

# MAINTENANCE FORUM 2018

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## ENGINEERING EDUCATION TO ENHANCE THE STATE'S ECONOMIC POTENTIAL

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Volga state university of technology*





# Competitiveness of the economy and GDP

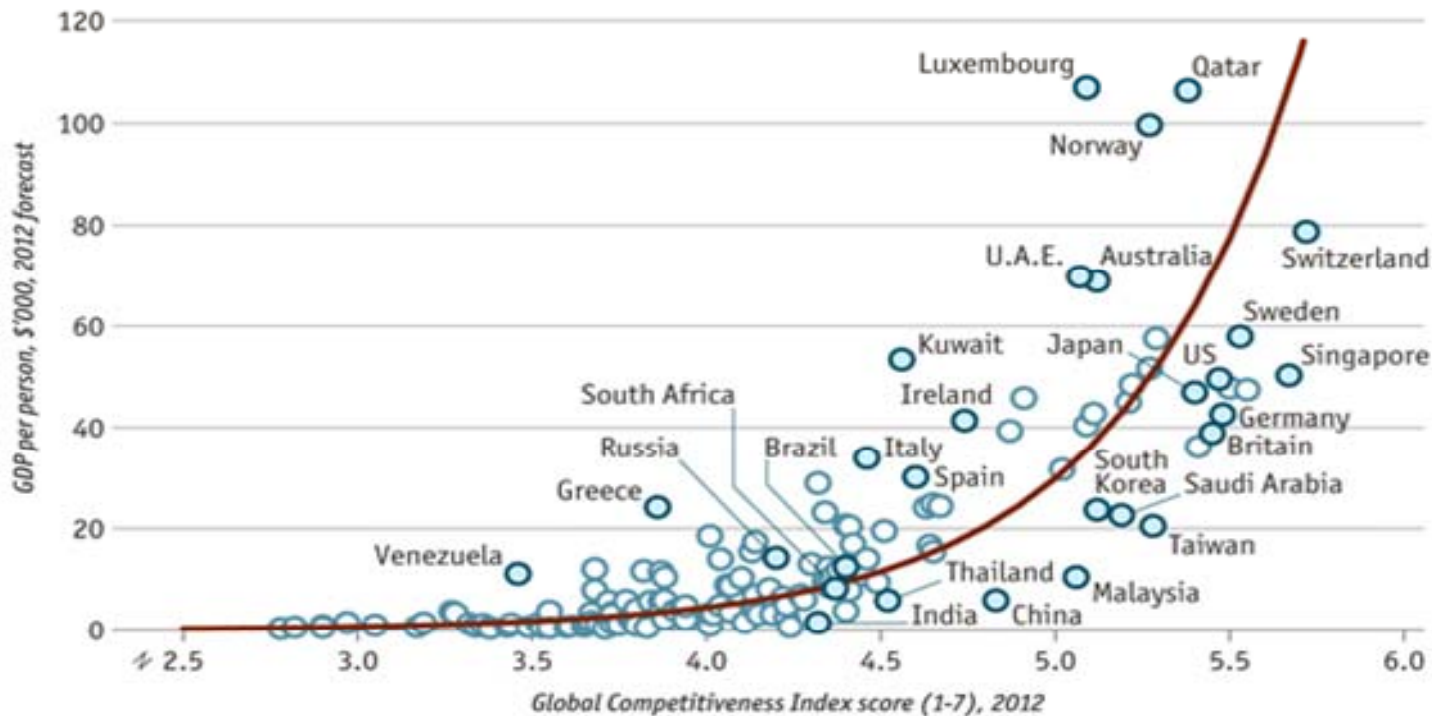
Competitiveness → Living standards → GDP →-----

– **Human Assets ->---> Education**

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**Global competitiveness and GDP per person**  
2012



