

SUMMARY

PART 1 CONCEPTUAL BASES OF ENGINEERING THINKING

**Anakhov S. V.,
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ENGINEERING THINKING: MATHEMATICAL AND NATURAL SCIENCE CONTEXT

Abstract. The article discusses the challenges that arise in engineering thinking in connection with the transition to the 6th technological order. Emphasis is placed on the need for changes in scientific and educational policy, taking into account new technological challenges.

Keywords: engineering, technological mode; the national technological initiative; digital economics, information technologies.

Kislov A. G., Ural Federal University, Yekaterinburg

ENGINEERING THINKING: MATHEMATICAL AND NATURAL SCIENCE CONTEXT

Abstract. The article discusses the challenges that arise in engineering thinking in connection with the transition to the 6th technological order. Emphasis is placed on the need for changes in scientific and educational policy, taking into account new technological challenges.

Keywords: engineering, technological mode; the national technological initiative; digital economics, information technologies.

**Kerimov T.Kh., Tomiltseva D.A.,
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**DIGITALIZATION OF SOCIETY AS SOCIAL ENGINEERING:
ETHICAL PROBLEMATIZATION**

Abstract. The article considers the connection between the engineer thinking, approaches to social typification and new forms of the human entity through the prism of ethical problematization.

Keywords: digitalization, ethics, engineer thinking, disciplinary society, society of control

**Bryanik N.V.,
Ural Federal University, Ekaterinburg**

**DYNAMICS OF ETHICAL COMPONENT OF ENGINEERING:
FROM EVALUATION OF CONDITIONS
TO EVALUATION OF RESULTS**

Abstract. Engineering activity of the modern (= industrial) type owes its origin to the ethics of Protestantism, which is justified in the studies of M. Weber. Social engineering is formed under the conditions of a change in the morality of egoism, oriented toward the individual, with the morality of society as a whole, which became the subject of consideration by O. Comte. The ethics of the engineering community and the persons giving verdicts to the creations of engineers were a painful issue for K. Tsiolkovsky. Since the 40s. XX century to this day, the emphasis in posing the ethical problems of engineering is shifted to the results of this activity, including in the field of creating artificial intelligence.

Keywords: engineering activity, ethics/ethical component, conditions, results.

**Kotelevsky D.V.,
Ural Federal University, Ekaterinburg**

**TECHNIQUE AND ENGINEERING THINKING
IN THE PHILOSOPHY OF GILBERT SIMONDON**

Abstract. The subject of this work is Gilbert Simondon's concept of technology. The aim of the work is to show the place of individual ideas of Simondon's philosophy of technology in European philosophical thought. The main attention is paid to the role of the basic concepts of Simondon. Such concepts of Simondon as "individuation" and "concretization" are increasingly used in modern philosophy and special attention is paid to them in the work.

Keywords: Simondon, philosophy of technology, technology, technical object, technical knowledge, engineering knowledge, individuation, criticism of hylemorphism, alienation, ethics of technology.

**Farkhitdinova O.M.,
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SOCIAL ENGINEER AND PROJECTIVE THINKING STYLES

Abstract. The article expresses the thesis about changing the framework of social engineering in the XXI century, due to the involvement of project activities in its subject field with characteristic categories and styles of thinking.

Keywords: social engineer, interdisciplinarity, age-related self-identification, projective thinking styles

**Azarenko S.A.,
Ural Federal University, Ekaterinburg**

ON THE ISSUE OF THE LANGUAGE OF REPRODUCTION OF ENGINEERING

Abstract. The article discusses the possibilities of the engineering language. The language of engineering thinking, as it seems to us, refers to "Assembly" or "assemblage", as a way of forming complex objects, multiple and self-organizing systems. In social theory, the concept of "Assembly" is used after the philosophy of J. Deleuze and M. Deland, where Assembly involves the formation and implementation of relationships simultaneously at all levels of the social system from individual, group and global levels. The processes of each individual level in the course of gathering are not a direct cause of the relationship of another level of sociality, but a condition that assumes the appropriate form of this relationship. In this

