

THE IMPROVEMENT OF INFORMATION TECHNOLOGIES AND METHODS ON CONTROL OF COMPLEX COMPUTERIZED INFORMATION SYSTEMS FOR SUPPORT OF CAREER GUIDANCE WORK IN THE HIGHER EDUCATION INSTITUTIONS

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Viktor Khodakov,

Dr. Sc. (Doctor of Technical Sciences), Professor, Honored Worker of Science and Technology of Ukraine, Maritime Institute of Postgraduate Education named after Rear Admiral Fyodor F. Ushakov (Admiral Ushakov Maritime Institute), Kherson, Ukraine,
E-mail: hodakov.viktor@gmail.com; ORCID ID: 0000-0002-8188-9125

Nataliya Krugla,

Ph.D. (Candidate of Sciences), Associate Professor, Dean of the Faculty of Information Technology and Design, Kherson National Technical University, Kherson, Ukraine,
E-mail: natalihdma@ukr.net; ORCID ID: 0000-0003-3512-6976

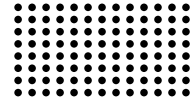
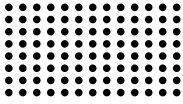
Andrei Sokolov,

Ph.D. (Candidate of Technical Sciences), Associate Professor, Associate Professor of the Department of Information Technologies, Kherson National Technical University, Kherson, Ukraine,
E-mail: hodakov.viktor@gmail.com; ORCID ID: 0000-0001-8442-6137

Galina Veselovskaya,

Ph.D. (Candidate of Technical Sciences), Associate Professor, Associate Professor of the Department of Information Technologies, Kherson National Technical University, Kherson, Ukraine,
E-mail: galina.veselovskaya@gmail.com; ORCID ID: 0000-0003-2896-0460

Abstract. The purpose of this article is to solve the urgent problem on finding reserves for significant increase the effectiveness of career guidance work with students and potential prospective students of higher education institutions on the basis of improving the organization, functioning and control of complex computerized information systems and technologies for support the implementation of this work. Research methods. The basis of research is the theory of probabilities and mathematical statistics, information and coding, information technologies, information systems, optimization control, artificial intelligence, synergetics. The main results of the study. The features of the career guidance work in institutions of



higher education, the condition of computerization and informatization for processes of its implementation, the consideration of the complexity factor for systems on its support, problems in its further improvement are highlighted. In this context, the following results were obtained: formed the concept of a common approach to solving problem; selected types and sets of information objects, processes, technologies, and systems; developed the scheme of the information system, which takes into account control with the optimization feedback; created the concept of the information essence for processes with adaptation to requirements and restrictions; formed formalized descriptions; created algorithms for action of information flows; the optimization problem on control of information systems is worked out; created the concept on improvement of information environments. Scientific novelty. Created new concepts and models, allowed to identifying, integrating and formalizing in whole components and relationships of complex computerized information systems, technologies, and methods of their control designed to the support of the career guidance work in higher education institutions, providing the possibility of improving them. Practical significance. The application in practical work of proposed theoretical propositions on the improvement of complex computerized information systems, technologies, and methods for control of them creates opportunities to radically improve results of the activities on their basis for the implementation of career guidance work in institutions of higher education.

Keywords: *information technology, complex system, control method, computer engineering.*

The problem`s statement. The high-quality training of specialists (professionals) is an important factor to ensure the demand for graduates of higher education institutions in the labor market and for the successful implementation of their employment activity.

Due to an objective process of continuous increasing in demands of the society and economics to the quality of labor resources, also is increasing the urgency of a problem on the search of reserves to further enhance the effectiveness and efficiency for training of specialists.

In the line with this problem, it should be noted that, at the moment, not all key compound elements of objects, relationships, conditions, processes, technologies and systems for training of specialists got proper attention and needs support.

To the above-noted elements, in the first place, is applies career guidance work.