Sources: World Economic Forum; IMF; The Economist

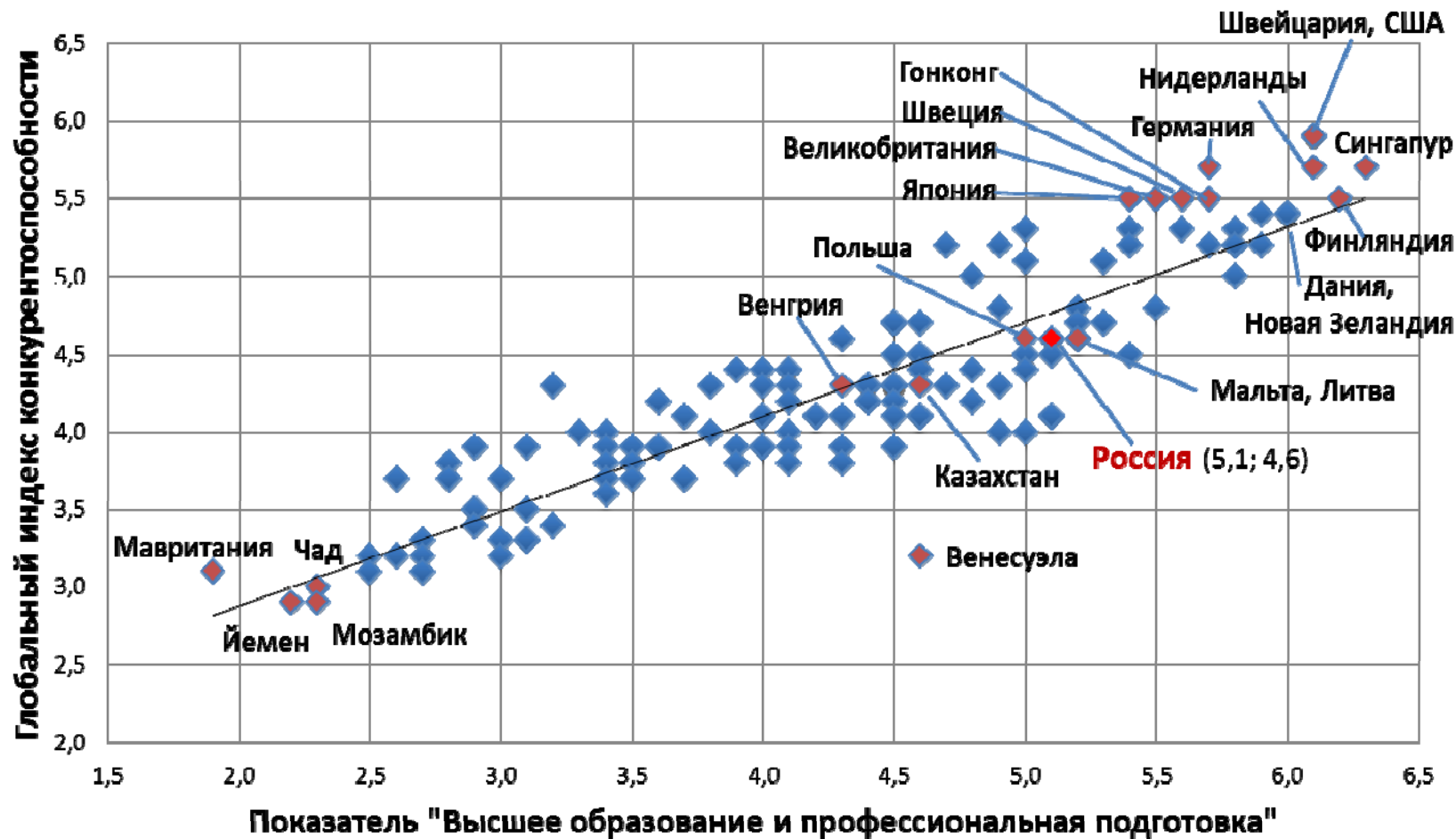
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## Global Competitiveness Index and Higher Education and Professional Training Indicator (*pillar 5*)