case, the social structure of society reveals topological complexity, distinguishing processes at different levels. The topology of “Assembly” implies the use of such terms as “corporeality”, “locality”, and “compatibility” in the language of engineering thinking. The classical approach assumed society as a whole, in a number of stages, such as feudalism, capitalism, and socialism. Delanda proposes a scheme of sociality: “individuals-institutions-cities – nation States”. It seems to us necessary to Supplement this scheme with such integrity as the “house”, believing that without it it is impossible both the interaction of individuals and the existence of this or that institution. Therefore, the scheme of the social set of individual entities will look like this: “individuals-houses-institutions-cities-States”.

Keywords: language of engineering thinking, Assembly, corporeality, locality, compatibility, “individuals-houses-institutions-cities-States”.

Dovgalenko N. V.,

Yuri Gagarin State Technical University of Saratov, Saratov

ENGINEERING: TRANSCENDENTAL PLAN

Abstract. Is there a need to consider engineering in a transcendental sense, detect universal constants in it? The concept of engineering is associated more with everyday life, practice, and not with thinking. But without this approach, it is impossible to understand the changes that are happening with engineering today. This approach reveals the essence of engineering rationality, which is based on the methodology of constructivism, reconstructivism and deconstructivism (engineering fragmentation). Constructivism extends reality by creating artificial objects. Reconstructivism is considered as a direction (D. Dewey), which defines the value orientations of constructivism: pragmatism, convenience, consumption. Deconstructivism raises the question of replacing objective reality with constructs. They are created based on the manipulation of various fragments of reality. A person participates in manipulations not only as a creative engineer, but also as a matter (body, cognitive abilities). The value of humanism is denied.

Keywords: engineering, rationality, constructivism, reconstructivism, deconstructivism, fragmentation.

**Andryukhina L. A.,
Russian State Vocational Pedagogical University, Ekaterinburg**

DIGITAL HUMANITIES: MENTAL MODELS OF HUMANITARIZATION OF ENGINEERING AND EDUCATION

Abstract. The article shows that in the context of the formation of a new technological structure, industry 4.0. a humanistic challenge is formed to the prevailing technocratic practice of training engineers. The humanization of engineering thinking and education is put forward among the priority tasks of innovative development. In modern conditions, one can not ignore that the ongoing processes of digitalization, the introduction of digital technologies lead to a change in the scientific landscape. Transfer-integrative, multidisciplinary areas of research and practice are emerging. It is in these areas that new methodological approaches and mental models are being formed. Analyzing such a transfer-integrative field as “digital humanities”, the author identifies several promising mental models of humanization of engineering thinking and education.

Keywords: engineering thinking, engineering education, humanitarization, mental models, digital humanities, digital information technologies, transfer-integrative fields of scientific knowledge.

**Kartasheva A. A.,
Ural Federal University, Ekaterinburg**

UNDERSTANDING THE CRASH OF THE CHALLENGER SHUTTLE IN ENGINEERING ETHICS

Abstract. The article reveals one of the problems of engineering ethics on the example of a theoretical discussion between M. Davis, R. Kline and W. Lynch. The subject of discussion is related to the problem of the ethical block in the professional training of engineers. The question is raised about the possibility for the engineer to resist pressure from considerations of economic expediency or expediency of the administrative and political order.

Keywords: engineering ethics, engineering thinking.

**Kondratyev V.M.,
Moscow City Teacher Training University**

**ENGINEERING EDUCATION:
THE LOGIC OF JUSTIFICATION OF CONTENT**

Abstract. The paper deals with the content of engineering education. The author supposes that the content of engineering education is based on the knowledge of how machines work and the ways of manufacturing and maintenance of engineering devices. The common feature of all ideal (thinking) and material objects is to resist change. Humanities and technical education differ in ways they react to changes being made by the objects.

Keywords: education, thinking, engineer, designer, technologist

**Kislov Al-der G., Fominykh E.A.,
Russian State Vocational Pedagogical University, Yekaterinburg**

**TO SCHOLARS' REFLECTION
ON GENERAL ENGINEERING EDUCATION**

Abstract. The article presents the arguments supporting mutual complementarity of scholars and engineers in understanding phenomena of technics, technology, engineering activities, engineering reflection and general engineering education.

