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MODERN DIGITAL EDUCATIONAL AND TELECOMMUNICATIONS TECHNOLOGIES IN VOSTOCHNY COSMODROME PERSONNEL TRAINING

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Abstract

The significant remoteness of the Vostochny cosmodrome from the leading scientific and educational centers of Russia causes a number of difficulties in forming professional teams that ensure the implementation of priority tasks for the development of the Russian space industry. The increase in the launch capacity of the Vostochny cosmodrome, the rapid commissioning of the launch complex of the heavy-class Angara launch vehicle creates an increased demand for specialists in the space industry in general and for specialists in the operation of information and telecommunications systems and complexes of the cosmodrome, in particular. The recruitment of the personnel of the Vostochny cosmodrome is carried out, firstly, by attracting and retaining specialists from among the residents of the region, secondly, by young graduates of educational institutions in the region, and, thirdly, by the personnel reserve of the Baikonur cosmodrome, which has real experience in the space industry. The leading educational institutions of the country that train specialists in infotelecommunications are usually located in the European part of the country. It is to be recognized that there is a problem in completing the Vostochny cosmodrome with highly qualified personnel, the solution of which can be based on the use of modern telecommunications and digital educational technologies for remote training of personnel without distraction from the place of performance of official duties. The article is devoted to solving the problem of training highly qualified specialists in operating information and telecommunications systems and complexes of the cosmodrome.

Keywords: Vostochny cosmodrome, information and telecommunications systems, educational centers

1. Introduction

The need to ensure the security of the state in the space sector has determined the need for the construction of a new cosmodrome on the territory of the Russian Federation. In turn, ensuring the safety of civilian infrastructure, as well as a number of strict environmental requirements during the launch of space rockets formed the basis for the decision to build a cosmodrome in a region of the Far East remote from the main infrastructure of the state (Radionov, et al., 2013; Sevastyanov, 2016). At the same time, the nearest large city with the potential for staffing is located approximately 200 km from the cosmodrome. A number of issues of everyday life and remoteness from infrastructurally developed areas forced the leadership of Roscosmos to resolve issues of personnel policy, firstly, at the expense of qualified personnel of the Baikonur cosmodrome, and secondly, by opening appropriate training areas at the Amur State University, and in- third, at the expense of motivated youth from among student construction brigades. This policy led to the development of a situation characterized by the forced acquisition of practical work experience without basic theoretical training corresponding to this experience, which in some cases led to a decrease in the quality of the tasks for the preparation and launch of space rockets from the Vostochny cosmodrome (Fadeev et al., 2012). On the other hand, the main scientific and educational centers, which are usually located in Moscow and St. Petersburg, have difficulties in implementing the requirements for providing highly practical competencies in the training of specialists in operating infotelecommunication systems and space complexes due to the significant remoteness from the objects of ground-based space infrastructure.

2. Problem Statement

The assessment of the quality of training of specialists was carried out on the basis of an analysis of the fulfillment of accreditation indicators of a number of leading universities in the space industry (Fadeev et al., 2018). It was shown that the existing system of training specialists in operating infocommunication systems and complexes of the Vostochny cosmodrome does not allow achieving the goals of the Federal State Educational Standard in development of the required professional and professional-specialized competencies.

Among the main reasons for this, the weak practical orientation of the taught disciplines and a strong gap between the high theorizing of lectures and the low degree of use of technical teaching aids and modern telecommunication equipment during practical classes were highlighted.

An analysis of the experience of introducing digital distance technologies into the educational process of educational technologies allows saying that, as a rule, the process of distance education comes down to the independent study of text and video materials by students posted on the Internet. In rare cases, the development of digital learning platforms provides the development of practical skills in working with modern telecommunications equipment.

Thus, we can talk about the problem of ensuring the required level of competence of specialists in the field of operation of modern information and telecommunication complexes based on the use of digital remote technologies that have already become standard (Kumar et al., 2018).

3. Research Questions

Among the directions of development of the modern digital educational environment for specialists in the operation of infocommunication complexes, the next can be distinguished (Opryshko & Poznina, 2014):

1. Creation and development of "online courses" providing equal opportunities for access to electronic educational resources for all Internet users (Open education, 2021; Osinina, 2018). The main drawback in the implementation of this direction is the lack of elaboration of practical professorial competencies of a specialist, based on an independent study of theoretical material. For a number of professions of humanitarian orientation, this approach can certainly be used, however, for technical specialists experience in solving practical problems on specific equipment is required.