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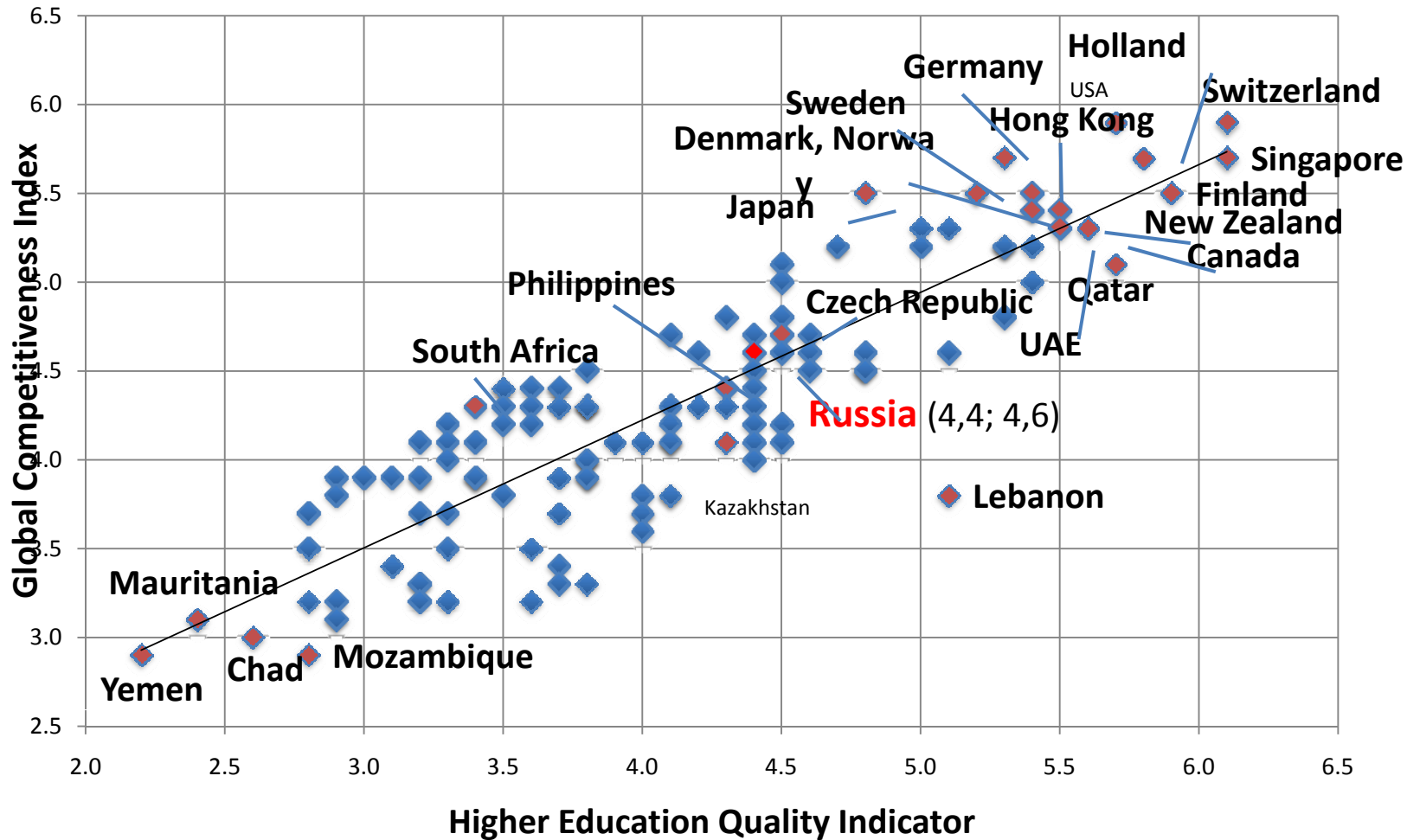
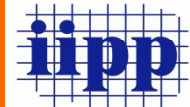


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# Global Competitiveness Index and Higher Education Quality Indicator (pillar 5.B.)

