

SIMULATORS AS A SUPPORTING TOOL IN THE TRAINING PROCESS FOR NEW SPECIALIZED PERSONNEL

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Abstract. The article deals with problems related to the application of simulators in training and describes the current role of simulators in preparing new specialized personnel in many industries. The author presents the possibilities of using simulators in the training for pilots, motor vehicle drivers, and train drivers. He points out to the benefits of using modern simulation systems.

Keywords: simulators; flight simulators; motor vehicle driving simulators; locomotive driving simulators; flight training; motor vehicle driving training; locomotive driving training

1. INTRODUCTION

The use of simulators as tools supporting the process of mastering the operation of various complex devices is becoming more and more widespread. There are many reasons for that. The main of those reasons is the necessity to maintain an appropriate safety level of the training and to reduce its costs. Training safety is extremely important, particularly when the risk of an error committed by a trainee may result in a fatality or serious personal injury, as well as in serious property damage.

Along with the development of information technology, training centers which use simulators are able to introduce more and more perfect tools that enable them to expand their training offer. The development of technology has positively increased the processing power of computers. It allowed, i.e. to use computer generated imagery (CGI) making the simulated conditions of the task practiced more realistic. The benefits of using simulators are appreciated in many industries, including such as aviation and road or rail transport.

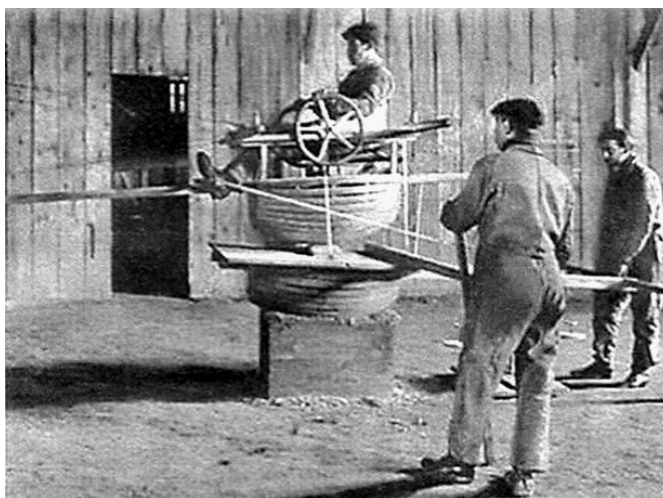


Figure 1 AntoinetteTrainer

It should be stressed that the application of simulators has become a very important element of training in aviation. Already at the beginnings of aviation history, it was necessary to look for better

ways of preparing pilots for safe operation and handling of aircraft. Flight training devices have developed with the development of aviation. Better and more modern aircraft required better and more advanced training devices. This is why training devices used in aviation have come a long way, from simple trainers such as the *Antoinette Trainer* (Figure 1) to the most technologically advanced flight simulators of the Full Flight Simulators (FFS) category (Figure 2).



Figure 2 Boeing 737 CL Simulator

A list of benefits of their use expanded with the development of simulators. Again, the first benefit to be mentioned is the safety of training. In aviation, many flight scenarios are possible to be trained only with the use of a simulator. These are, i.a. the scenarios which prepare aircrews to perform correct actions in the event of dangerous, emergency situations. A good example of that would be training the aircrew how to deal with an engine fire in various flight phases, or with a fire on board. Another benefit of using simulators is a reduction of the training costs. An hour of simulator training costs much less than an hour of flight training using a real aircraft. When we take into consideration various aircraft, we may assume that the higher the operating costs of the aircraft (the amount of fuel consumed, and the cost of the aircraft's use per its lifetime), the larger that difference will be (in favor of simulators).