2. The issue of the development of practical professional competencies is worked out more deeply in the framework of distance education courses of the Cisco Academy (Cisco Networking Academy, 2021), which contain not only theoretical, but also a serious practical part. Practical classes use flash technology to create emulators of the operating system of Cisco switches and routers, which ultimately allows forming the necessary set of competencies of specialists. The obvious disadvantage of this direction is the focus solely on Cisco products, as well as a narrow range of product types (switches, routers), while the telecommunications infrastructure of the Vostochny cosmodrome includes a wide range of equipment for wired communications, radio communications, radio relay communications, satellite communications, telephone communications, video communications, etc.

3. The development of the competencies in specialties with operational orientation is quite effectively carried out on the basis of training complexes use (Altukhov et al., 2013). This approach, on the one hand, accumulates all the gained experience of operating tools, systems or complexes and makes it possible to guarantee the formation of the necessary set of specialist competencies, and on the other hand, it is localized within the framework of a specific university (department). However, the experience of creating and using a training complex in this case, with great costs, can be expanded or transferred to another educational institution or to a related specialty. Such systems do not initially provide for open use over the Internet.

4. Purpose of the Study

The development of the technology for training the specialists of the information and telecommunication complexes of the Vostochny cosmodrome is aimed at resolving the above contradictions and consists in:

1) creating the most flexible and open knowledge base using the open Moodle platform;
2) ensuring the development of the competencies of specialists by gaining experience in solving practical problems on equipment that is currently used in the space industry;

3) providing the opportunity to exchange experience of participants in the educational process;

4) ensuring the development of training facilities, their delivery and access to them for all participants in the educational process.

5. Research Methods

The technology for training the specialists of the information and telecommunication complexes of the Vostochny cosmodrome is based on creating two digital educational clusters (DEC) interconnected through the central element - Space Military Academy named after A. F. Mozhaysky:

