

# Quality Engineering Education in the Context of Industry 4.0



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# INTRODUCTION

- In the context of Industry 4.0, the energy sector is receiving new challenges, which requires finding adequate answers related to the introduction of innovative technologies, robotics, the creation of information systems based on artificial intelligence, and the training of highly professional specialists, who in turn are the driving force in the development of Industry 4.0 technologies.
- The intensive spread of information and telecommunications technologies in the era of Industry 4.0 and their penetration into all spheres of society raises the problems of information protection and cybersecurity to a new level.
- High-quality education of specialists in the field of combating information threats is an essential condition for the development of the digital economy, including the energy sector.

# 1. INDUSTRY 4.0 - " SMART ENERGY»



**Klaus Schwab**

- The founder and President of the world economic forum in Davos, Klaus Schwab, in his writings on the fourth industrial revolution, highlights its key manifestations – artificial intelligence, industrial Internet of things, robotics, unmanned vehicles, simulation and augmented reality technologies, cloud technologies, bioengineering and new materials, big data analysis, unlimited access to the Internet and the development of information technologies that are becoming a reality in modern reality.

1.

*Шwab К. Четвертая промышленная революция. - М.: Эксмо. 2016.*

# National program "Digital economy of the Russian Federation".

- accepted in 2017.
- received the status of "national program" in 2019.
- **Includes six Federal projects**
  - "Regulatory regulation of the digital environment",
  - "Human resources for the digital economy",
  - "Information infrastructure",
  - "Information security",
  - "Digital public administration"
  - **By 2025, almost 1.62 trillion rubles will be invested in their implementation.**

3. ПАСПОРТ НАЦИОНАЛЬНОГО ПРОЕКТА НАЦИОНАЛЬНАЯ ПРОГРАММА «ЦИФРОВАЯ ЭКОНОМИКА РОССИЙСКОЙ ФЕДЕРАЦИИ» [Электронный ресурс] – Режим доступа <https://bazanpra.ru/sovet-pri-prezidente-rf-po-strategicheskomu-razvitiyu-i-natsionalnym-proektam-pasport-ot04062019-h4447516/> (дата обращения: 18.11.2019).

# Digitalization of the Russian electric power industry

It is implemented within the framework of the long-term integrated program "national technology initiative" (NTI)

**The Energy Net project** - "Distributed energy from personal power to smart grid, smart city" - is designed to create a new image of the energy network and organize the energy market that meets current and future challenges.

**The goal** is to create conditions for global technological leadership of Russian companies in new markets of smart power networks and to ensure a sustainable prospect of modernizing the electric power infrastructure.

5. *Энерджинет. Национальная технологическая инициатива [Электронный ресурс]. – Режим доступа <https://nti2035.ru/markets/energyne> (дата обращения: 18.11.2019).*

# The architecture of the project Energy Net

**It is based** on reliable and flexible networks that meet performance criteria in terms of reliability, availability, cost of ownership, openness and adaptability to new market participants.

**Potential** - distributed energy, which provides the inclusion of distributed generation, storage, and micro-networks in the network, and the creation of virtual power stations to reduce the peak of the power reserve in the system.

**Perspective** - new types of energy consumer services that can replace the functions of familiar subjects of the energy market with network software applications for end users/

6. *EnergyNet. Национальная технологическая инициатива [Электронный ресурс]. – Режим доступа <https://energy.net.ru/?p=whatisit> (дата обращения: 18.11.2019).*

## According to experts ' estimates

- "Distributed energy is a catalyst and a key element of the "energy transition" from the traditional organization of energy systems of the XX century to the new technologies and practices of the XXI century."
- The "energy transition" is based on decentralization, digitalization, and intellectualization of energy supply systems, with the active involvement of consumers themselves and all types of energy resources, and is characterized by increased energy efficiency and reduced greenhouse gas emissions (primarily from renewable energy sources)»
- **Pilot projects of distributed (small) energy in the Russian Federation:**
  - ❖ digital RES project-Yantarenergo (Kaliningrad region);
  - ❖ project on implementation of smart grid technologies in Sevastopol

8. *«Энерджинет»: распределенная энергетика от personal power до smart grid, smart city // Национальная технологическая инициатива. [Электронный ресурс]. – Режим доступа <http://www.nti2035.ru/markets/energynet> (дата обращения: 18.11.2019)*