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## University Graduates' Main Weaknesses (according to the opinion of employers and employment agencies)

- ✓ Extremely low efficiency and productivity of engineering labour among university graduates, insufficient knowledge, skills and experience in using high-performance integrated computer network design tools (CALS-technology);
- ✓ Lack of knowledge about the business processes and the specific features of the Russian business environment in general;
- ✓ Insufficient business communication skills, negotiations, lack of communication and presentation skills;
- ✓ Insufficient level of foreign language training;
- ✓ Lack of knowledge about the complex systems development methods (synergetics);
- ✓ Inflated demands and ambitions not corresponding to the level of training, inability to assess one's value in the labour market.

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## What do the young professionals lack? *(Large and medium-scale companies)*

- ✓ professional skills;
- ✓ knowledge of laws and methods of creative solutions to the engineering problems;
- ✓ motivation,
- ✓ focus on professional development and career growth;
- ✓ readiness for teamwork;
- ✓ ability to present oneself and the results of their work in the professional environment.

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## CONTRADICTION BETWEEN THE QUALITY OF ENGINEER TRAINING AND EMPLOYERS' REQUIREMENTS

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### Employers' requirements:

- ability to systematically and independently think and effectively solve production problems using the competencies gained at the university;
- skill to work in a team;
- knowledge of business processes and business environment in general;
- ability to generate and perceive innovative ideas;
- ability to present one's idea in a well-argued manner;
- ability to use foreign languages for work.

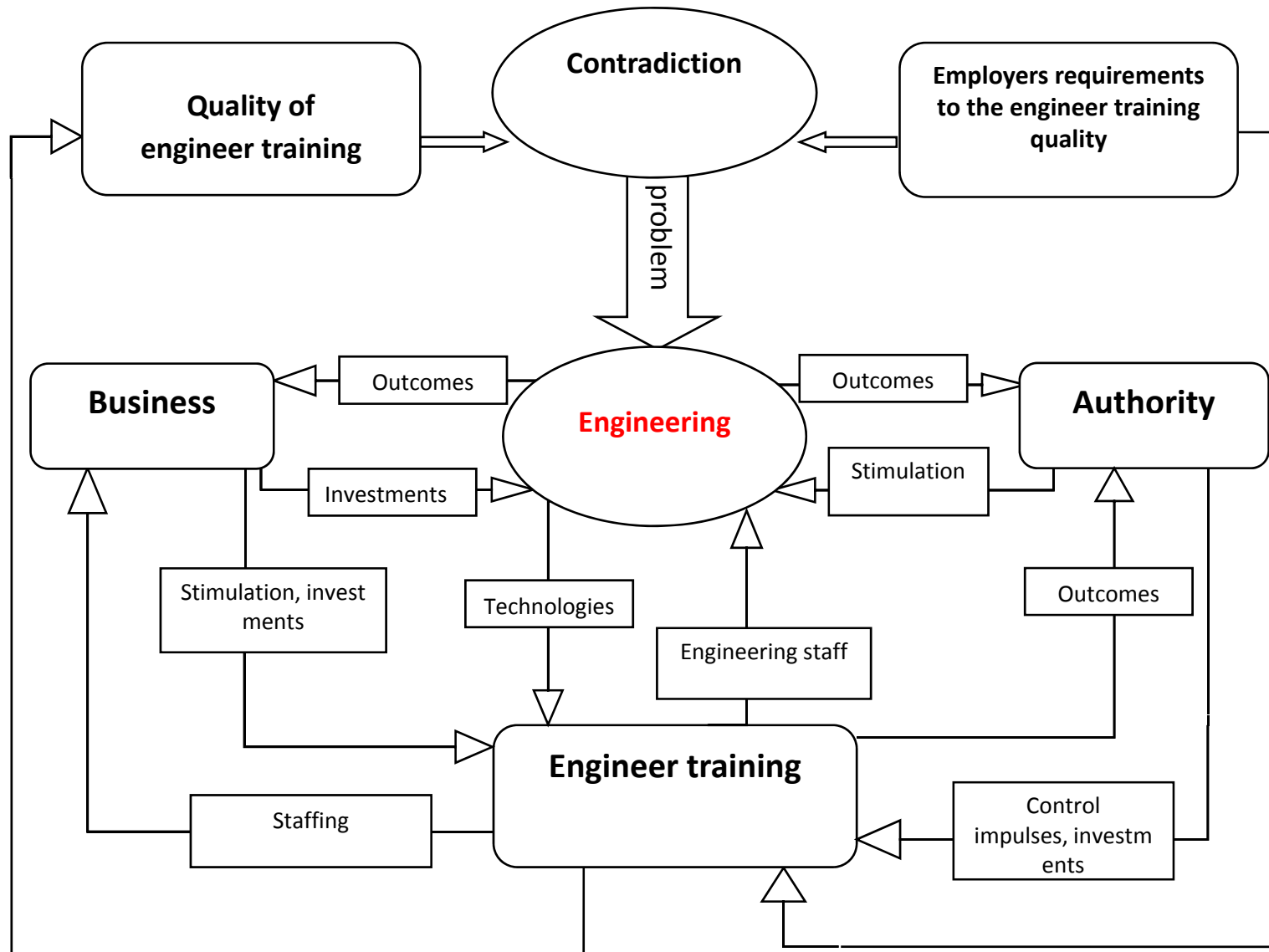
**Higher educational institutions** mainly provide their students with **the knowledge in the subjects studied:**