1. Interuniversity digital educational cluster, the structure of which is shown in Figure 1 and 2.
2. Engineering space digital educational cluster, the structure of which is shown in Figure 1 and 2.
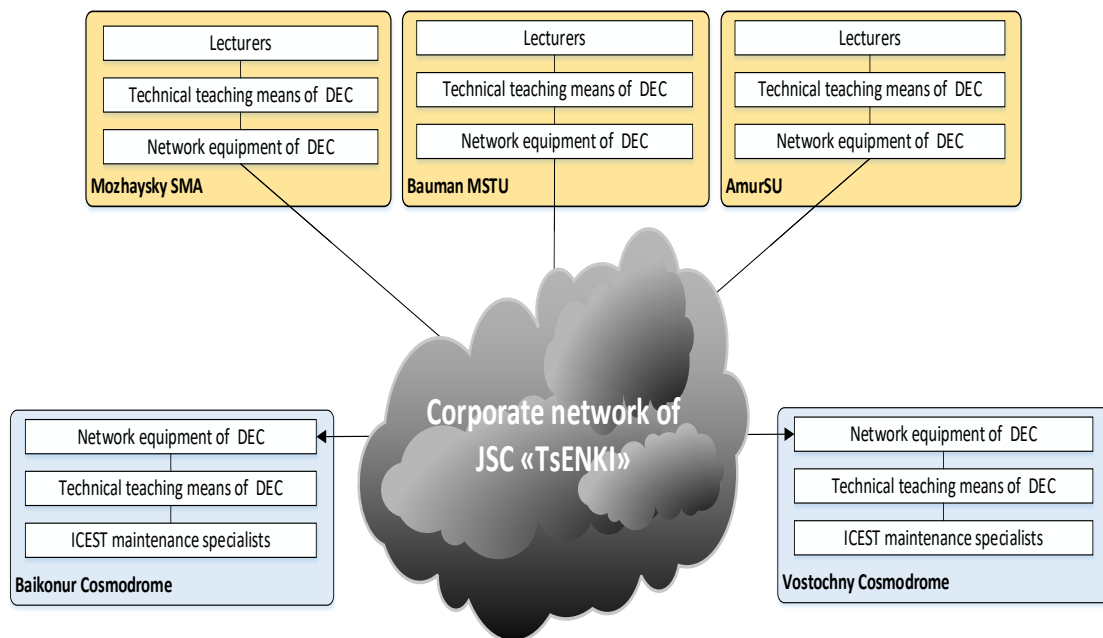
Figure 1. The use of Interuniversity digital educational cluster and Engineering space digital educational cluster for remote training the specialists in operating information and telecommunication systems and complexes of the Baikonur and Vostochny cosmodromes
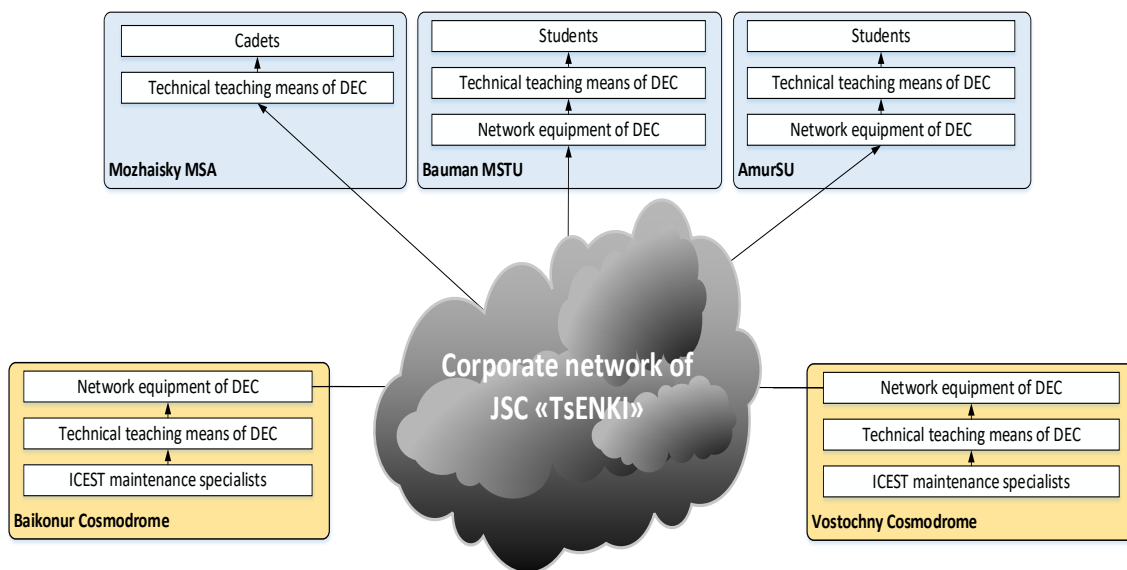
Figure 2. The use of Interuniversity digital educational cluster и Engineering space digital educational cluster for distance classes with students of MSTU and AmurSU, as well as cadets of MSA

Each of the digital educational clusters has a typical structure, in general, it includes:

1) educational programs of professional and military-professional cycles based on the use of educational and training facilities and with an emphasis on practical classes;

2) educational and training tools that implement the functions of practical training of skills in operating equipment, control of knowledge and the level of mastering skills, provide opportunities for the implementation of technologies and methods of distance education, in turn, including software and methodological complexes developed by Space Military Academy named after A. F. Mozhaysky and training complexes developed by the leading Russian enterprises (JSC Russian Institute of Radio Navigation and Time, JSC Yaroslavl Radio Plant, JSC Research Institute of Information Technologies, FSUE Radio Research and Development Institute);

3) information educational tools, namely, textbooks "Communication networks and switching systems", "Radio relay and satellite systems for transmitting information for special purposes", "Radio communication systems for special purposes" and textbooks on disciplines of professional and military-professional cycles that have the greatest contribution in the formation of professional and specialized competencies;

4) teaching technologies and teaching methods.

The material and technical basis (Sevastyanov & Shestopalova, 2013) of a typical digital educational cluster is a system of interconnected territorially distributed training facilities of the communication system of the Baikonur cosmodrome, the satellite communication system of the Vostochny cosmodrome, the digital complex for switching and distribution of television information of the Vostochny cosmodrome, the

hardware and software complex measurements of digital paths of the Vostochny cosmodrome, the UT system of the Vostochny cosmodrome, the Primorka-M satellite communication system.

