

Innovative Competencies of Mining engineers in Transition to the Sustainable Development

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Abstract. The transition to the sustainable development posed new challenges to the system of mining higher education. They are determined by the acceleration of scientific and technological progress and widespread introduction of innovations, convergence of technologies from various industries. On the one hand, globalization and rapid technology development are constantly increasing quality requirements for the labor resources of the mineral and raw materials complex and constant improvement of their skills. On the other hand, the transition to the sustainable development provides the necessity for rational use of raw materials and environmental protection. This requires the improvement of staff support system for mining operations and the interaction of enterprises with universities training mining engineers, aimed at the innovative competencies development of future miners.

1 Introduction

Today, many branches of the mineral resource complex are experiencing the need for highly skilled managers and specialists, which is not only a deterrent for the development of national economies, but also one of the main reasons for the loss of life and large-scale pollution of environment caused by industrial accidents.

Along with this, the development of mining complex, the basic one for the Russian economy, has always depended on the latest development results in mining, engineering, and power industry. Mining and processing enterprises have always been high-technology facilities, where the rapid introduction of the latest developments in the production process took place. Kuzbass is not an exception; it is a region with an ultrahigh concentration of mining operations, which exert a significant load on environment. The sustainable development of such mining region is impossible without staff support, which can be guaranteed only by the existing educational system being ready to train innovative competencies for future mining engineers.

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The leader of engineering education in Kuzbass – T.F. Gorbachev Kuzbass State Technical University - has old traditions and unique "know-how" in the field of resource base and power industry [1]. It is responsible for creating the prerequisites for the transition of the extracting region to the sustainable development changing the quality of human capital at mining and processing enterprises.

2 Materials and Methods

The challenges that technical universities involved in training of mining engineers will inevitably face in the first half of the 21st century are the following:

1. The global inter-industry and inter-disciplinary integration, which enhances the development of individual industrial complexes, scientific and technological progress and structural changes in the economy, which together can dramatically change the structure of demand for engineering staff in the near future.

2. The trend towards aging of the population in industrialized countries, which is going to lead to employable population reduction and, as a result, the decrease in number of highly skilled staff which provide the operation of mineral resource and raw materials complex facilities and conduct scientific research.

3. The development of geo-information technologies and unmanned mining of mineral resources that will transfer the profession of a mining engineer to a qualitatively new level.

4. The development of aviation, space remote sensing and navigation systems, which will result in the formation of integrated control systems for the search, exploration, extraction, transportation and processing of minerals. This will greatly enhance the role of IT in training future mining engineers.

5. The development of NBIC-convergence (nano-, bio-, information-, cogno) technologies will have a revolutionary impact on the demand structure of the extractive industry in future. There will be the replacement of fossil fuels with synthetic and biomass, wide distribution of biological underground leaching of metals. Particular attention will be paid to post-mining and restoration of ecosystems by using bioremediation of soils and sub-soils contaminated with hydrocarbons. As a result, the professional competences of a mining engineer are substantially altered, as are the tasks set for him/her by the innovative development of the mineral and raw materials complex [2].

3 Results and Discussion

In order to meet the requirements set by the transition to the sustainable development for the higher mining education, a modern technical university should provide innovative activity in the following key areas of mining training:

- influencing on the policy in the field of mining and technical education at the regional and national levels and drawing up the recommendations and proposals for the innovative development of mining enterprises;
- implementing the concept of ideas and innovations' laboratory in the field of natural-and-scientific and engineering education, as well as promoting global dialogue between universities, finding new ways for innovative development of mining education, strengthening their importance in the business community of the mineral resource complex;
- providing the scientific-and-technical cooperation with enterprise-stakeholders to create an effective system for interaction between the research and production sector ensuring the demand for research and development and affecting the independence and competitiveness of the mineral and raw materials complex;

- creating favorable conditions for the global mobility of students, post-graduate students, teachers and scientists at inter-regional, national and international levels, expansion of inter-university cooperation in the field of academic and research programs;
- developing the continuous professional education system, including all the necessary knowledge, skills and experience of innovative activity and facilitating full integration of mining specialists into the international professional environment.