This kind of activity allows you to create powerful reserves to increase the effectiveness and efficiency for training of specialists because it provides the following capabilities.

First, the preconditions are created for the initial recruitment of students with the much higher quality of the preparation for mastering the profession.

Second, it contributes to a significant increase in the activity of such a powerful catalyst for the quality of education, as a motivation to obtain future profession and further work exactly in it.

The authors of enough not small methodical developments, popular science and academic publications

on issues of the career guidance work in educational institutions paid the preferential attention to psychological and pedagogical, and general organizational aspects of this kind in activity within the framework of the extracurricular work in the process on parenting in schools.

Further these achievements, in the exchange of the teaching experience, was used in educational institutions of other types, including institutions of higher education.

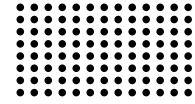
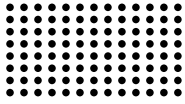
However, in this context, has not received sufficiently broad and systematic consideration of both aspects to take into account the specifics of higher education institutions themselves and issues of the modern computer-oriented support for doing by them the career guidance work on the basis of progressive information technologies and systems.

The posed problem requires a synthesis of the consideration, with the subsequent integration of the accumulated (done) elements and technologies on the basis of carefully reasoned conceptual approaches.

Also it is necessary to consider the essential factor of the complexity for the systems in the specified type, due in the first place, not elementary structure, and not trivial behavior, with the active dynamic of objects, relationships, properties, and technologies associated with these systems.

The above determines the relevance and practical value for the researching in the subject of improved information technologies and methods for the control of complex computerized information systems on support the career guidance work in higher education institutions.

The recent research`s and publication`s analysis. In light of this problem, whose solution should be sought



at the intersection of a whole series of the indicated below independent, powerful, well-established in the scientific world and in the practical work subject areas, need to be considered indicative publication concerning each of these areas, given their close relationship.

A study of modern actual publications in information technologies and systems, presented in works [1–9], covered the following topics.

The authors analyzed the specifics of the evolution, current condition and progressive development trends in the relation to subject areas that are based on concepts of the information society [1], information systems [2–5], information technologies [2–3, 6–7], computer sciences [7], information and communication technologies [8–9].

The purpose of the analysis was to obtain a generalized picture of achievements and perspectives that give at the moment and may provide in the future the above subject areas in the academic and professional fields of the activity.

As a result, the emphasis was placed on the expediency of the activation in the use of multimedia information technologies and multimedia content as a mean to the substantially improve the efficiency of the perception for the career guidance information, as well as Web technologies and cloud technologies as the instrumental support in the environment of the global computer Internet network.

Among the demonstration publications on the role, features and formalized description of the application in a computerized training process, information objects, processes and threads, modern information technologies and systems, it should be noted the works [9–20].

Marked works are devoted to the consideration of aspects which are following below.

In publications [9–15] studies the issues on common features of higher education in the digital era, the specificity of information systems, information technologies, information and communication technologies in the education on the basis of computerized technical means, with the use of online approaches to education on the basis of network technologies, remote communication, integrated tool environments, and competence-oriented modules.

In works [16–20], the main emphasis is on the complex and, especially, intellectualized models of information essences for processes of computer-based training.

With regard to the analysis of that relevant studies and publications that cover issues of the identification and presentation for computerized information technologies and systems related to modern educational processes in

a formalized view with the enough high degree of the difficulty, it is necessary to separately note the works [18–20].

These papers are reviewed and solved problems of the structural complexity, increased dynamics, partial certainty and predictability in the behavior of such systems and technologies.

These problems in the first place, connected with such extremely important and integral aspect as individual, group, and collective human factor.

This aspect quite often produces processes of stochastic nature, which are characterized by a high degree of the nonlinearity, the insufficient distinctness of the information, the enough low clarity of relationships between input data and output responses of the system.

Also very strongly influenced by the aspect, which is in a constant development of scientific-technical and socio-economics processes, with corresponding progress in the surroundings (by external environments), subject areas, and instrumental means of the support.