Keywords: technics, engineering reflection, general engineering education, the principle of objectivism, subjectivity.

PART 2

TRAINING OF ENGINEERING PERSONNEL IN THE CONDITIONS OF DIGITALIZATION

Gurskaya T. V.,
Private educational institution of higher education
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TRIZ IN THE SYSTEM OF PRACTICE-ORIENTED TRAINING OF ENGINEERS

Abstract. Ural mining and metallurgical company define a task for UMMC Technical University to train a perfect engineer for future. A rapidly developing company needs human resources, where people can work both efficiently in the rapidly changing realities of production and solve innovative problems as well.

The University has created a practice-oriented system for training engineers who can generate practical ideas and solutions, especially in urgent applied problems.

The Course theory of inventive problem solving was introduced into the University's educational programs. The purpose of this course is to train students the methods and tools of invention, the laws of development of technical and business systems, to gain experience in their use for solving non-standard tasks and analyzing specific situations and processes that arise in economic, organizational, information and technical systems.

Keywords: engineering education, engineering thinking, creative thinking, practice-oriented training, theory of inventive problem solving.

Fedotova V. V., Danilova N. V.,
Ural Federal University, Yekaterinburg

QUALIFICATION SYSTEM: TRAINING TOOLS FOR HIGH-DEMANDED ENGINEERS

Abstract. The issues of trainings for potential engineers, associated with national qualification system are discussed in the article.

**Ashilova M. S.,
Kazakh University of International Relations
and World Languages named after Abylay Khan
Begalinov A. S.,
International University of Information Technology
Begalinova K. K., Kazakh National University named
after al-Farabi, Almaty city**

**ENGINEERING IN DIGITALIZATION: DEVELOPMENT TRENDS
AND PROSPECTS (ON THE EXAMPLE OF KAZAKHSTAN)**

Abstract. The article discusses the development trends of engineering education in the context of digitalization, requiring the formation of competent specialists.

Keywords: engineering education, digitalization, professionalism, competence, humanization

Dniprov S. A.

**INTERACTION OF TEACHERS AND STUDENTS IN THE ERA
OF DIGITALIZATION: EDUCATION AND ERGONOMICS**

Abstract. The article discusses the ergonomic mechanisms of the optimal functioning of a modern university. The author presents the position of understanding the essential meaning of pedagogical ergonomics in the activities of a modern university. Ergonomic aspects of the activity of a modern university based on a systematic and integrated approach are presented. The holistic activity of a modern university is substantiated as a structural and functional study of the activities of a teacher and student.

Keywords: ergonomics, activity, educational process, modern university.

**Plaksina L. T.,
Russian state vocational pedagogical university, Ekaterinburg**

**THE USE OF INFORMATION TECHNOLOGIES FOR FORMATION
OF ENGINEERING THINKING OF UNDERGRADUATES PROFES-
SIONAL-PEDAGOGICAL UNIVERSITY**

Abstract. The article considers the possibilities and importance of information technologies for the formation of engineering thinking of undergraduates of welding specialization of a professional pedagogical University.

Keywords: information technologies, engineering thinking, digitalization, welding production, training of specialists, undergraduate, professional education.

**Beryl S. I., Burmenko F. Yu., Zvonky V. G.,
Pridnestrovian State University. Taras Shevchenko, Tiraspol**

EXPERIENCE OF IMPLEMENTATION OF CONTINUOUS MULTI-LEVEL ENGINEERING EDUCATION AT THE CLASSICAL UNIVERSITY

Abstract. The article discusses approaches to improving the quality of vocational education by improving educational and methodological support and developing new forms of organization of the educational process, by forming a regional system of continuing professional education, networking, scientific and technologically innovative support in the field of personnel training.

Keywords: problems and tasks of engineering education, models of engineering education, engineering thinking, educational programs for a new industry.

