

# THE TARGETED TRAINING OF THE STUDENTS ENROLLED IN AERONAUTICAL PROGRAMS

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## **ABSTRACT**

There are considered the training process as the feedback system and its components, the reasons of the disagreement between input and output “signals” of the system. The several ways for improvement of the training are considered briefly and more detail-“the targeted training”.

There are discussed the tasks of the targeted training (acquisition of knowledge non-fixed in the textbooks, use of modern equipment installed at the industrial companies, motivation of the students, reduction of duration of adaptation to solution of the engineering tasks, etc.) content of the targeted training conducted by Moscow aviation institutes and the different forms of it. The efficiency of the targeted training, in particular the decrease of the duration for adaptation of students is considered too.

## **KEYWORDS**

Targeted training, integration of the training with the industry, competencies, motivation of students, work in a team, standards of CDIO.

## **THE TRAINING AS THE FEEDBACK SYSTEM**

The training of the future specialist is oriented on active acquisition of the modern knowledge in different subjective fields. It requires the qualified staff, laboratories with the modern facilities, curriculums, textbooks etc. All these elements have to be associated each other in the process of training as the elements of closed-loop system. This system has to correspond to the requirements of agreement between the input and output signals, as any other system.

Main elements of any technical closed-loop system show on fig. 1 are the controller, actuator, controlled element, sensors.

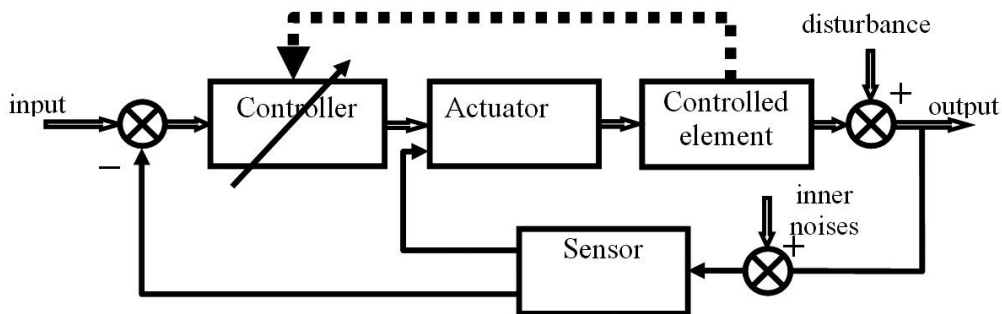


Figure 1. Closed-loop technical system

In case of change of conditions of operation, or parameters of system elements, the controller has to adopt its parameters providing the tracking of input signal with high accuracy. The reasons of disagreement between input and output signals are the inner noise and disturbances, non-accurate tuning of controller parameters, possible non-linearity's in actuators and sensors, variability of controlled element characteristics.

It is possible to show that training can be described with help of the closed-loop system too (fig. 2).

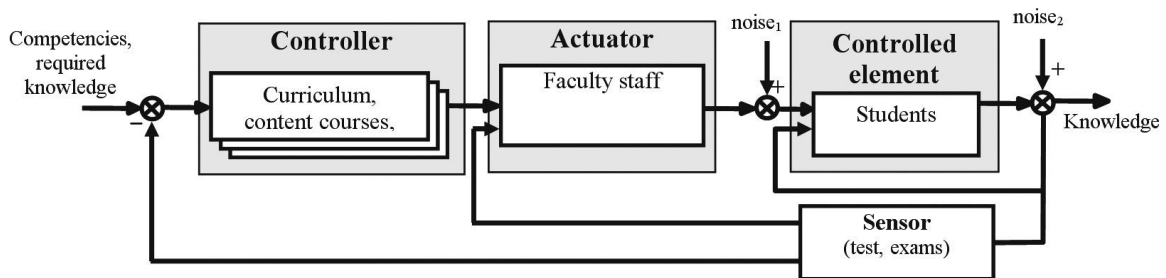


Figure 2. Training as closed-loop system

The input signal here are the competencies (required knowledge) which student has to get in the educational process.

The role of controller plays the curriculums, content of courses, facilities. The faculty staff is practically actuator of the closed-loop system, the controlled element and sensors are the students and exams correspondingly. The sources of the noises in this system are:

- old equipment, non-perfect way for the presentation of lectures and organization of the training ( $noise_1$ );
- motivation of the student, week knowledge of the secondary school curriculum and individual peculiarities ( $noise_2$ ).