However, the increasing complexity of socio-economics processes brings a number of external and internal influences with destructive, destabilizing and sometimes quite unpredictable nature.

From the point of view of the formal apparatus for description and modeling, to show the complexity for systems and technologies of the class in question, it is advisable to use fuzzy sets and models, the theory of artificial intelligence, methodology of synergetics.

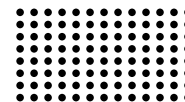
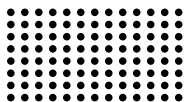
The emphasis should also be done on the modeling of the situational control based on the simulation modeling, work with samples, and expert technologies.

The analysis of the above-mentioned literary sources allows you to make the following further conclusions.

The systematization and integration of existing approaches and best practices are urgently needed.

From the perspective of the set problem in the first place, it is appropriate to consider the following modern Internet information Internet technologies and Web technologies: multimedia, hypermedia, and interactivity; realistic three-dimensional visualization, and virtual reality; cloud technologies; mobile digital technologies; information and communication technologies of distance learning systems, etc.

As a priority and a fundamental components of integration, it is advisable to use exactly those existing best practices (processes, systems, etc.), which belong to the above actual and promising subject areas.



The study's objective. The main goal of this work is solving the urgent problem of finding reserves for significant increase the effectiveness of the career guidance work with students and potential applicants of higher education institutions on the basis of improving the organization, functioning and control of complex computerized information systems and technologies for the support in the implementation of the specified work.

The research's findings. First of all, we spend the analysis of the subject area showing the features of the career guidance work in higher education institutions, highlighting its most problematic and, therefore, promising for the study aspects.

In the career guidance work, ongoing in higher education institutions can be conditionally allocated a few most characteristic, key, and target directions of activities, which will be characterized and analyzed below.

The first strategy is to form students with strong and active aspirations to the getting of the specialty, high-quality mastering of their chosen profession directly in the learning process and associated with it independent and individual work under the guidance of a teacher, initiative theoretical and practical self-training.

The second direction is aimed to form students as future graduates with carefully reasoned and stable motivational settings for the further work according to the received specialty.

First of all, the specified settings are formed during students performing the mandatory work, defined by curriculums (study plans and programs) during planned classroom and extracurricular activities, as well as forms of control, under the guidance of a teacher.

Also an important role for the formation of such attitudes is played by the following forms of work with students: group consultations on independent work and individual consultations conducted in accordance with the schedules of the departments; thematic group professional orientation events organized in the framework of the approved schedule of the extracurricular work with students by curators of academic groups of students, the Dean's office, and the leadership of higher education institution.

In many ways, these activity directions effective to the extent that graduates initially right chose the direction of training, specialty, and specialization.

The correctness of such a choice usually is determined by its compliance with following properties, formed in

students at the time of its implementation: life values; goals; ambitions; abilities; knowledges and skills; experience; theoretical and practical competences in general.

The third area in career guidance activities of higher education institutions is to provide a full set recruit of training, in qualitative and quantitative terms, among those who will strive purposefully enter or could potentially enter the institution of higher education on a certain level of training.

Ideally, this set should be of the highest quality.

Quantitatively, this set needs as much as possible to ensure the full ability of the approved licensed volume on recruit of applicants (for stationary, extramural and evening, budget and contract forms of education, respectively).

From the above list, the third direction seems to be the most problematic from the point of view of communication, to transmit the career guidance information to the extent that a considerable number of potential applicants trained within the walls of other educational institutions (secondary, secondary special or higher education).

Less severe but also problematic is the fact that the trainees have the opportunity to choose among a number of other institutions for education, when necessary its continuation at a higher level.

If you analyze all three areas in general, it should be noted the close relationship and mutual influence for the course and results of the processes occurring within them, which is due to, first of all, the active communication of young people through a Web-based Internet sites, social networks, mobile applications and other methods of communication.