- knowledge in the field of natural sciences;
- knowledge of design algorithms and technologies;
- knowledge in the field of general engineering disciplines.

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## System Vision of the Problematic Situation in the Field of Engineering and Engineering Training in Russia



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## Present-day Challenges to Higher Engineering Education

1. Lack of aligned connections of the "Triple Spiral" (power - business - science)
2. Lack of market trends understanding
3. Lack of a venture market and a startup market in Russia
4. A small number of high-level scientific research
5. A low level of entrepreneurial competence among the university graduates

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## Responses to the Challenges of Engineering Universities

- ✓ The general trend being the movement toward the establishment of an entrepreneurial university
- ✓ Transformation of the university corporate culture
- ✓ Transformation of the content and the form of the study programmes and technologies
- ✓ Managerial, research and teaching staff qualification improvement

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## Entrepreneurial University (University 3.0)

- ✓ An entrepreneurial university is defined as a university that has the capability to innovate, recognize and create opportunities, to work in a team, to take risks and to respond to challenges (Kirby, 2002a).
- ✓ In other words, it is a natural incubator that provides a support structure for teachers and students to initiate new businesses: intellectual, commercial and combined ones (Etzkowitz, 2003).

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## ENTREPRENEURIAL UNIVERSITY (UNIVERSITY 3.0)

- ✓ A key competence: the ability to manage the intellectual activity, outcomes, to establish an entrepreneurial ecosystem, to develop the urban environment around itself.
- ✓ In fact, the university is to become a city-forming center.
- ✓ An economic agent, a large company. The most important element of the transition to this model is one's own competencies in understanding of how markets develop.
- ✓ It provides better competencies in understanding the market than the surrounding corporate environment. That is why it applies for professors, students, knowledge, joint projects.

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## INNOVATION ACTIVITIES DEVELOPMENT

### Students' entrepreneurial thinking

1. The system of involvement in innovation and entrepreneurial activity
  - Developing a line of extracurricular activities
  - Setting up a student online-platform
  - Supporting social networks as a communication channel for students
2. Teaching Technology Entrepreneurship
  - Optional subjects
  - Master's degree program
  - Training teachers
3. Establishment of student entrepreneurial clubs
4. Setting up industrial co-working space (prototyping center for technical universities)

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## INNOVATION ACTIVITIES DEVELOPMENT TOOLS

### Acceleration and incubation of projects

1. Setting up the regulatory framework of the business incubator
2. Launch of the accelerated programme at the university
3. Arranging a school of trackers for incubator projects
4. Setting up services for the incubator:
  - Marketing;
  - Investment raising;
  - Protection of Intellectual Property, etc.
5. Starting a mentoring programme in the incubator

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## INNOVATION ACTIVITIES DEVELOPMENT TOOLS

### Arrangement of the investment raising system

1. Formation of the investment raising competence
2. Arrangement of work with venture funds
3. Establishment of the investor's club (private individuals)