To achieve the goals of innovative development based on the strategic vision of sustainable development, the technical university must complete a number of long-term tasks:

1. The development of a unified approach to assessing the quality of training and minimum threshold knowledge of mining specialists through engaging stakeholders into assessing the level of professional skills of future mining engineers.

2. The development of joint educational programs and training plans together with employers that meet modern challenges and trends in the development of mining, and use, as the multiplier, the synergy of the best international achievements of the mineral resource universities' community.

3. Conducting joint research with innovative companies in strategic scientific areas of development of the mineral and raw materials sector and making promising proposals and recommendations in the field of mining, transport and processing of mineral raw materials.

4. Equitable access for students studying at the expense of the state, own means and programs of targeted training to the educational and research infrastructure, including available scientific centers, laboratories, installations and instruments for fundamental and applied mining education.

5. Holding joint multi-university educational and scientific sessions and practices, creating joint effective systems for advanced training of teaching staff, as well as specialists and managers of the mineral and raw materials complex.

To complete a number of interrelated tasks set before the university by the imperative of sustainable development, the target area in which innovative competences will be trained should include the following:

1. Manufacturing new equipment which provides a condition for the industrial development of non-traditional sources of hydrocarbon resources.

2. The development of systems and methods for increasing the extraction of mineral raw materials, including depleted deposits of energy carriers.

3. The introduction of systems for complex and deep processing of mineral raw materials for increasing the extraction of both main and associated components at the sites of minerals.

4. The discovery of new genetic types of deposits, as well as the expansion of the geography of search and exploration of mineral deposits.

5. The development of resource-saving technologies for complex coal enrichment for involving off-balance reserves in processing and profitable use of waste from concentrating plants.

6. Introduction of new developments that contribute to reducing the level of environmental pollution, including minimization of areas for storage and disposal of waste in the areas of mining baffles of coal mines and open pits.

7. The introduction of equipment for pre-enrichment, working on different principles, at a quarry or in a mine.

The areas of application of innovative competences of mining engineers in the transition to the sustainable development include Intelligent Mine, Green Mining, integrated development of mineral resources and energy-saving technologies for their processing, including the associated extraction of components.

Taking into account all mentioned above, the initial range of innovative competences of the mining engineer, from which the upgrading of his university training should begin, is the following:

- understanding the basic positions of IT embedding in mining.
- the ability to rationalize the production of high-quality end products due to a new look at the international ISO quality standards;
- the ability to treat man-made waste as a resource for restoring the economy and solving environmental problems in the regions;
- the skill in applying and improving technologies for increasing the efficiency of processing resources, which will allow creating a mechanism for regulating the distribution of mineral resources among regions;
- a systematic understanding of the rational use of raw materials in the entire technological cycle of their extraction and complex processing obtaining products with high added value;
- understanding the basic positions of IT and the Internet of Things-technologies.

Training of these innovative competences requires a review of the functions of a technical university, ensuring its transformation into a regional center for innovative development. In the transition to the sustainable development, the functions of Alma Mater should include the following:

1. Increasing the relevance of higher mining education as an element of high-quality and inclusive education for all throughout life and participation in the formation of mechanisms that promote the sustainable development in the mineral and raw materials complex.

To achieve that, modern technical university will need to develop concepts and mechanisms for involving stakeholders (consumers of innovations) in planning, managing, drawing up curricula and training programs for miners' training, developing and assessing their professional skills, and also for cooperation between universities and mineral resource enterprises in the region for training in the workplace.

Along with this, the university should develop and present relevant mechanisms and tools for identifying current and future mining engineers' competencies being in demand in the mineral complex in transition to the sustainable development. The success of this lies in ensuring the relevance and quality of training programs for mining engineers in the context of changes in the labor markets and innovative development of the economy.

2. Activation of scientific research at the mineral resource technical university for setting up an information basis for the development of breakthrough innovations that ensure the reduction of environmental damage from the increasing extraction of mineral raw materials.

In turn, this requires the establishment of an effective system of interaction between scientific research and educational activity of the technical university, ensuring the correspondence of higher education training programs to the real needs and prospects for the development of enterprise-stakeholders of the mineral and raw materials sector.

Technical university, accordingly, should play the role of ideas and innovations' laboratory in the field of engineering mining education, as well as promote dialogue between company-stakeholders, and search for new ways for the conceptual development of the mining and processing industry.