Also, for all three directions characterized by the fact that, in their framework, is unacceptable little attention and time is given to independent and individual career guidance work in institutions of higher education, especially, to its motivation and control of it, as initiative on the part of the learner (applicant) process.

Consider the description and approaches to solving this local problem in more detail.

Modern institutions of higher education can be considered as multi-stage systems with control, in which the human factor plays a significant role.

Moreover, each stage of the system corresponds to a specific element of the accepted gradation of educational levels (junior bachelor, bachelor, master, etc.).

At the inputs of module-stages of the system, the certain contingents of trainees corresponding to quantitatively approved licensed volumes must be received.

To form the required quantitative contingent, a process of the preliminary career guidance is required, which should systematize, expand, detail and strengthen the knowledge of those who would purposefully strive to enter or potentially could enter at training (in a specific specialty).

As a result, a very positive and extremely stable motivation for obtaining a specific specialty should be formed that does not have potential conflicting prerequisites on the part of the subconscious settings for the formed personality of the future student.

The formation of this motivation can be contributed or discouraged by internal and external disturbing factors.

We carry out a certain concretization and formalization of the above features and approaches.

In this regard, fully autonomous models will be proposed below that expand the existing methodological apparatus, allowing us to consider the posed problems from a different angle of view and provide a more comprehensive coverage of them.

First of all, we are updating the case of traditional training, which consists in obtaining the required knowledge, skills and generalizing their competencies.

Unlike of this, in the case of career guidance work, the main result should be to get unstable settings to the implementation of the required professional choice and professional activities; wherein proper situational reactions must be formed.

We are talking about the model below the following form (Fig. 1).