The reasons of disagreement between input and output signals of the considered closed-loop system are:

- disagreement between curriculum and real content of the courses, not reflecting the required level of knowledge;
- low qualificational level of the faculty staff;
- imperfect way for the evaluation of the student knowledge.

All elements of the system have to modify periodically for improvement the results of education. For example the curriculums have to be adapted to the current level of knowledge. The staff and industry have to participate in this process. Except it the required competencies also have to be discussed with representatives from the industry and have to be changed in case of necessity.

## Ways for the improvement of the training

Developed many principles of training system developed at MAI in the past and modified several times correspond completely to the main standard of CDIO.

The main ways for improvement of training process from our point of view are the following:

- tight integration with the industry;
- active involvement of the faculty staff and students in research process;
- usage of the modern facilities;
- “targeted” training of the students.

The integration of universities and industry was developed quite a long time and it has different forms. In general it might be presented with help of the flowchart show on fig. 3.

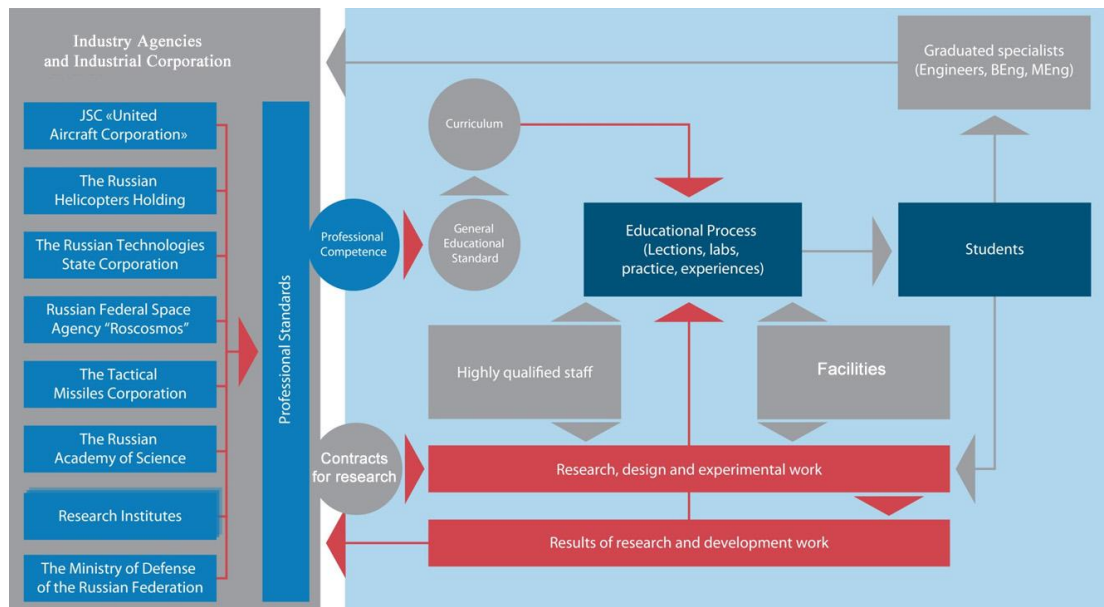


Figure 3. Integration of university and industry

The organization of educational process is based on professional standards developed by team uniting the representatives from industry and faculty staff. About 10 professional standards for the training of the aeronautical engineers were modified in the last several years. Such tight and constant work with the business community corresponds to the 12 CDIO standard. Each developed professional standard contains the competencies which a future specialist has to have. On the basis of these documents the educational standards are formulated where the description of knowledge in the block of courses (humanities, fundamental, general technical and special) are given. Recently the educational standards were formulated by the Ministry of Science and Education. Because Moscow aviation institute received the new status – National Research University, we received recently the rights to develop the educational standards by ourselves. Such standards are developed now and they are the requirements for the curriculum for the different specialties and the programs of the different courses. Such work corresponds to the 3-rd standard of CDIO and we plan to finalize it to September 2014. The curriculum include the obligatory industrial immersion of students by holding the practices at the industry. The curriculum for specialist’s program contains 36 credit hour totally for such practices. As for the bachelor programs they have twice less hours for practices. In any case such system existed at MAI since eighties of last century corresponds to the CDIO standard 5. The practical work at the industry gives the