3. Promotion of processes and results of mining engineers' training focused on the acquisition of innovative competencies, the exchange of knowledge and the promotion of ideas and values of engineering education in mineral and raw materials sector of the economy.

To realize this function, the technical university - the center for innovative development of the region - should strive to create favorable conditions for the global mobility of students, post-graduate students, teachers and scholars and the expansion of inter-university

cooperation in the field of educational and scientific-research programs for mineral resource and raw materials complex.

The establishment of an inter-regional center for the engineering practical training sessions within the framework of international cooperation for scientific and staff support of the extracting region in transition to the sustainable development means inclusive access to the educational and scientific infrastructure, including functioning scientific centers, laboratories, unique facilities and instruments for fundamental and applied education.

4 Conclusion

All mentioned above will fully determine the vector of development of scientific and educational activities at T.F. Gorbachev Kuzbass State Technical University as it is being transformed into a center for innovative development of the region and organization of engineering practical training sessions. The goal of the next decade for Alma Mater will be to increase the prestige and attractiveness of getting mining engineer profession focused on training innovative competencies in the mineral and raw materials sector.

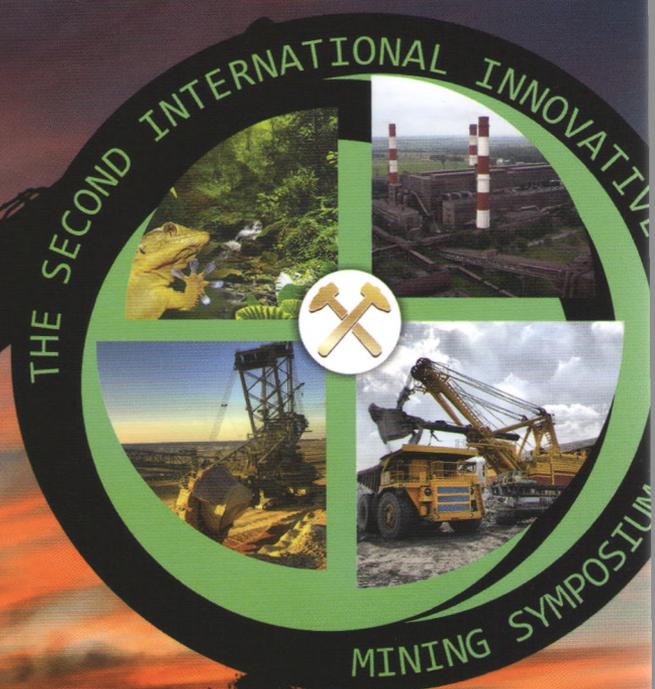
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Contents

00001 Preface: Innovative Competencies of Mining engineers in Transition to the Sustainable Development

A. Krechetov, A. Khoreshok and V. Blumenstein

00002 Preface: From Mining Innovations to Sustainable Development: Keynote Speakers of the First to the Second International Innovative Mining Symposium

M. Cehlár, J. Janočko, N. Demirel, S. Anyona, S. Vöth, M. Tyulenev and S. Zhironkin

Environment Saving Mining Technologies

01001 Gas Hydrates of Coal Layers as a Methane Source in the Atmosphere and Mine Working

V. Dyrdin, S. Shepeleva and T. Kim

01002 The Mine Working's Roof Stress-strain State Research in the Perspective of Development of New Coal Deposits of Kuzbass

S. Kostyuk, N. Bedarev, O. Lyubimov and A. Shaikhislamov

01003 Carbon-Containing Waste of Coal Enterprises in Magnetic Sorbents Technology

E. Kvashevaya, E. Ushakova and A. Ushakov

01004 Predicting the Possibility for Deep Hydroprocessing of Some Kuzbass Coals

I. Petrov and B. Tryasunov

01005 Development and Substantiation of Parameters of Environmentally Friendly Technology for Filling the Vertical Mine Workings with Autoclaved Slag-Concrete

A. Uglyanitca and K. Solonin

01006 Rock Deformation Behavior Near Excavations Under the Influence of High Tectonic Stress in Coal Seam V-12, "Severnaya" Mine, JSC "Urgalugol"