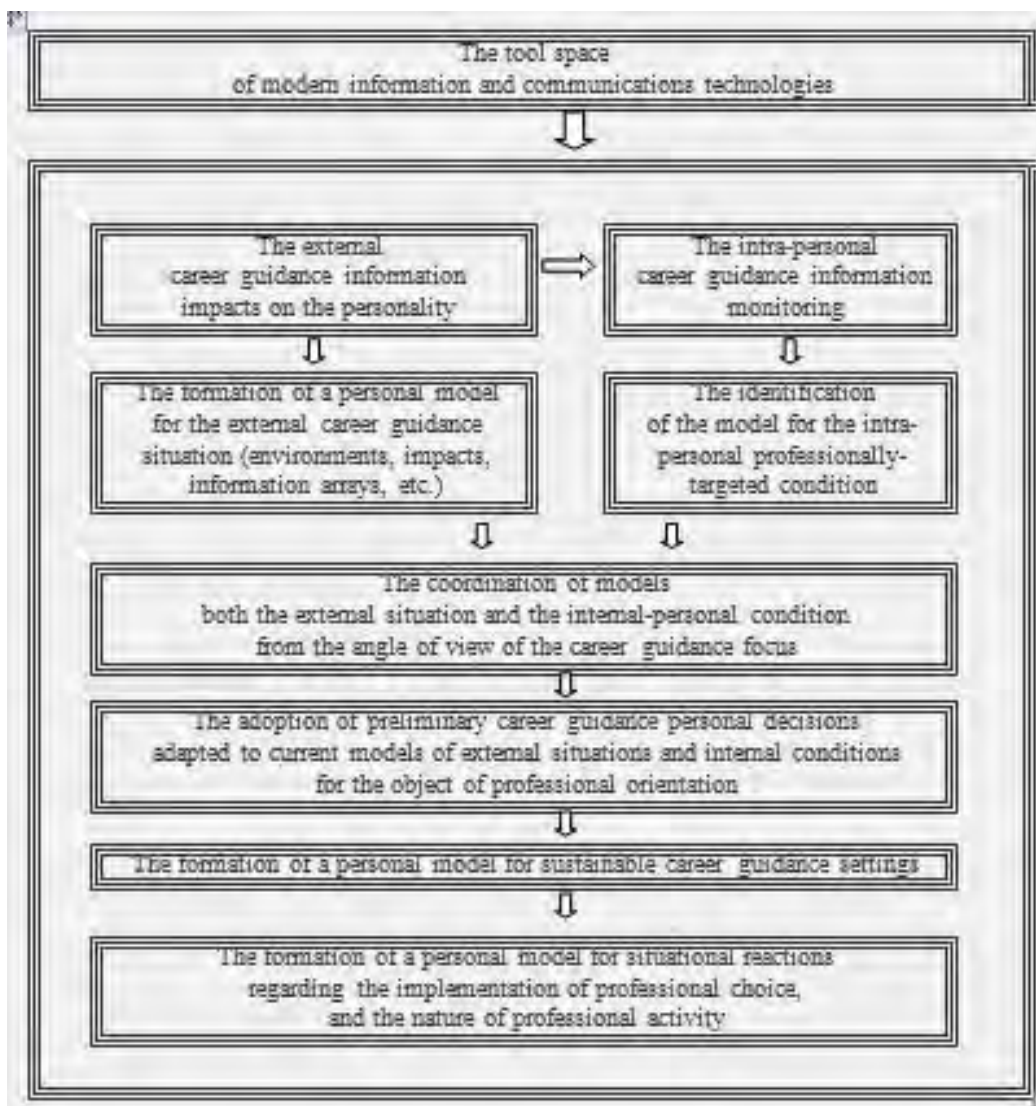


Fig. 1 – The generalized structural model for the formation of motivation-based career guidance

In general, we should talk about a model for the condition of readiness to make a certain professional choice (Fig. 2).

We will consider the impact on the trainee, which targeted career guidance work in the framework of the system with the following type (Fig. 3).

In this case we will use the following designations.

We denote as T the generalized model for the system of tools on modern information and communication technologies.

Using the symbols O, we name the model for the object of professional orientation, and with the designation E_0 –

the model for the environment of the object on professional orientation.

Moreover, let I denotes the systematized totality of information arrays, resources, repositories, and models for the source career guidance information, and MI is a model for conversion (modification, transformation, etc.) of the totality I by the object of career guidance in personally valuable knowledge.

Also we denote by F_s the model of personal motivational attitudes to the making of career guidance decisions with assessment of the sustainability for motivation, using F_p – the model of required career guidance motivational settings,

Readiness level	↑	Level 5	The psychological readiness to make a certain professionally-oriented decision
		Level 4	The socio-economic preparedness for training and work by profession
		Level 3	The psychological and physiological readiness to solve professional problems
		Level 2	Theoretical (information) readiness for the choice of profession
		Level 1	Readiness to receive the comprehensive assistance in choosing a profession based on modern information and communication technologies

Fig. 2 – The generalized hierarchical model for the condition of readiness to make a professional choice