Apart from increasing the safety of training and reducing its costs, an equally important advantage of using simulators is their high training efficiency. Owing to the application of modern simulators, which accurately reflect the flight conditions, pilots' knowledge and skills become comparable to the effects achieved in flight training. Furthermore, a simulator gives more possibilities to the instructor who may repeatedly return to the elements of the flight causing difficulties for the trainee pilot, without the necessity to repeat the entire flight. The instructor may also "freeze-frame" the flight, to indicate and discuss, in real time, significant errors committed by the trainee. This eliminates the risk of the trainee being distracted by the instructor's comments, which could be the reason for his committing further errors (domino effect). It should be stressed that there are more benefits of using simulators in the training process. Apart from those mentioned above, simulators also provide the opportunity to conduct the training, irrespective of the weather conditions being a major limitation in aviation. Conducting flight training when the weather conditions are below the allowable minimums is not only unreasonable but prohibited by law in the first place.

The simulator gives the opportunity to practice flights in various simulated weather conditions. Owing to that, simulator training can be conducted without having to wait for the right weather, which would be impossible in real conditions. Moreover, it should be noted that weather has a great impact on the smoothness and dynamics of training, and, what it involves, also on the effectiveness of the whole training.

An important advantage of the use of simulators is also the fact that they offer the trainees the opportunity to learn from their own mistakes. In order to avoid the risk, the instructor does not have to react immediately to the errors committed by the trainee. The instructor's reaction may be delayed so that the trainee may verify the effects of their decisions or actions, as learning from errors brings the intended training effects sooner. Simulator training consolidates the correct habits and actions of the pilot, which is necessary to conduct flights in a safe and professional manner. A simulator is also a good tool to allow the trainee to master the optimum attention distribution in various flight phases. The ability to receive and analyse all data, from on-board instruments and from the environment outside the cockpit (situation in the airspace, radiotelephony correspondence, etc.), is the basis for making correct decisions, which is a requirement to ensure an adequate level of flight safety. The simulator is also invaluable in analysing the causes of air accidents and developing procedures for the proper actions of aircrews. It is extremely important in avoiding similar safety occurrences in the future. Because of the procedures developed in such a way, aircrews can train on a flight simulator actions to be taken in the event of similar threats.

2. SIMULATORS IN FLIGHT TRAINING

Taking into consideration the advantages of using simulators, it is obvious that the aviation industry has extensive experience in their use. The application of various types of simulation devices is necessary both in the training and in professional development of pilots throughout their career. At the initial stage, simulation devices are used for verifying the predisposition of candidates for being pilots, then they are used by them in learning and mastering the skills required, and, finally, they are used for the training and professional development of the trained pilots. While the use of simulation devices to verify the predispositions of candidates for being pilots is not widespread in civil aviation, it is an important element of selection of candidates in military aviation.



Figure 3 "Selekcjoner" Trainer

In the Military University of Aviation in Dęblin, the "*Selekcjoner*" [Screener] training device (Figure 3) is used for verifying the candidates' predispositions for the studies in Aeronautics in the Aircraft Pilotage specialization. Training devices and flight simulators are widely used in instruction and mastering flight skills. In flight training for civilian or military pilots, simulators may be used to a varying extent, depending on the tasks to be performed.

The most commonly used in mastering the IFR flights are Basic Instrument Training Devices (BITD) (Figure 4). These devices do not support outside view visualization features, but they give the opportunity to learn and master basic flight maneuvers, multitasking skills, interpreting instrument indications, basics of radio navigation, and the fundamentals of procedural flights.



Figure 4 Basic Instrument Training Device (BITD)

After the basic skills have been mastered by the trainee, the next stage of training requires the use of more advanced training devices of the Flight and Navigation Procedures Trainers (FNPT) type (Figure 5), which, additionally, have cockpit instrument replication and outside view visualization features.



Figure 5 Flight and Navigation Procedures Trainer (FNPT II)

In advanced air training and instruction, more technologically advanced simulators of the Full Flight Simulators (FFS) category are used. They visualize the maneuvers performed by the aircraft, and provide the sensation of flight dynamics by imitating the motion sensations.