**Guzanov B. N., Fedulova M. A.,
Russian State Vocational Pedagogical University, Ekaterinburg**

INTERDISCIPLINARY APPROACH TO FORMATION OF TRANSPROFESSIONAL COMPETENCES OF STUDENTS OF A PROFESSIONAL AND PEDAGOGICAL UNIVERSITY

Abstract. The authors consider the engineering thinking of students of a vocational pedagogical university as an integral part of trans-professional competencies and propose the use of an interdisciplinary approach in the formation of the content of professional training.

Keywords: interdisciplinary approach, professional competencies, engineering thinking, professional and pedagogical education.

**Lomovtseva N. V.,
Russian state vocation pedagogical university, Ekaterinburg**

**CORPORATIVE ELECTRONIC TRAINING:
DEVELOPMENT PROSPECTS**

Abstract. For continuous staff training in an ever-changing business environment, e-learning is the most essential component of corporate training. The relevance and importance of e-learning is caused by global processes of transition to the digital economy and digital society. This type of training for organizations allows you to quickly and effectively respond to a changing situation, providing employees with relevant knowledge on demand and without interruption from their core business. That is why e-learning allows modern companies to consider it as an investment that helps the company maintain a competitive advantage.

Keywords: corporate training, e-learning, digital educational environment, continuing education, access to education.

**Zvonkii V. G., Tsaruk E. A.,
Shevchenko State University of Pridnestrovie, Tiraspol**

**ADVANCED TRAINING OF ENGINEERING PERSONNEL
AS A FACTOR IN THE DEVELOPMENT OF INNOVATIVE
ACTIVITIES OF INDUSTRIAL ENTERPRISES**

Abstract. The article shows the possibility of developing innovative activities of industrial enterprises. At the same time, one of the priority areas is the development and implementation of a system of advanced training of engineering personnel, which allows adapting the training system to rapid changes in order to increase the level of labor productivity. We propose a management system for training modern specialists, which is aimed at implementing promising educational models that cover all areas of the educational process.

Keywords: multi-industry economy, innovative activity, advanced training system, modern graduate model, assessment of the quality of education.

**Gushchina N.V., Kulikov V.V.,
Ural State University of Railways, Yekaterinburg**

**PROMISING GUIDANCE IN MATTERS OF ENGINEERING
PERSONNEL TRAINING IN MODERN CONDITIONS**

Abstract. The article discusses the features of engineering education in the conditions of digitalization of design solutions, the problems of goal-setting in training for decision-making in the conditions of the fourth technical revolution.

Keywords: industrial revolution, engineering education, information modeling of objects, training, railway transport, safety.

**Melnikova O.Y.,
Ural State University of Economics, Ekaterinburg**

**QUALITY OF ENGINEERING PERSONNEL TRAINING
IN MODERN CONDITIONS**

Abstract. The article based on the social study conducted among the management of enterprises where students and graduates with technical training work. Opinions have been received on the quality of engineering personnel training.

Keywords: engineering personnel, technical education.

**Fedulova K.A.,
Russian State Vocational Pedagogical University, Ekaterinburg**

**DEVELOPMENT OF INFORMATION-ENGINEERING THINKING
AT STUDENTS OF VOCATIONAL-PEDAGOGICAL UNIVERSITY**

Abstract. The article discusses the problems of development of information and engineering thinking of the future teachers of vocational training and proposes a simplified model of its formation based on the usage of information and design tasks.

Keywords: information and engineering thinking, teacher of vocational training, interdisciplinary module “Computer modeling”, information and design tasks.

**Fedulova M.A.,
Russian State Vocational Pedagogical University, Ekaterinburg**

**ROLE OF TECHNICAL THINKING IN PREPARATION
OF STUDENTS OF PROFESSIONAL
AND PEDAGOGICAL UNIVERSITY**

Abstract. The article discusses the specific features of technical thinking and its role in the preparation of competitive teachers of a vocational school.

Keywords: technical thinking, professional and pedagogical education, trans-professional competencies, spatial thinking, logical thinking, algorithmic thinking.