### Setting up work with the business assets of the university (setting up share management of the small innovative enterprise (university spin-off))

1. University regulations for small innovative enterprises
2. Asset management company to work with small innovative enterprises

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## INNOVATION ACTIVITIES DEVELOPMENT TOOLS

Self-presentation of the university (including the involvement of the business community)

1. Holding forums, conferences, roundtables on the entrepreneurship subjects at the regional and federal level
2. Holding university-based business forums
3. Holding competitions of university projects involving investors

Establishing business contacts with the industrial partners

1. Organization and submission of joint grants (FTP, Resolution No. 218, etc.)
1. Establishing technology transfer through licenses

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## TOOLS TO SET UP PROFESSIONAL AND PERSONAL COMPETENCIES OF PROSPECTIVE ENGINEERS

1. Use of the competency approach to design and to implement engineering study programmes
2. Use of practice-focused and project-organized educational technologies, the formation of new and exclusive competencies
3. Use of industrial capacities for training engineers
4. Professional training taking into account student's abilities and inclinations
5. Teamwork training
6. Management training



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## USE OF THE COMPETENCY APPROACH

1. Creating professional standard-based engineering study programmes
2. Identifying the required competencies for the students of Bachelor, Specialist, Master's degree programmes
3. Implementing the viable projects while training
4. Inclusion of the work experience internship at the modern enterprises in the curricula

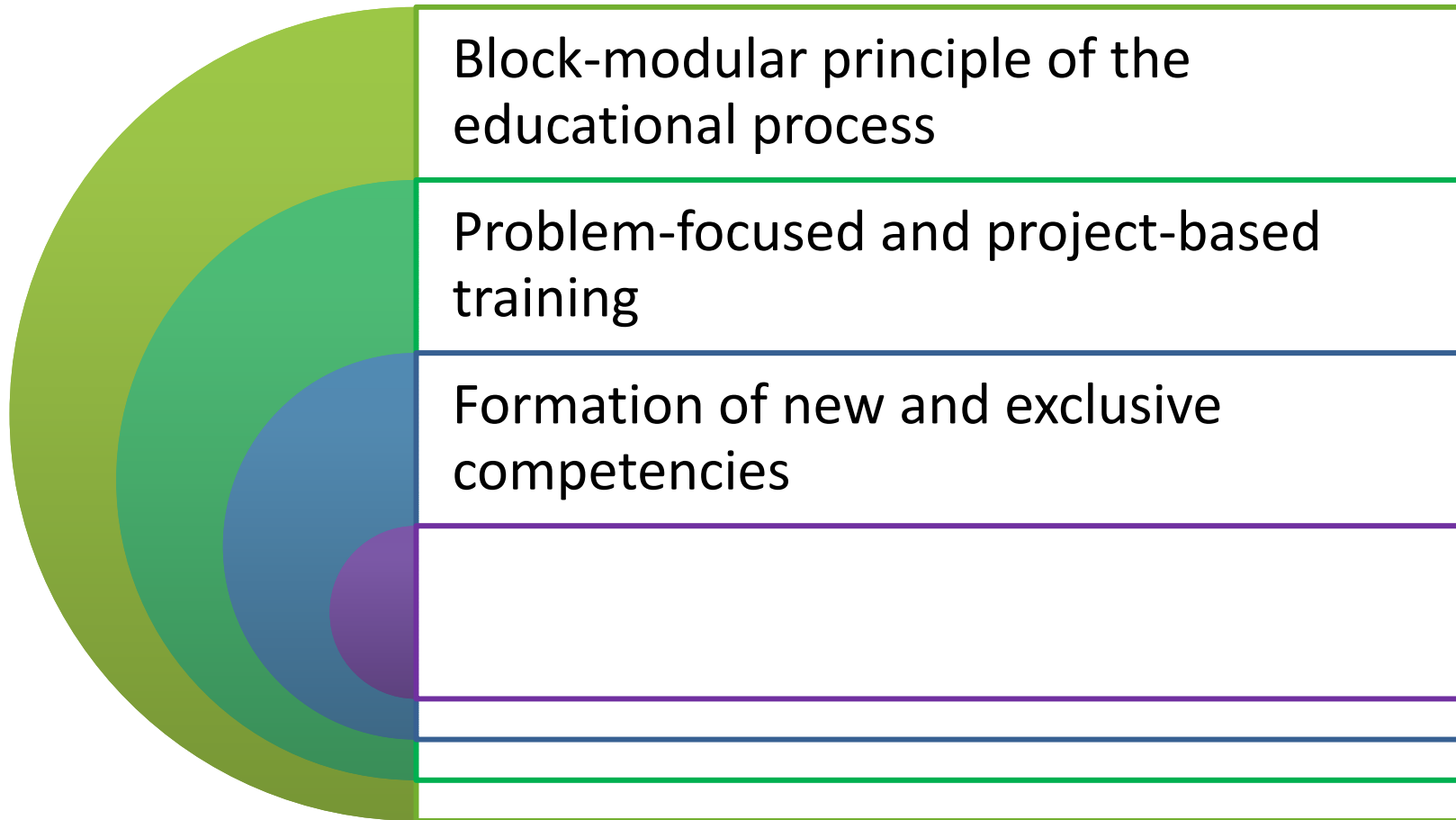
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## PRACTICAL AND PROJECT-FOCUSED EDUCATIONAL TECHNOLOGIES