3. SIMULATORS IN MOTOR VEHICLE DRIVING TRAINING

The benefits of using training simulators have also been noticed in the automotive industry. They are used mainly in the training for professional drivers, i.e. drivers of buses and large trucks. The use of training simulators in motor vehicle driving training centers (Figure 6), resulted in – first of all, – the increase in the safety level for both instructors and trainees, the reduction of the training costs, and the 40 ÷ 50% reduction of the training duration.



Figure 6 Motor vehicle driving training simulator

In the in adopted EU regulations, the European Parliament includes the use of training simulators in motor vehicle driving training. The regulations specify that in order to obtain the appropriate ratings a driver ought to complete a training course. A course and pre-qualification test may be used as an example of including the possibility of using simulators in such training. It comprises 280 hours and at least 20 hours of that is spent driving a given class of vehicle. Furthermore, 8 of those 20 hours is a training of driving in various weather conditions and at different times of the day or night. The regulations state that during those 8 hours a trainee may be assigned to drive a vehicle in a particular terrain or take a high-class simulator training. Such driving courses and tests may be organized in training centers approved by the competent authorities of an EU Member State.

It is worth mentioning that simulators are also used in motor sports. In preparing their drivers, Formula F1 teams use simulators modeled on their cars. Owing to that, the driver trains the mastery of operating and using the car controls. He learns the track at which the race will take place in order to get acquainted with the car's capabilities, and to "feel" e.g. when to start braking before a corner and in which gear to negotiate it. All the capabilities of the simulator are used to prepare the driver for competition at the real track, so that he may achieve the best results. Technologies available on the market already provide a lot of potential for the comprehensive use of training simulators, and the continuous progress in that respect will bring ever more perfect solutions.

4. SIMULATORS IN LOCOMOTIVE DRIVING TRAINING

As in other modes of transport, the use of training simulators has also been noticed in rail transport. In Poland, already before World War II, a simulator (Figure 7) was built at the Central Training Center for Train Drivers, which was used by the Polish State Railways Center for Psychotechnical Studies to test train drivers.



Figure 7: Steam locomotive simulator

In the railway industry, the factor having an impact on the decision to introduce simulation devices into training was also the necessity to optimize it, i.e. to reduce training costs and raise its safety level. According to the legal regulations in force in Poland, train drivers' practical skills were to be improved using a railway vehicle simulator, and the employer was obliged to organize professional development training and periodic tests at least once every 4 years.

Actions taken by the European Union in that respect have contributed to the harmonization of formal and legal solutions regarding the use of simulators in training in the Member States. As a result, Poland introduced the regulations according to which each train driver is obliged to participate in a periodic training using a railway vehicle simulator (Figure 8) at least once a year.



Figure 8: Locomotive simulator

The use of simulators makes it possible for the trainees to learn and master the correct use of locomotive control mechanisms and also the correct observation and reading of indicators. This allows the trainees to master practical skills and habits necessary to drive trains correctly and safely, and learn in practice the procedures to be followed in the event of non-routine events or failures of systems and vehicle installations. The use of simulators is an invaluable tool for verifying the academic and practical knowledge of train drivers.

5. CONCLUSION

Rapid technological development in many areas places increasing demands on new specialized personnel. For academic instruction it would be enough to have a well-equipped classroom, lecturer, and a curriculum with set learning objectives, as well as a set of criteria for assessing the knowledge mastered by the trainees. A good specialist, however, has not only specialist knowledge but also practical skills. Thus, it is important that the preparation of specialists should include both academic instruction and practical training.

The development of tools used to simulate the operation of various devices or machines allows the trainees to learn how to use them in real life. It is possible to carry out the training without taking the risk of the loss of life or personal injuries of the participants. Owing to simulation tools it is also possible to avoid property damage that could arise during the practical training involving the use of real devices or machines for the operation of which the trainee is prepared. The preparation of pilots, motor vehicle drivers, or train drivers without the use of modern simulators is difficult to imagine. They provide opportunities not only for specialist instruction and training, but also for verification of practical skills.

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Figures:

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Figure 2: **Boeing 737 CL Simulator**, Source: <http://www.balticcaa.com/pl>, Access on 06 April, 2020

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