students the experience to work on real engineering tasks to get the skill of team work. One of the practice is the flight practice. It is carried out at MAI aviation center located 100 km from Moscow, where we have the airfield and 5 airplanes. During this unique training program the students acquire knowledge of piloting, ground operation of plane, they reduce the recorded in-flight data to estimate the flying qualities and to compare them with the requirements. The close relationship with the industry includes also the participation of representatives from the industry in educational process and execution of research by faculty staff on contracts with the industrial enterprises. About 70% of the total sum which MAI receives for the researches is from the industrial companies and 30% from the different grand and research programs. Active work of faculty on contracts allows to increase their professional level what agrees with the 9 CDIO standard. The results of the staff activities are the new basic and applied results of research for practical use in industry. The previous versions and current curriculum were developed with taking into account the requirement of acquisition of systematic knowledge by students. It allowed them to understand that any design element is the element of the big system. Such education corresponds to the 3 CDIO standards.

Except these principles of education the others were offered in different periods of MAI history and used widely now in training process.

Since 1980 the course "Introduction to aeronautical and space engineering" was added in curriculum of all students of MAI to give them the bridge to the engineering courses which will be studied later. This principle corresponds to the CDIO standard 4.

Each department of the MAI has its own laboratories equipped with the modern facilities, where the students can carry out the experiments, research and to get the practical skill in developing of theory. The institute has also and interdepartment laboratories "resource center" having the highly cost equipment and conducting the training for the students of different specialties. There is realized so-called "the through" principles of training corresponding to the requirement of integrated principle of education (7 CDIO standards). The undergraduate students design some construction elements (details), then to draw it with help of 3D graphic software, to develop the software for CNS machine, to manufacture it and finally to check the sizes of the detail. The graduate students realize such integrated type of training by development of models for wind tunnel tests, execution of the experiments on definition of aerodynamic characteristics, development of aircraft mathematical model with help of MATHLAB/Simulink and ground-based simulation for the evaluation of flight qualities of designed aircraft.

The specific place in improvement of education has so-called targeted training.

### ***Targeted training of the students***

The main goals of the targeted trainings are:

- to give the students the non-fixed in the textbook knowledge;
- to increase the motivation of the students to acquisition of the knowledge, to reduce the time for adaptation of alumni to solution of complicated engineering tasks;
- to improve the level of education;
- to create the stable long duration relationship with industry.

The content of the targeted training is the following:

- modification of the course contents, development of new courses included the modern approaches, technologies and technique training of students by use the modified curriculums agreed with industry;
- participation of representatives from the industry in training process at universities or on companies sites;
- training to the new programs (specialties) necessary for the industry;

- training of students on the new multidisciplinary curriculums;
- work with secondary's students (orientation) on selection of the candidates for the undergraduate students.

A number of forms of such type of education are existed. The main of them are the following:

- organization at MAI specific departments ("basic departments") on initiative of industry with organization of training process at MAI and industry sites simultaneously;
- organization of the MAI training centers at the industrial enterprises;
- professional training of students at the companies and research centers;
- education according to the contracts between industrial company and student. This form supposes the inclusion of some additional courses in curriculums;
- partial work of students at the companies according to the personal contracts;
- realization of competition for the secondary school students, organization of specialized teams for design at school.

Some examples of successful realization of such targeted training form are given below.

One of them is carried out at the department "Preliminary design of aviation complexes", founded at 1974 at MAI together with GosNIIAS (State Research Institute of aviation system). The main research and development area of this institute is development of requirements and design of aviation system as the complex system (transport, military, etc.). This department realizes the following principle of training:

- 1 and 2 years of education is realized at Moscow aviation institute with partial participation of GosNIIAS staff in the delivering of several courses;
- The training at the 3-rd year of training is carried out at GosNIIAS one day in a week;
- 4 year – the students spend 2 weeks at GosNIIAS;
- 5 year – the students spend 3 week at GosNIIAS.

The Diploma project is carried out on the GosNIIAS research topics with consultation by one of the GosNIIAS scientists. Because of the students at the third year of training are involved in the real researches, their work is paid according to the contract signed by the GosNIIAS and students. According to the opinion of this institute's administration and research staff the positive result of such principle is the potentiality of the student to solve the engineering tasks by himself to the end of training.