## 2. CYBERSECURITY: STANDARDIZATION OF DEFINITIONS AND VARIABILITY OF TASKS

- Industry 4.0 has given rise to the concept of "Quality 4.0".
- Quality 4.0 includes the digitalization of quality, management systems, and conformity assessment, and focuses less on the application of technology in an organization than on improving a culture of collaboration and leadership through the use of technology. Качество 4.0
- **Cybersecurity** is the state of security of cyberspace, a complex environment created by a combination of information, the information environment and the information impact of people.
- According to ISO / IEC 27032: 2012, the term "cybersecurity" is mainly associated with network security, application security, Internet security, and the security of critical information infrastructures (CII)

10. *Международный стандарт ИСО / МЭК 27032:2012 Руководящие указания по кибербезопасности «Информационные технологии. Методы обеспечения безопасности. Руководящие указания по кибербезопасности».*  
(дата обращения: 05.11.2019).



# Federal project "Information security"

The goal is to create a secure and sustainable information infrastructure for citizens, business and government representatives in the digital space.

## Indicators by 2024:

- 100 export-oriented developer companies will receive support;
- 90% of the network traffic of the Russian segment of the Internet will be routed on the territory of Russia;
- 97% of the population will use information security tools;
- less than 10% will be the cost share of foreign software purchased or leased by public authorities»

11. «Информационная безопасность». Министерство цифрового развития, связи и массовых коммуникаций Российской Федерации [Electronic resource] <https://digital.gov.ru/ru/activity/directions/874/> (дата обращения: 05.11.2019).

## The increase in the number of IT crimes in Russia

- 2016 г. – 60 thousand,
- 2017 г. – 91 thousand,
- 2018 г. - 170 thousand,
- 2019 г. - 294 thousand,

In early 2020 The Russian investigative Committee has created a Department to investigate cybercrime.

In the structure of the Ministry of internal Affairs in the Central office and on the ground organized special forces to combat cybercrime

# Achieving maximum information security for the Russian energy sector.

- The Russian energy industry and companies in the energy sector are currently undergoing a period of formation and improvement of cybersecurity systems.
- This is due, first, to an increase in cyber attacks on power generation and sales management systems, and, second, to an increase in the state's requirements for CII security.
- According to the head of Rosset, P. A. Livinsky, every year the company's specialists block about 9 million attempts to penetrate the corporate perimeter and the company's defense costs are about 2 billion rubles a year.

12. «Россети» тратят около 2 млрд рублей в год на защиту от кибератак [Электронный ресурс].  
– Режим доступа <https://tass.ru/ekonomika/6953053> (дата обращения: 18.11.2019)

### 3. ENGINEERING EDUCATION: STRATEGY AND PRACTICAL STEPS

**Targets** of the national project in the field of education approved by the decree of the President of the Russian Federation from may 7, 2018 No. 204 "On the national goals and strategic objectives development of the Russian Federation for the period until 2024" :

- “ensuring global competitiveness of Russian education, the entry of the Russian Federation among the 10 leading countries in quality of General education;
- education of a harmoniously developed and socially responsible person based on the spiritual and moral values of the peoples of the Russian Federation, historical and national cultural traditions”.

14. *Указ Президента РФ от 7 мая 2018 г. № 204 «О национальных целях и стратегических задачах развития Российской Федерации на период до 2024 года» Электронный ресурс]. – Режим доступа <https://www.garant.ru/products/ipo/prime/doc/71837200/>(дата обращения: 05.11.2019).*

# The main activities of the Russian Government for the period up to 2024 in the field of "Education" <sup>13</sup>

- to meet an increasing demand for strategically important sectors for highly qualified personnel with a high level of professional expertise in critical technological areas, trades and professions,
- formation of integral system of reproduction of personnel for research and technological development of the country,
- Russia's entry into the top 10 countries on the quality of General education, expanding the presence of Russian universities in the top 500 global University,
- rankings - Academic Ranking of World Universities (ARWU), Times Higher Education (THE), QS World University Rankings (QS).

15. «Основные направления деятельности Правительства Российской Федерации на период до 2024 года» (утв. Правительством РФ 29.09.2018) [Электронный ресурс]. – Режим доступа <http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=LAW&n=307872&fld=134&dst=1000000001,0&rnd=0.020330185845882642#09877719478826179>(дата обращения: 05.11.2019).