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## BLOCK-MODULAR PRINCIPLE OF THE EDUCATIONAL PROCESS

### Block-modular principle of the educational process:

- Face-to-face training for a trimester (2-3 weeks of face-to-face training 3-4 times a year)
- Job placement (in the course of training)
- Solving real production problems in the course of training (viable projects)

### Advantages of the block-modular principle:

- It provides practical guidance
- It allows us to integrate the educational process and work activity
- It reduces (or eliminates) the period of graduate's adaptation to work

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## FORMATION OF THE NEW AND EXCLUSIVE COMPETENCIES

The implementation of practice-focused training allows us to form competencies to be in demand on the labour market:

- ❖ Ability to think critically, systematically and creatively (analysis);
- ❖ Ability to see contradictions, to identify and to formulate problems, to justify their relevance;
- ❖ ability to select and clearly articulate the purpose of the work and the methods (tools) to achieve it (synthesis);
- ❖ Ability to evaluate the resources required to achieve the goal; to evaluate the social consequences of the work outcomes;
- ❖ Ability to plan the attainment of the project goal;
- ❖ Ability to work in a team and to have good communication skills.

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## CDIO Vision

Training to **emphasise the engineering foundations** laid out in the context of the life cycle of real systems, processes and products in accordance with the model **"Conceive – Design – Implement – Operate"**:

- Completeness of the curriculum with design and engineering projects
- Integration of professional skills training with teamwork and communication
- Prevalence of active learning and experience-based training
- Quality assurance and continuous improvement to achieve higher goals rather than just accreditation

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## USING THE POTENTIAL OF THE INDUSTRY TO TRAIN ENGINEERS

1. Establishment of basic departments at the enterprises to train engineers and master's degree students in the field of technology
2. Use of the material base of the advanced industrial enterprises
3. Bringing qualified experts from the manufacturing sector to train engineers
4. Organization of systematic internships of university teachers at the advanced industrial enterprises
5. Use of the potential of the advanced industrial enterprises for doing joint research and on-the-job training

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## TRAINING OF SPECIALISTS TAKING INTO ACCOUNT THEIR ABILITIES AND INCLINATIONS

1. Development of the methodology and systems to test the students' abilities and inclinations
2. Arrangement of top-quality technical training
3. Development and implementation of steering documents of the classroom disciplines with in-depth content in the field of engineering and technology (research, construction, TRIZ, technology, engineering entrepreneurship, etc.)