The targeted training is carried out at the "Helicopter Design" department too. All students here are carried out the course projects and diploma work in companies of Helicopter Holding: Mil and Kamov companies. The key and well-known specialists of these companies deliver the lectures according to the curriculum in the new, well-equipped educational center builded by the Holding. Except it the students have the possibility to work on contract. The best students involved in the targeted education at the Mil Company have the Mil stipend from the company.

Implementation of the targeted training principle in Helicopter Holding's companies started in 2003 and led to that about 90% of all alumnus continue their work at the companies after the education at MAI.

Long-term and carefully thought form of targeted training is created in aviation company "Sukhoi". Here together with MAI was developed the whole system for training of the students educated in special groups of targeted training.

The theoretical part of curriculum is added by specialized courses for these students and additional courses which are different for the different individual training trajectories. Such courses, general for the different trajectories, are:

- Fundamentals of military and civilian aircraft and its system design (1-2 year);
- 3D design in Unigraphics system (2-3 year);
- Language of business communication (2 year);

- Standards on development, manufacturing, tests of civilian and military aircraft (3 year);
- Modern technology and production (3-4 year);
- Professional English (3-4 year);
- Peculiarities of design of the modern military and aircraft design (3-4 year);
- Computer added design, CAD/CAE systems (4 year);
- Technological-economy analysis (4 year);
- Fundamental of management (4 year).

Three individual training trajectories are realized now, on the fifth year of education:

- 1) Engineer on program “aircraft design”. The students trained on this trajectory have the additional courses on preliminary design, stealth technology, design of construction from composite materials etc.
- 2) Specialist in “after sale service”. The students trained on this trajectory have the additional courses of certification, standardization, logistic, project management etc.
- 3) Specialist on computer design. Students trained on this trajectory receive the second educational program on IT-technology and Moscow State University (school of calculated math). This program includes programming, simulation, data bases etc.

Sukhoi Company gives the possibility for the MAI students to work at their different departments and to participate in the real projects on modernization or development of perspective aircraft. The students involved in work on real projects and demonstrated successful results have the considerable income (fig. 4) and are motivated to stay at the company after the education.

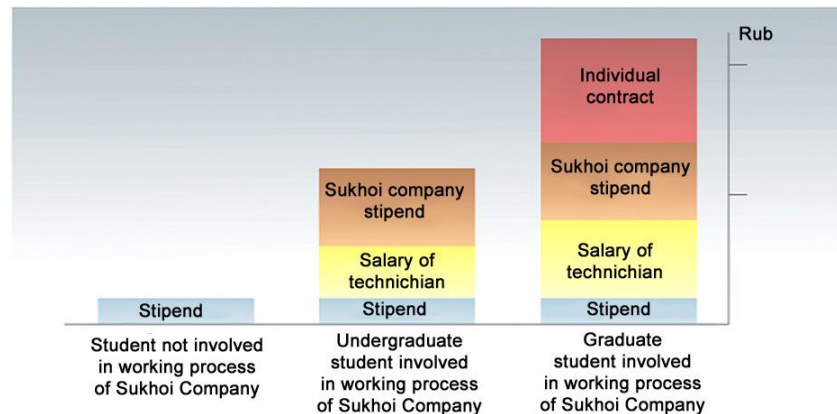


Figure 4. Motivation of students

Comparative analysis of the duration for adaptation of alumnus to engineering work of the students from the targeted group and from the common form of education demonstrated that the first group can carry out it independently considerably earlier. The difference is approximately 2.5 year.

## CONCLUSION

The different forms of cooperation between industry and technical universities allowed to realize many principles of CDIO and to improve the professional level of faculty staff, to motivate the students to the work in the team and their interest to engineering work and research, to use actively the qualified staff working in the industry in the training process to

modify the curriculum and programs of courses including the new technology, innovations, challenges.

The target training developed at MAI allowed to synergize these effects. It has the different forms but in all of them students spend more time at the industrial companies participating in realization of the real projects. This work is correlated with the curriculum. Such immersion of students in the industry allows to improve the professional skill of students and leads to decrease of time for adaptation of the young engineers to self-depended work.

## **BIOGRAPHICAL INFORMATION**

***Geraschenko Anatoly N.***, Ph.D. of Sc. Is the rector of Moscow aviation institute. The head of association of the Russian aerospace universities. The author of a number of the books on the improvement of the training process. His current scholarly activities are associated with improvement the system of higher engineering education at Moscow aviation institute and in other Russian universities.

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