situational awareness. Taking into account the previous considerations, it seems that is not the case. Therefore, changing the content of the teaching aids and materials seems to be insufficient, as the highly-structured existing system of flight training discourages the students from taking the initiative and approach a problem in a complex manner.

References

[1]   Baylis J., Witz J., Gray C.S., Cohen E., Strategia we współczesnym świecie. Wprowadzenie do studiów strategicznych, Wyd. UJ, Kraków 2009.

[2]   Friedman G., Następne 100 lat. Prognoza na XXI wiek, AMF+, Warszawa 2010.

[3]   Friedman Th., Świat jest płaski, czyli historia XXI wieku, REBIS, Poznań 2009.

[4]   Hać R., Kozub M., Rurak A., Udział lotnictwa w operacjach połączonych pierwszych dekad XXI wieku, Wydawnictwo WSO SP, 2012.

[5]   Kaku M., Fizyka przyszłości. Nauka do roku 2100. Prószyński i S-ka. W-wa 2011.

[6]   Kerns S.Z., E-learning In aviation, ASHGATE, Farnham 2010.ň

[7]   Rajchel J., Rurak A., Model funkcjonowania profesjonalnych sił zbrojnych w społeczeństwie XXI wieku, Zeszyty Naukowe Wyższej Szkoły Oficerskiej Wojsk Lądowych, Wydanie Specjalne, Wrocław 2012.

[8]   U.S. text Army Technical Manual (1941) – source – P. Renshaw , ATSB Materiały z Kursu Czynnik ludzki, Cambera, Australian Transport Safety 2006.