P. Grechishkin, E. Razumov, O. Petrova, A. Kozlov and E. Aushev

01007 New Technical Solution for Vertical Shaft Equipping Using Steel Headframe of Multifunction Purpose

E. Kassikhina, V. Pershin and Y. Glazkov

01008 Research of the Quality of Quarry Dumpers Engine Crankshafts Sliding Bearings of Various Manufacturers

A. Korotkov, L. Korotkova and D. Vidin

01009 New Opportunities to Expand Information on Intense-Strained State of the Earth's Crust in the Areas of Development Mineral Resources During Monitoring Creation

V. Pershin and A. Solovitskiy

- 01010 The Extent of Destruction Zones Within Protective Pillars in Jsc “Suek-Kuzbass” Underground Mines
N. Pirieva and I. Ermakova
- 01011 Prerequisites for the Establishment of the Automated Monitoring System and Accounting of the Displacement of the Roof of Underground Mines for the Improvement of Safety of Mining Work
A. Abramovich, E. Pudov and E. Kuzin
- 01012 Increasing Stability of Mine Surface Facilities on the Fill-Up Ground
M. Sokolov and S. Prostov
- 01013 Logistic Principles Application for Managing the Extraction and Transportation of Solid Minerals
A. Tyurin
- 01014 Promising Technologies of Mining and Processing of Solid Minerals
S. Shabaev, S. Ivanov and E. Vakhianov
- 01015 Three-Dimensional Computer Simulation as an Important Competence Based Aspect of a Modern Mining Professional
O. Aksenova and A. Pachkina
- 01016 Unmanned Mine of the 21st Centuries
I. Semykina, A. Grigoryev, A. Gargayev and V. Zavyalov
- 01017 Determination of the Geometric Form of a Plane of a Tectonic Gap as the Inverse Ill-posed Problem of Mathematical Physics
D. Sirota and V. Ivanov
- 01018 Parameters of Solidifying Mixtures Transporting at Underground Ore Mining
V. Golik and Y. Dmitrak
- 01019 Drilling Rig Operation Mode Recognition by an Artificial Neuronet
F. Abu-Abed and N. Borisov
- 01020 Perspectives for application of moulded sorption materials based on peat and mineral compositions
O. Misnikov
- 01021 Technogenic Rock Dumps Physical Properties’ Prognosis via Results of the Structure Numerical Modeling
S. Markov, V. Martyanov, E. Preis and A. Abay
- 01022 Modeling of Energy-saving System of Conditioning Mine Air for Shallow Underground Mines
A. Nikolaev, T. Miftakhov and E. Nikolaeva

- 01023 Knowledge Assessment Software in Mining Specialist Training
V. Lebedev and O. Puhova
- 01024 Modeling of Three Flat Coal Seams Strata Developing at Open Pit Mining
T. Gvozdkova, S. Markov, N. Demirel and S. Anyona
- 01025 Parameters of Transportation of Tailings of Metals Lixiviating
V. Golik and Y. Dmitrak
- 01026 Ecological and Economic Prerequisites for the Extraction of Solid Minerals from the Bottom of the Arctic Seas
A. Myaskov and A. Gonchar
- 01027 Efficiency of Low-Profile External Dumping at Open Pit Coal Mining in Kemerovo Region
A. Selyukov, V. Ermolaev and I. Kostinez
- 01028 Numerical Simulation of Aerogasdynamics Processes in a Longwall Panel for Estimation of Spontaneous Combustion Hazards
S. Meshkov and A. Sidorenko
- 01029 The Development of Environmentally Friendly Technologies of Using Coals and Products of Their Enrichment in the Form of Coal Water Slurries
V. Murko and V. Hamalainen
- 01030 Assessing the Effects of Underground Mining Activities on High-Voltage Overhead Power Lines
V. Gusev, A. Zhuravlyov and E. Maliukhina
- 01031 Using of Wide Stopes in Coalless Zones Mined by Shovels and Backhoes
V. Kolesnikov, O. Litvin, J. Janočko and A. Efremenkov
- 01032 Intelligent Mining Engineering Systems in the Structure of Industry 4.0
M. Rylnikova, D. Radchenko and D. Klebanov
- 01033 Causes of Low Efficiency of Combined Ventilation System in Coal Mines in Resolving the Problem of Air Leaks (Inflows) Between Levels and Surface
V. Popov, Y. Filatov, Hee Lee and A. Golik
- 01034 Problem of Methane-Air Mixture Explosions in Working Faces of Coal Mines at Mining Intensification and Ways of its Solution
S. Novoselov, V. Popov, Y. Filatov, Hee Lee and A. Golik
- 01035 Coal Squeezing-Out, its Description and Conditions of Development
S. Kostyuk, A. Gegreen, V. Meljnik and M. Lupeey