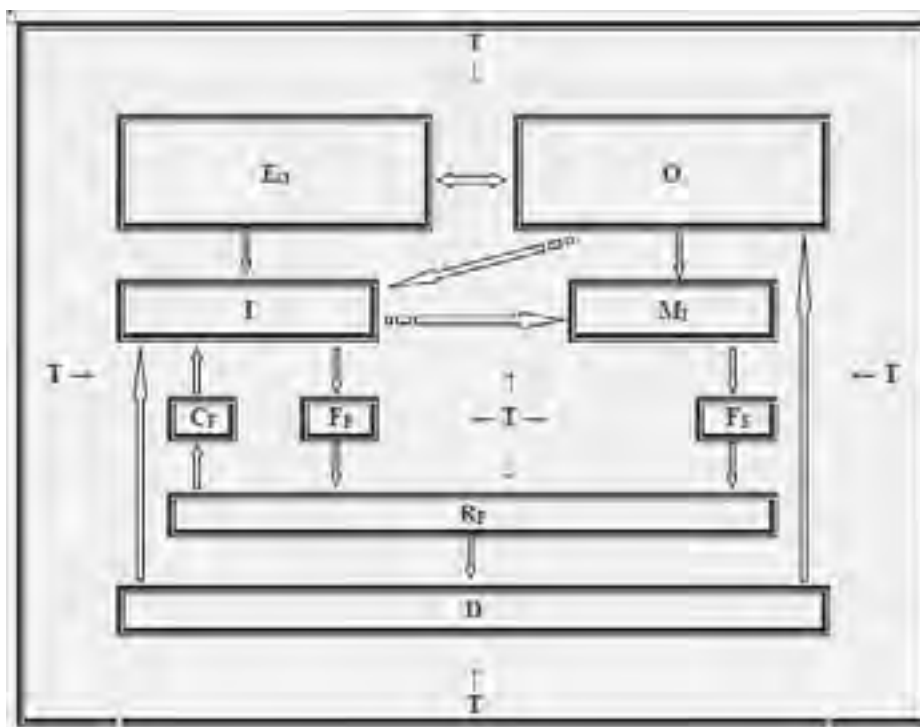
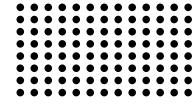
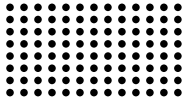


Fig. 3 – The structural model for a complex system on the formation of required motivational settings, pre-conceptions and situational reactions regarding the making of personal career guidance decisions



using RF – the technology for comparison of the formed and required models on career guidance motivational settings.

Accordingly, by C_f we denote the model for generation of corrective impacts on the formation of a given level for the sustainable professional motivation through the application of expert artificial intelligence systems.

Also, we introduce the symbol D for output data in the work of the system, in the format received career guidance motivational settings with a definite level of the sustainability.

It should be noted that the packet of input data from modules O, I to the module MI of a system is formed in an order to the further develop of preliminary personal motivational career guidance settings on the specific behavior for the making of career guidance decisions.

In turn, the package of output data for the module MI of the system is formed to the subsequent generation of sustainable personal motivational settings, preliminary decisions and reactions to situations on samples having the career guidance focus.

In the general structure of the above system, the trainee who is exposed to impacts of processes on the career guidance work is that key link of computerized information systems, and technologies for professional orientation, which makes the system complex.

Namely, the presence of a human factor generates that specific nature of a complexity for the system, in which, owing to the very significant lack in the certainty of the information, the following assumptions are mostly considered as appropriate, and made.

The system is considered as a black box.

The output of the system is required to provide well-defined reactions (required sets of values on numeric,

linguistic and logical parameters, tuples of operating actions, sets of compliances to the criteria on the efficiency, safety and reliability of the system).

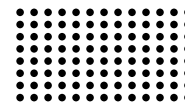
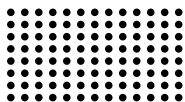
At the entrance of the system should be guaranteed proper input information and other operational impacts associated with the support of the given output reactions.

That is, in the end, there must be provided a process and mechanisms of the control for the system with the above type, taking into account the described nature of its complexity.

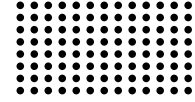
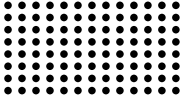
The research's conclusions. The urgency of the problem on increasing the effectiveness for the career guidance work in higher education institutions on the basis of improving complex computerized information systems and technologies for support of this work, improving their control is substantiated. The features of this work, its computerization and informatization, the complexity of its support systems, and its improvement are highlighted. In the light of the problem being solved, the following are proposed: general concept of the solution; analysis of information components; control scheme with optimization; conceptualization of the informational essence for processes with adaptation; information flow algorithms; development of an optimization control task; the concept of improving information environments; formalized descriptions. As a result, new concepts and models were obtained that made it possible to identify, integrate and formalize the features of complex computerized information systems, technologies and methods for managing them, aimed at improving support for career guidance work in higher education institutions. The practical application of proposed theoretical provisions provides an opportunity to radically improve the results of career guidance work in higher education institutions.