**Taradanov A.A.,
Chelyabinsk State University. Chelyabinsk**

**ENGINEERING IN THE MANAGEMENT OF LABOR MOTIVATION
OF EMPLOYEES OF AN ENTERPRISE OR ORGANIZATION**

Abstract. The technology of management of labor motivation of employees of an enterprise (organization) involves the development of a methodology for determining the level and factors of labor motivation for various departments and categories of personnel. The corresponding method is presented.

Keywords: methods of managing the labor motivation of the company's personnel.

**Prokubovskaya A.O., Chubarkova E.V.,
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Russia, Yekaterinburg**

**ON CONTINUOUS TRAINING OF PERSONNEL
FOR THE ELECTRIC POWER INDUSTRY IN THE CONDITIONS
OF DIGITALIZATION OF EDUCATION**

Abstract. The features of the implementation of continuous training for the electric power industry in the conditions of digitalization of education – from obtaining a specialty in the programs of secondary pro-

fessional education to obtaining a higher education qualification at the bachelor's level.

Keywords: continuing education, energy, secondary vocational education, bachelor's degree, elective modules.

**Chetkova N.B.,
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SOME ASPECTS OF SOLVING THE PROBLEM OF PROVIDING SOCIETY WITH SPECIALISTS IN THE DIGITALIZATION OF THE ECONOMY

Abstract. The article discusses the problem of the lag in adapting the education system to the conditions of a rapid change in the technological cycle and the emergence of new specialties. The rapid development of science and technology, the digitalization of the economy today dictate to the education system the task of training specialists in information technology. It is talking about specialists who, at the same time, also have competencies in certain subject areas. This requires educational institutions to develop a theoretical and practical base and appropriate training for teachers.

Keywords: digitalization of the economy, IT-technologies, educational environment.

PART 3 TECHNOLOGIES OF ENGINEERING THINKING

Molodnyakova A. V., LLC ABSPANTHERA, Nizhny Tagil

EDUCATIONAL TECHNOLOGY OF 3D MODELING IN LIGROGAME AS A METHOD OF DEVELOPMENT OF ENGINEERING THINKING OF CHILDREN IN THE CONDITIONS OF DIGITALIZATION

Abstract. The article discusses the educational opportunities of the 3D LigoGame electronic environment for developing learning and technical creativity of preschool children, the practice of implementing computer 3D modeling technology in LigoGame within the framework of the addi-

tional program of natural science and technical directions “Playing and modeling in LigoGame”, the model of children’s project activity based on cdio engineering standards.

Keywords: STEM education, engineering education, engineering thinking, CDIO standards, ICT technologies, computer 3D modeling, technical creativity.

Panasova E.P.

THE ROLE OF THE COMMUNITY IN THE FORMATION OF IT PERSONNEL IN THE ERA OF DIGITALIZATION – EXPERIENCE OF THE ACCELERATION PROGRAM FOR SCHOOL CHILDREN “UNIT URAL”

Abstract. The article considers describes the methodological foundations of the “UnIT Ural” program, which successfully implements project education in IT sphere. Around the program, a community is being formed that contributes to the further development of schoolchildren through the events of “UnIT Ural” program, which is a kind of IT accelerator for young people.

Keywords: additional education, innovation in education, career guidance, project activities, soft skills, IT.

Vu Thien Thuy Hien,
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PROBLEMS IN THE AUTOMATIC THINKING SYSTEM, WHICH HAVE INFLUENCE ON THE ABILITY OF WRITTEN-TEXT IMITATION OF ARTIFICIAL INTELLIGENCE

Abstract. The article discusses the limitations and features of automatic thinking systems in connection with their ability to write coherent written texts. The ability of intelligent systems of imitation written speech is associated with the modeling of different levels of cognitive phenomena in automatic thinking systems.

Keywords: automatic thinking system, artificial intelligence, imitation, written text.

**Gavrilova A.S., Taran V.N.,
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TRAINING WITH ENGINEERING SPECIALTIES WITH THE HELP OF ARRIVED REALITY

Abstract. This article discusses what augmented reality is, its use, main features, advantages and disadvantages. Examples of the use of augmented reality technologies in engineering education are given, on the example of such companies as ArPoint.