Environment Problems in Mining Regions

- 02001 Energy and Resource-Saving Sources of Energy in Small Power Engineering of Siberia
M. Baranova
- 02002 The Increase of Power Efficiency of Underground Coal Mining by the Forecasting of Electric Power Consumption
V. Efremenko, R. Belyaevsky and E. Skrebneva
- 02003 Scientific Background for Processing of Aluminum Waste
O. Kononchuk, A. Alekseev, O. Zubkova and V. Udovitsky
- 02004 Research of Environmental and Economic Interactions of Coke And By-Product Process
V. Mikhailov, T. Kiseleva, S. Bugrova, A. Muromtseva and Y. Mikhailova
- 02005 Coal Producer's Rubber Waste Processing Development
E. Makarevich, A. Papin, A. Nevedrov, T. Cherkasova and A. Ignatova
- 02006 Enhancement of Operating Efficiency of the Central Coal-Preparation Plant of "MMK –UGOL" Ltd. Under Current Conditions
M. Basarygin
- 02007 Diagnostics of Oil Pollution Zones by Electro-Physical Method
S. Prostov and E. Shabanov
- 02008 Ensuring the Environmental and Industrial Safety in Solid Mineral Deposit Surface Mining
K. Trubetskoy, M. Rylnikova and E. Esina
- 02009 Rare and Rare-Earth Metals in Coal Processing Waste
T. Cherkasova, E. Cherkasova, A. Tikhomirova, A. Bobrovnikova and I. Goryunova
- 02010 Effective Processing of the Iron Ores
V. Kuskov, Y. Kuskova and V. Udovitsky
- 02011 Influence of Coal Industry Enterprises on Biodiversity (on the Example of Formicidae)
S. Blinova and T. Dobrydina
- 02012 Land Resource Management as the Ground for Mining Area Sustainable Development
A. Solovitskiy, O. Brel, N. Nikulin, E. Nastavko and T. Meser
- 02013 Adaptive Adjustment in Taraxacum Officinale Wigg. in the Conditions of Overburden Dump
O. Legoshchina, I. Egorova and O. Neverova

02014 Formation of Mesoherpetobionts Communities on a Reclaimed Coal Open Pit Dump

S. Luzyanin and N. Eremeeva

02015 Resource-Saving Cleaning Technologies for Power Plant Waste-Water Cooling Ponds

L. Zakonnova, I. Nikishkin and A. Rostovzev

02016 Innovative Production of Polyvinylchloride on the Basis of Vertical Integration of Business and Cluster Organisation

I. Kudryashova, N. Zakharova and E. Kharlampenkov

02017 The Environmental Impacts of the Coal Industry

S. Burtsev, V. Efimov and T. Korchagina

02018 Stimulation of the Methane Production with the Use of Changing of the Rock Massif Physical Conditions

M. Baev, V. Khyamyalyaynen and A. Shevtsov

02019 Increasing the Reliability of the Work of Artificial Filtering Arrays for the Purification of Quarry Waste Water

M. Tyulenev, Y. Lesin, O. Litvin, E. Maliukhina and A. Abay

02020 Organizational-Legal and Technological Aspects of Ensuring Environmental Safety of Mining Enterprises: Perspective Analysis in the Context of the General Enhancement of Environmental Problem

E. Vorontsova, A. Vorontsov and Y. Drozdenko

02021 Belt Aligning Revisited

V. Yurchenko

02022 Spectral Study of Modified Humic Acids from Lignite

S. Zhrebtsov, N. Malysenko, L. Bryukhovetskaya and Z. Ismagilov

Innovations in Mining Machinery

03001 Substantiation of the Necessity for Design of Geohod Control System

V. Aksenov, I. Chicherin, I. Kostinez, A. Kazantsev and A. Efremenkov

03002 Dependence of Reliability and Resource of the Elements of the Design of Quarry Automatics with the Degrees of their Downloads