# Transformation of the education system in the context of digitalization of the economy

- changing the infrastructure of the educational process,
- development of training programs using artificial intelligence,
- transformation of education management (administration and control over the development of academic disciplines by students, their universal identification, tools for evaluating the knowledge obtained),
- improving the professionalism of the teaching staff in the field of IT technologies, etc.

# Changes in engineering education in the context of Industry 4.0

## Main direction is the introduction of a new model for training "engineers of the future"

Building an educational process based on interdisciplinary breakthrough technologies

- Implementation of practice-oriented educational programs.
- Formation of personal qualities of a specialist:
  - ❖ high civil responsibility,
  - ❖ spiritual and moral values based on national historical and cultural traditions,
  - ❖ interpersonal communication skills.

# Federal project «Personnel for the digital economy»

## Indicators

- 120 thousand people will be admitted annually to higher education programs in it specialties in accordance with the admission targets set by the Ministry of education and science of the Russian Federation;
- 270 thousand working professionals, including heads of organizations and representatives of Executive authorities (starting in 2019), will be trained in the digital economy competencies;
- all graduates of the professional education system must have the key competencies of the digital economy;
- 2000 projects related to the development of advanced educational technologies of the digital economy will be supported.



# Training of specialists in the field of «Information security»

## Increasing enrollment in higher education institutions

In 2014, the enrollment was 4,400.

- In 2019, 8000 students were accepted for the 1st year in the direction of "Information security", and the share of paid admission is 35% of the number of applicants (2750 people). человек).

In the rating of quality of budget and paid admission to higher education institutions, NIU " MPEI " takes a worthy 9th place out of 125 universities that conduct admission in this direction.

16. *Качество приема в российские вузы — 2018. Часть 2. Направления подготовки / под ред. М. С. Добряковой, Я. И. Кузьминова ; Нац. исслед. ун-т «Высшая школа экономики».* — М.: Изд. дом ВШЭ, 2018. (дата обращения: 05.11.2019).

# The digitalization of the educational process in the National research university «MPEI»

1. The use of new information technologies and specialized application software packages in the learning process, specifying them depending on the direction of training and certain competencies in accordance with the Federal state educational standards of higher education (FSES VO 3++).

- Educational and scientific divisions of NRU " MPEI " - 11 institutes of NRU" MPEI "carry out the formation and practical application of effective educational technologies and electronic educational and methodological complexes in all the main academic disciplines taught at NRU"MPEI".
- All key Department and Institute auditoriums are equipped with modern multimedia facilities, and all plans and programs are in compliance with the FSES VO 3++.
- NRU " MPEI " has an information infrastructure that allows for effective implementation of basic educational programs and programs of additional education, including the extensive use of distance education technologies.

# The digitalization of the educational process in the National research university «MPEI»

## 2. The use of new technologies and methods of organizing educational processes, providing administrative and managerial personnel with opportunities for information management of educational activities.

- The information and computing center of NRU "MPEI" regularly conducts research and development of advanced information technologies, their implementation to meet the information needs of the University in the scientific, educational and administrative spheres.
- Functioning of the MPEI Corporate information system (CIS).

### CIS includes subsystems:KMC

- ❖ learning activities (Student, Session, BARS, Practice, Employment, help, student, Graduate student, Student SOT, SOD Graduate),
- ❖ management activities (Personnel, STIM PPP/THEM, TIMEUP, Division),
- ❖ scientific activities (Site councils, Competitor, Contract R & d),
- ❖ financial and economic activities (one stop shop).

# CONCLUSION

- Energy is a strategically important sector of the economy and is directly linked to Russia's national security.
- Training specialists who ensure the stability of energy facilities from cyber threats is a necessary requirement for the effective functioning of energy systems in the conditions of the fourth industrial revolution.
- Modernization of higher education based on modern learning models provides for the introduction of practice-oriented educational programs and allows students to form modern professional competencies.
- Practical experience of National Research University "MPEI" shows the concrete results of the use of digitalization in the educational process and its management.
- At the stage of formation of the digital economy, interdisciplinary educational approaches should be aimed at training specialists who are able to develop science, technology and technology, and at the same time have the knowledge to protect these achievements from cyber threats.

# Thank you for attention!

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