The typical composition of educational and training means from the composition of a typical digital educational cluster includes (Figure 3):

1) a software and methodological complex, constructed using the modern e-education system Moodle (Domenico & Cohrs, 2016; Sulisworo et al., 2016), designed for teaching and testing knowledge; admission to the operation of communication facilities; studying the purpose, application procedure, capabilities of communication facilities (tactical and technical characteristics), control bodies of communication facilities; control of the level of theoretical and practical training of a specialist at all stages; mastering the sequence of actions when preparing communications equipment for work and in the process of providing communications (mastering operations); modeling of administration processes and situational management of the cosmodrome communication network resources; modeling of exchange processes of various types of information using modern telecommunication technologies; calculation of parameters and characteristics of satellite radio lines, digital radio relay and fiber-optic lines in various conditions.

2) a training complex designed to simulate the processes of resource management of communication networks of cosmodromes in various modes of its operation; practicing trainees' skills in practical work, operation and maintenance; training of trainees' actions in emergency situations; influence on the part of the head on the conditions for ensuring communication; work on various types of communication means; simulation of various conditions for the use of communications; working out joint actions of personnel while ensuring management and interaction in the course of performing tasks as intended.

Analysis of the experience of functioning of digital educational clusters, each of which is a unique combination of modern network technologies, the latest achievements of enterprises in the space industry and the military-industrial complex, the requirements of the Federal State Educational Standards, the experience of creating elements of a digital educational environment, the professionalism of practicing specialists in the space industry and education, allows asserting, that an effective training technology has been created that has signs of novelty.
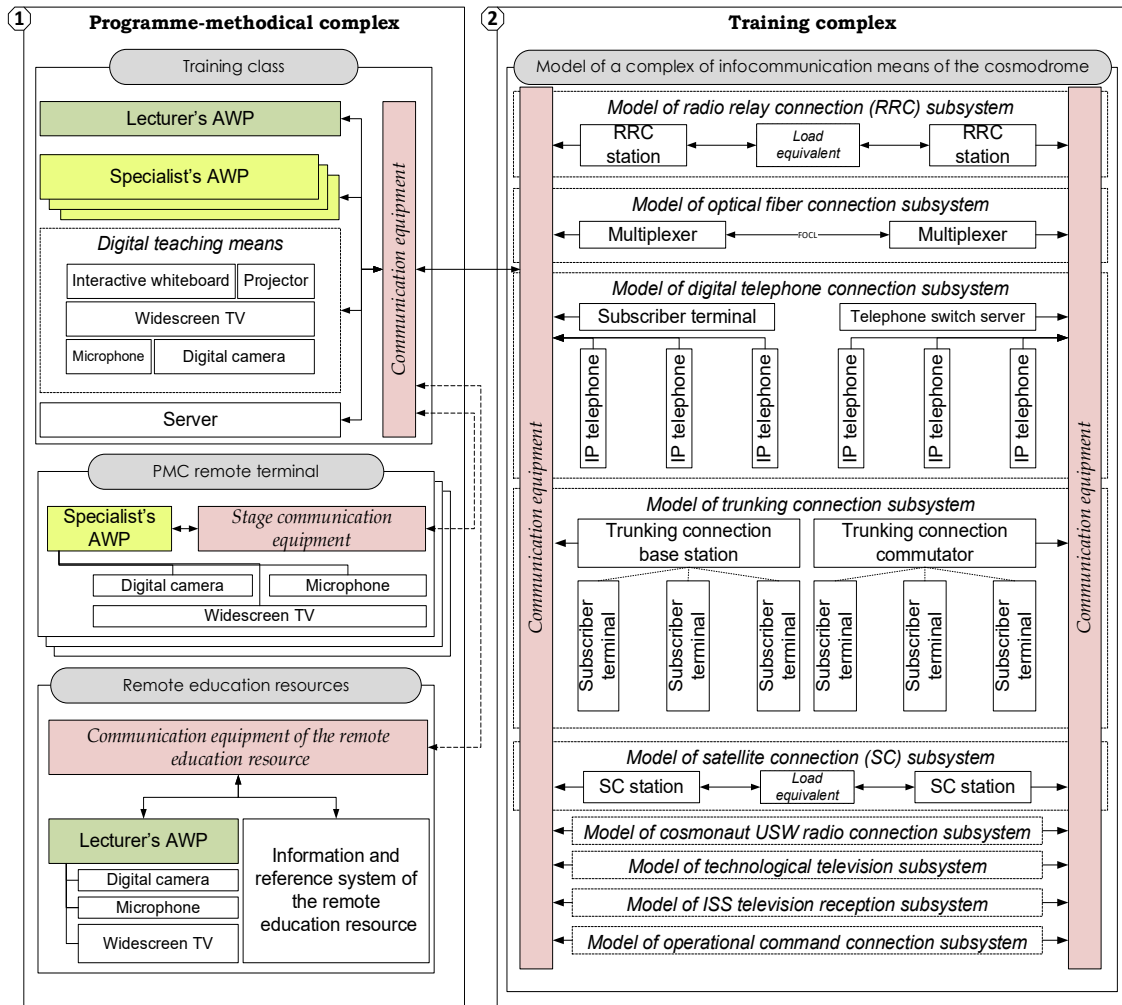
Figure 3. Typical structure of the training facility