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## TEAMWORK TRAINING

- Development of methodology and educational technologies to provide development of abilities to work in a team (brain storms, workshops, etc.)
- Setting up interdisciplinary teams for real projects and research
- Training to work in a virtual team

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## MANAGEMENT TRAINING

- Training of the new generation of university administrators
- Improvement of the entrepreneurship study programmes
- Development and implementation of study programmes in engineering business
- Training the system approach, strategy and tactics in project and enterprise management

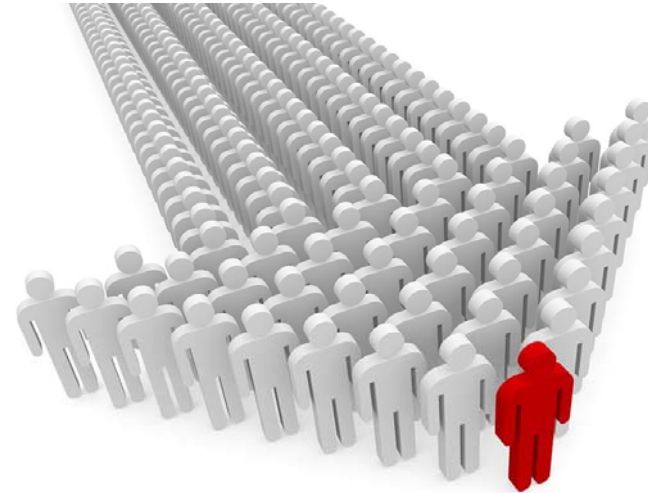
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**IMPROVEMENT OF THE ORGANIZATION AND  
EDUCATIONAL TECHNOLOGIES IS POSSIBLE ONLY  
WITH CONSTANT ENHANCEMENT OF THE  
UNIVERSITY MANAGEMENT QUALITY**



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# PROFESSIONAL DEVELOPMENT PROGRAMMES FOR THE UNIVERSITY ADMINISTRATORS

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## Long-term programmes

1. Master's degree programmes:
  - Study field of Management, specialization of Management in the Sphere of Education and Science
  - Study field of Innovation Studies, specialization of Innovation Studies of Higher Education
2. MBA Programme "Management in the Scientific and Educational Institution"

## Short-term programmes

- Professional development programmes and retraining of various periods of time



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## Conclusion

Implementation of practice and project-focused study programmes will result in:

- **training specialists and implementing real innovative projects that ensure sustainable development and competitiveness of the economy of the regions and the country;**
- the transformation of universities into the centers of innovative, technological and social development of the regions and the country.

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**Thank you for your attention!**

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## The Key Recommendations

1. To carry out expeditiously an independent, systematic analysis of the state of engineering, engineering education in Russia and the level of competency of Russian engineers;
2. To find out the systemic objective causes of problems in domestic engineering;
3. To develop and implement the Comprehensive Programme for the Modernization of Engineering and Technical Education;
4. To develop and adopt the National Doctrine of Engineering Education of Russia;

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## The Key Recommendations

5. To organize systematic activities to improve the legal and regulatory framework for engineering and engineering education in Russia and to ensure the implementation of this framework;
6. To adopt the Engineering Profession Act;
7. To establish an internationally recognized certification system for engineering qualifications in Russia and to establish a national register of professional engineers;
8. To take systematic measures to enhance technological susceptibility and to reduce the innovative resistance of the society;

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## The Key Recommendations

9. To develop and implement the system of measures aimed at improving the prestige of engineering work in society;
10. To establish the federal, regional and sectoral system to forecast needs for engineering personnel and to develop the appropriate forecasts;
11. To develop the system of legal and economic incentives to attract business to finance professional training and to participate in the training of engineering personnel;
12. To promote the creation of temporary creative teams at the universities, academic institutions, engineering firms and manufacturing companies implementing the scheme "From the idea to the sales of products";

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## The Key Recommendations

13. To develop and implement a system of incentive measures for teams creating the domestic engineering products that are competitive on the world markets;
14. To curb the level of bureaucratisation in the organisation of teaching, scientific and engineering activities;
15. Using the RF mass media to intensify activities to popularize engineering and technical education and science, to improve the prestige of technical universities, to create a positive image of an engineer and an engineering profession.

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