Keywords: augmented reality, virtual object, mobile applications, e-learning, virtual reality, mixed reality, engineering specialties.

**Ivanchenko M.A.,
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ROBOPSYCHOLOGY: FOUNDATIONS, PERSPECTIVES

Abstract. Robopsychology is the profession of the future, which will focus on the successful interaction between biological and robotic systems. Robotic psychologists will be in demand in all areas of human life – where robots and cyborgs are in contact with them. Ubiquitous automation and technology lead to the need to develop engineering thinking, particularly in terms of computer literacy. It is already unthinkable to work without using PCs, MFPs, email and software to process video, sound, graphics and text editors. People are becoming more and more cyborphic, many even implant chips and electrodes under their skin to better manipulate the digital mass of data. New types of robots are appearing, social robots, religious robots, such as the robot Buddha in Japan, are added to the already familiar manipulators in production. Some people hold wedding ceremonies with robotic systems such as Hatsune Miku, a vocaloid. There is a need to translate from human language to program code. People with programming competence and psychological education can be excellent mediators between the two types. In addition to HR, GR and PR, RR will be added.

Keywords: robopsychology, engineering thinking, posthumanism, artificial intelligence, robots, futurism.

Panasova E.P.

**DEVELOPMENT OF ENGINEERING THINKING
IN SCHOOLCHILDREN (EXPERIENCE OF NPO AUTOMATIKA)**

Abstract. The article covers systematic career guidance work carried out at Scientific and Production Association of automatics named after academician N.A. Semikhatov. The main goal is to encourage young people to develop engineering thinking and interest in scientific research.

Keywords: additional education, career guidance, engineering thinking.

**Uymina O.I.,
Ural Federal University, Yekaterinburg**

**STEREOTYPES AS THE BOUNDARIES
OF CREATIVE ENGINEERING THINKING**

Abstract. Engineering thinking is formed by formal logic and deterministic laws. The man himself and his thinking are driven into stereotypes. At the same time, the development of human intelligence is affected by genetics, gender, family, physiological characteristics of the body, social environment and much more. Creativity of thinking is manifested in the fact that with a certain set of factors that shape thinking, an individual is able to make a breakthrough beyond the boundaries of formed stereotypes. Such a person is able to destroy the old system in search of a new solution to the problem. This is possible if a person has his own personal interest, and he is not afraid of stereotypes, acts contrary to, and not thanks to.

Keywords: engineering thinking, intelligence, creative thinking, stereotypes.

**Zaruchevskaya G. V., Kostin I. V.,
Northern (Arctic) Federal University named
after M. V. Lomonosov, Archangelsk**

**FINE-GRAINED LOCAL PARALLEL COMPUTING
FOR MULTIPLE INTEGRAL CALCULATIONS BY TRAPEZOIDAL
RULE IN THREE-DIMENSIONAL SPACE**

Abstract. The article considers the possibilities of using the fine-grained local-parallel programming style for an approximate calculation of multiple integrals. Given example of an approximate calculation of multiple integrals by trapezoidal rule.

Keywords: fine-grained local-parallel programming, numerical integration methods, trapezoidal rule.

**Skutin A. S.,
Ural Federal University, Ekaterinburg**

OBJECTIVE-LOGICAL APRIORI OF SCIENTIFIC-CONSTRUCTIVE KNOWLEDGE: OPPORTUNITIES AND LIMITATIONS

Abstract. The article explores the a priori platform of scientific and constructive knowledge, its capabilities and limitations. A generative-teleological approach is applied to the disclosure of the historical genesis of a rationalistic tradition. The study carried out the essential description of the objective-logical a priori accompanying its dualistic ontology. The authors partially demonstrated the intentional dynamics of the emergence of a scientific-constructive attitude of consciousness.

Keywords: teleological-historical self-understanding, objective-logical a priori, scientific-constructive knowledge, idealized objectivity, dualism, life world.