The training technology takes into account the possible remote nature of the interaction of participants in educational activities. In addition, the widespread use of modern network technologies makes it possible to take into account the interdepartmental nature of the exchange of educational information in the learning process, namely:

- students have the opportunity to master the skills of operating information and telecommunication systems and complexes of the Vostochny cosmodrome, taking into account the most relevant experience gained by leading industry experts;

- current specialists in the space industry have the opportunity to expand their horizons and improve theoretical training by the best specialists in the field of education - scientists, teachers and methodologists of the country's leading scientific and educational centers;

- the work of the subject-methodological commissions of universities in relevant specialties is based on the best experience in the operation of information and telecommunication systems and complexes of the Vostochny cosmodrome with the involvement of leading industry experts;

- the work programs of educational disciplines in the specialties of the digital educational cluster take into account the advanced experience of specialists in the operation of information and

telecommunication systems and complexes, thematic plans and methodological recommendations make full use of the possibilities of the digital educational cluster in organizing information exchange between all subjects of educational activity, regardless of their geographical location.

The technology of training allows in a new way to assess the level of training and diagnose the results of mastering educational programs at various stages of training through the introduction of a distributed knowledge testing system built on a modern basis using the technology of online courses.

6. Findings

The introduction of digital educational clusters in the educational process of universities, as well as in the process of official and professional training of enterprises of the space industry and the military-industrial complex made it possible to:

- provide a significant contribution to the development of the digital economy of the Russian Federation by improving the quality of training of specialists in the operation of information and telecommunication systems and complexes of the Vostochny cosmodrome, while simultaneously reducing the cost of training such specialists;
- make a significant contribution to the development of the digital educational environment of the Russian Federation by creating an information educational system open to a potentially unlimited number of users;
- improve the safety level of the operation of information and telecommunication systems and complexes of the Vostochny cosmodrome;
- increase the percentage of localization of malfunctions of information and telecommunication systems and complexes of the Vostochny cosmodrome;
- exclude emergency launches of space rockets associated with the insufficient level of training of specialists in the operation of information and telecommunication systems and complexes of the Vostochny cosmodrome, and to reduce material damage during the operation of ground space infrastructure facilities;
- create an interdepartmental digital educational space for training specialists in the operation of information and telecommunication systems and complexes of the Vostochny cosmodrome on the basis of interaction and integration of military and civil educational institutions;
- to create an interdepartmental educational and material base for training specialists in the operation of information and telecommunication systems and complexes of the Vostochny cosmodrome;
- reduce by several times the cost of retraining and advanced training of specialists from remote areas.

7. Conclusion

The developed technology for training personnel of information and telecommunication complexes of the Vostochny cosmodrome on the basis of modern digital educational technologies ensures the achievement of the required level of competence of specialists, determined by the corresponding federal state educational standards. The technology makes it possible to implement professional and job training programs for personnel of the Vostochny cosmodrome without interrupting their duties and, after appropriate refinement, can be used to train personnel not only for the information and telecommunication complexes of the Vostochny cosmodrome, but also for any other systems and complexes of the cosmodrome.

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