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**УДОСКОНАЛЕННЯ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ І МЕТОДІВ УПРАВЛІННЯ
СКЛАДНИМИ КОМП'ЮТЕРИЗОВАНИМИ ІНФОРМАЦІЙНИМИ СИСТЕМАМИ ПІДТРИМКИ
ПРОФОРІЄНТАЦІЙНОЇ РОБОТИ В ЗАКЛАДАХ ВИЩОЇ ОСВІТИ**

Віктор Єгорович Ходаков,

доктор технічних наук, професор, Заслужений діяч науки і техніки України,
Морський інститут післядипломної освіти імені контр-адмірала Ф.Ф. Ушакова, м. Херсон, Україна,
e-mail: hodakov.viktor@gmail.com; ORCID ID: 0000-0002-8188-9125

Наталія Анатоліївна Кругла,

кандидат наук, доцент, декан факультету інформаційних технологій та дизайну,
Херсонський національний технічний університет, м. Херсон, Україна,
e-mail: natalihdma@ukr.net; ORCID ID: 0000-0003-3512-6976

Андрій Євгенович Соколов,

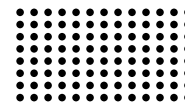
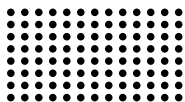
к.т.н., доцент, доцент кафедри інформаційних технологій,
Херсонський національний технічний університет, м. Херсон, Україна,
e-mail: hodakov.viktor@gmail.com; ORCID ID: 0000-0001-8442-6137

Галина Вікторівна Веселовська,

кандидат технічних наук, доцент, доцент кафедри інформаційних технологій,
Херсонський національний технічний університет, м. Херсон, Україна,
e-mail: galina.veselovskaya@gmail.com; ORCID ID: 0000-0003-2896-0460

Анотація. Мета статті полягає у вирішенні актуальної проблеми знаходження резервів для істотного підвищення результативності профорієнтаційної роботи зі студентами та потенційними абітурієнтами установ вищої освіти на основі вдосконалення організації, функціонування й управління складними комп'ютеризованими інформаційними системами та технологіями підтримки здійснення зазначеної роботи. Методи дослідження. Основою досліджень є теорії ймовірностей і математичної статистики, інформації та кодування, інформаційних технологій, інформаційних систем, оптимізаційного управління, штучного інтелекту, синергетики. Основні результати дослідження. Виділено особливості профорієнтаційної роботи в закладах вищої освіти, стану комп'ютеризації й інформатизації процесів її здійснення, врахування фактору складності систем її підтримки, проблеми подальшого її вдосконалення. У даному контексті, одержано такі результати: сформована концепція загального підходу до вирішення проблеми; виділені види та множини інформаційних об'єктів, процесів, технологій і систем; розроблена схема дії інформаційної системи, що враховує управління з оптимізаційним зворотним зв'язком; створена концепція інформаційної суті процесів із адаптацією до вимог і обмежень; сформовані формалізовані описи; створені алгоритми дії інформаційних потоків; опрацьована оптимізаційна задача управління інформаційними системами; створена концепція вдосконалення інформаційних середовищ. Наукова новизна. Створено нові концепції та моделі, що дозволили виявити, інтегрувати та формалізувати в цілому компоненти та взаємовідносини складних комп'ютеризованих інформаційних систем, технологій і методів управління ними, призначених для підтримки профорієнтаційної роботи у закладах вищої освіти, забезпечуючи можливість їхнього вдосконалення. Практична значимість. Застосування в практичній роботі запропонованих теоретичних положень із вдосконалення складних комп'ютеризованих інформаційних систем, технологій і методів управління ними створює можливості кардинального поліпшення результатів здійснюваної на їхній основі діяльності з проведення профорієнтаційної роботи в закладах вищої освіти.