D. Stenin and N. Stenina

03003 Functional Quality Criterion of Rock Handling Mechanization at Open-pit Mines

Y. Voronov and A. Voronov

- 03004 Definition of Static Voltage Characteristics of the Motor Load for the Purpose of Increase in Energy Efficiency of Coal Mines of Kuzbass
F. Nepsha and V. Efremenko
- 03005 Disk Rock Cutting Tool for the Implementation of Resource-Saving Technologies of Mining of Solid Minerals
L. Mametyev, A. Khoreshok, A. Tsekhin and A. Borisov
- 03006 Technical Diagnostics of Ventilation Units for Energy Efficiency and Safety of Operation
E. Kuzin, V. Shahmanov and D. Dubinkin
- 03007 Load Cases Relevant for Proof of Competence of Fast Running Hoists
S. Vöth
- 03008 The Influence of Parameters on the Generatrix of the Helicoid Form Guide of Geokhod Bar Working Body
V. Aksenov, V. Sadovets and D. Pashkov
- 03009 Application of Mathematical and Three-Dimensional Computer Modeling Tools in the Planning of Processes of Fuel and Energy Complexes
O. Aksenova, E. Nikolaeva and M. Cehlár
- 03010 Justification of the Shape of a Non-Circular Cross-Section for Drilling With a Roller Cutter
G. Buyalich and M. Husnutdinov
- 03011 Improving the Repair Planning System for Mining Equipment on the Basis of Non-destructive Evaluation Data
M. Drygin and N. Kuryshkin
- 03012 The Raising Influence of Information Technologies on Professional Training in the Sphere of Automated Driving When Transporting Mined Rock
A. Kosolapov and S. Krysin
- 03013 Estimation of Energy Efficiency of Means of Transport According to the Results of Technical Diagnostics
A. Shalkov and M. Mamaeva
- 03014 Innovations of Engineering Company and Competitiveness in the Mining Equipment Market
V. Pogrebnoi, L. Samorodova, L. Shut'ko, Y. Yakunina and O. Lyubimov
- 03015 Increasing the Technical Level of Mining Haul Trucks
Y. Voronov, A. Voronov, S. Grishin and A. Bujankin
- 03016 Forecasting of a Thermal Condition of Pneumatic Tires of Dump Trucks
A. Kvasova, B. Gerike, E. Murko and D. Skudarnov

03017 Perfection of Methods of Mathematical Analysis for Increasing the Completeness of Subsoil Development

M. Fokina

03018 Factors Determining the Size of Sealing Clearance in Hydraulic Legs of Powered Supports

G. Buyalich, K. Buyalich and M. Byakov

Mining Regions' Sustainable Development

04001 Individual Learning Route as a Way of Highly Qualified Specialists Training for Extraction of Solid Commercial Minerals Enterprises

E. Oschepkova, I. Vasinskaya and I. Sockoluck

04002 Sustainable Development vs. Post-Industrial Transformation: Possibilities for Russia

S. Zhironkin, M. Gasanov, G. Barysheva, E. Gasanov, O. Zhironkina and G. Kayachev

04003 Neo-Industrial and Sustainable Development of Russia as Mineral Resources Exploiting Country

M. Prokudina, O. Zhironkina, O. Kalinina, M. Gasanov, F. Agafonov

04004 Viral Management as a New Type of Enterprise Management in Coal Industry

O. Garafonova, S. Grigashkina and A. Zhosan

04005 The Regional-Matrix Approach to the Training of Highly Qualified Personnel for the Sustainable Development of the Mining Region

E. Zhernov and E. Nehoda

04006 Improvement of the System of Training of Specialists by University for Coal Mining Enterprises

V. Mikhailchenko and I. Seredkina

04007 The Concept of Resource Use Efficiency as a Theoretical Basis for Promising Coal Mining Technologies

V. Mikhailchenko

04008 Ideological Paradigms and Their Impact on Environmental Problems Solutions in Coal Mining Regions

V. Zolotukhin, N. Zolotukhina, M. Yazevich, A. Rodionov and Marina Kozyreva

04009 The Prospects of Accounting at Mining Enterprises as a Factor of Ensuring their Sustainable Development

T. Tyuleneva

04010 Tools of Realization of Social Responsibility of Industrial Business for Sustainable Socio-economic Development of Mining Region's Rural Territory