Ключові слова: інформаційна технологія, складна система, метод управління, комп'ютерна інженерія.



**СОВЕРШЕНСТВОВАНИЕ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ И МЕТОДОВ УПРАВЛЕНИЯ
СЛОЖНЫМИ КОМПЬЮТЕРИЗИРОВАННЫМИ ИНФОРМАЦИОННЫМИ СИСТЕМАМИ
ПОДДЕРЖКИ ПРОФЕССИОНАЛЬНО-ОРИЕНТАЦИОННОЙ РАБОТЫ
В УЧРЕЖДЕНИЯХ ВЫСШЕГО ОБРАЗОВАНИЯ**

Виктор Егорович Ходаков,

доктор технических наук, профессор, Заслуженный деятель науки и техники Украины,
Морской институт последипломного образования имени контр-адмирала Ф.Ф. Ушакова, город Херсон, Украина,
e-mail: hodakov.viktor@gmail.com; ORCID ID: 0000-0002-8188-9125

Наталья Анатолиевна Круглая,

кандидат наук, доцент, декан факультета информационных технологий и дизайна,
Херсонский национальный технический университет, город Херсон, Украина,
e-mail: natalihdma@ukr.net; ORCID ID: 0000-0003-3512-6976

Андрей Евгеньевич Соколов,

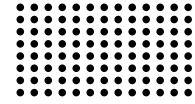
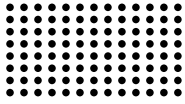
кандидат технических наук, доцент, доцент кафедры информационных технологий,
Херсонский национальный технический университет, город Херсон, Украина,
e-mail: hodakov.viktor@gmail.com; ORCID ID: 0000-0001-8442-6137

Галина Викторовна Веселовская,

кандидат технических наук, доцент, доцент кафедры информационных технологий,
Херсонский национальный технический университет, город Херсон, Украина,
e-mail: galina.veselovskaya@gmail.com; ORCID ID: 0000-0003-2896-0460

Аннотация. Цель статьи состоит в решении актуальной проблемы нахождения резервов для существенного повышения результативности профессионально-ориентационной работы со студентами и потенциальными абитуриентами учреждений высшего образования на основе совершенствования организации, функционирования и управления сложными компьютеризированными информационными системами и технологиями поддержки осуществления указанной работы. Методы исследования. Основой исследований являются теории вероятностей и математической статистики, информации и кодирования, информационных технологий, информационных систем, оптимизационного управления, искусственного интеллекта, синергетики. Основные результаты исследования. Выделены особенности профессионально-ориентационной работы в учреждениях высшего образования, состояния компьютеризации и информатизации процессов ее осуществления, учета фактора сложности систем ее поддержки, проблемы дальнейшего ее совершенствования. В данном контексте, получены такие результаты: сформирована концепция общего подхода к решению проблемы; выделены виды и множества информационных объектов, процессов, технологий и систем; разработана схема действия информационной системы, учитывающая управление с оптимизационной обратной связью; создана концепция информационной сути процессов с адаптацией к требованиям и ограничениям; сформированы формализованные описания; созданы алгоритмы действия информационных потоков; проработана оптимизационная задача управления информационными системами; создана концепция совершенствования информационных сред. Научная новизна. Созданы новые концепции и модели, позволившие выявить, интегрировать и формализовать в целом компоненты и взаимоотношения сложных компьютеризированных информационных систем, технологий и методов управления ними, предназначенных для поддержки профессионально-ориентационной работы в учреждениях высшего образования, обеспечивая возможность их совершенствования. Практическая значимость. Применение в практической работе предлагаемых теоретических положений по совершенствованию сложных компьютеризированных информационных систем, технологий и методов управления ними создает возможности кардинального улучшения результатов осуществляемой на их основе деятельности по проведению профессионально-ориентационной работы в учреждениях высшего образования.

Ключевые слова: информационная технология, сложная система, метод управления, компьютерная инженерия.



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