T. Jurzina, N. Egorova, N. Zaruba and P. Kosinskij

- 04011 Score Mining Rents in Terms of Investment Attractiveness of Peat Mining
G. Alexandrov and A. Yablonev
- 04012 Mastering Foreign Language Competence of Ecology and Environment Managers for Mining Industry of Kuzbass
O. Greenwald, R. Islamov and T. Sergeychick
- 04013 NBIC-Convergence as a Paradigm Platform of Sustainable Development
E. Dotsenko
- 04014 Sustainable Development Strategy for Russian Mineral Resources Extracting Economy
E. Dotsenko, N. Ezdina, A. Prilepskaya and K. Pivnyk
- 04015 Humanity and Environment Co-influence in the Shadow of Technological Convergence
N. Ezdina
- 04016 Modern Trends of Additional Professional Education Development for Mineral Resource Extracting
O. Borisova, V. Frolova and E. Merzlikina
- 04017 Corporate Social and Ecological Responsibility of Russian Coal Mining Companies
N. Ravochkin, V. Shchennikov and V. Syrov
- 04018 Diversification of the Higher Mining Education Financing in Globalization Era
V. Frolova, O. Dolina and T. Shpil'kina
- 04019 Andragogical Model in Language Training of Mining Specialists
E. Bondareva, G. Chistyakova, Y. Kleshevskyi, S. Sergeev and A. Stepanov
- 04020 Improving Occupational and Industrial Safety Management System at Coal Mining Enterprises
S. Smagina, O. Kadnikova, K. Demidenko, G. Chistyakova and A. Rolgayzer
- 04021 Education within Sustainable Development: Critical Thinking Formation on ESL Class
I. Pevneva, O. Gavrishina, A. Smirnova, E. Rozhneva and N. Yakimova
- 04022 Some Diversification Factors of Old Industrial Regions' Economy and Transition to the Innovative Development
O. Tabashnikova
- 04023 Key Trends in Institutional Changes Under Sustainable Development
O. Karpova, I. Pevneva, I. Dymova, T. Kostina and S. Li
- 04024 Integration of MOOCs in Advanced Mining Training Programmes

I. Saveleva, O. Greenwald, S. Kolomiets and E. Medvedeva

04025 Innovative Technological Development of Russian Mining Regions (on Example of Kemerovo Region)

E. Shavina and O. Kalenov

04026 Age-Sex Structure of the Population and Demographic Processes in Environmentally Challenged Mining Region (on the example of Kemerovo region)

T. Leshukov, O. Brel, A. Zaytseva, Ph. Kaizer and K Makarov

04027 The Distribution of the Informative Intensity of the Text in Terms of its Structure (On Materials of the English Texts in the Mining Sphere)

L. Znikina and E. Rozhneva

04028 Training of Engineering Personnel for the Innovative Coal Industry: Problems and Ways of Solution

N. Zaruba, T. Fraltsova and T. Snegireva

04029 Innovative Model of Practice-Oriented Training of Employees of the Town-Forming Enterprise in the Mining Region (by the Example of JSC "SUEK-Kuzbass")

S. Kulay and G. Kayachev

04030 Improvement and Development of the Motivation System in the Occupational and Industrial Safety Field

A. Pavlov and D. Gavrilov

The sustainable development of mining regions requires synchronous impetus of innovations in mineral resources extracting and processing, environment protection technologies, mining machinery and social-and-economic activities. The whole industrial complex of the region including subsoil use, modernization of mining equipment and the development of human capital should become a platform for sustainable development. The aim of The 11nd International Innovative Mining Symposium (Devoted to Russian Federation Year of Environment) is to create a workshop for international discussion of urgent issues of resource sector's environment-friendly development worldwide by specialists, experts and researchers. The leading role in this discussion belongs to the mineral resource universities – the centers of innovative development of the mining regions.

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