

## **ENGINEERS AS AN OBJECT AND SUBJECT OF THE DEVELOPMENT OF INNOVATIVE ENTREPRENEURSHIP AT THE MESOECONOMIC LEVEL**

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*The authors studied at the mesoeconomic level the priorities and problems in developing innovative entrepreneurship and increasing the role of engineers. Having in mind a variety of interpretations offered both by foreign and Russian scholars, the authors proposed a concept of "entrepreneurship" which is defined as a type of economic activity based on independent initiative, responsibility, and innovative entrepreneurial idea. The article describes an institutional environment for innovative entrepreneurship. Monitoring the number of small and medium enterprises, the average number of employees, wages and the volume of investments allowed to determine the dynamics of their economic status over the past six years. The authors emphasized the importance of attracting engineers to business, by creating small enterprises, technology parks, business incubators and other innovative institutions in collaboration with higher educational institutions. This has become essential in response to sanctions and in the context of import substitution.*

*Key words: Engineer, Entrepreneurship, Investment, Employment, Labor market, Human potential*

### **INTRODUCTION**

In a market economy engineers as the future of the Russia's innovation-driven economy are regarded as a requirement for creating an institution of entrepreneurship as well as developing self-employment and small business. All forms of small, medium and individual entrepreneurship are seen as a single market environment capable of generating a significant number of jobs and ensuring a consistently high level of economic development and employment [1].

Such foreign scholars as R. Cantillon, J.B. Clark, A. Marshall, J.B. Say, J.A. Schumpeter and others investigated the issue of innovative entrepreneurship and self-employment. V.O. Aygistova, V. F. Gaponenko, A. F. Gembarskaya, V. Lisina, and S. G. Polyakova studied the Russian experience in running business incubators, science and technology parks.

At all stages and levels, entrepreneurship is viewed as a search for new economic opportunities [2]. Within the framework of the national [3] and regional legislation [4] Volga State University of Technology (Volgatech) started up a representative office of the Foundation for Promotion of the Development of Small Enterprises in Scientific and Technical Sphere in the Republic of Mari El. The Foundation promotes and supports innovative youth projects and enterprises of the republic. Thus, implementation of the youth projects allowed to increase the number of small enterprises in the Republic of Mari El over the past 5 years by 56.7%, consequently, the number of employees increased by 6.1% [5].

### **THEORY AND EXPERIMENT**

The concept of entrepreneurship can be interpreted in many different ways. Thus, the Russian scholar, Doctor of Economic Sciences V.Ya. Gorfinkel believes that "entrepreneurship is a type of business activity that individuals, enterprises or organizations carry out to produce goods or provide services, and to purchase or sell goods in exchange for other goods or money for mutual benefit of interested persons, enterprises or organizations" [6]. The French economist J.B. Say defined entrepreneurship as an integration of three classical factors of production - land, labor, and capital [7]. The Scottish economist A. Smith believes that entrepreneurship is an economic risk in order to make a profit [8]. The American economist P. Samuelson says that entrepreneurship is associated with innovation, and an entrepreneur is a courageous person with original thinking, who strives for successful implementation of new ideas [9]. The founder of entrepreneurship, the Austrian economist J. Schumpeter, interprets the concept of "entrepreneurship" as innovation, and the concept of "entrepreneur" as an innovator. He believed that "entrepreneurship is not an occupation, but rather a mindset of a person" [10].

Having explored the concept from different angles, the authors determine that entrepreneurship is a special type of economic activity, which relies on independent initiative, responsibility and innovative entrepreneurial idea.

A certain entrepreneurial institutional environment, which refers to socio-economic condition, economic freedom, supremacy of market-scale economic linkages, the possible accessibility to capital formation, the ability to use necessary resources, and the availability of engineers - all make entrepreneurship feasible. The institutional environment for entrepre

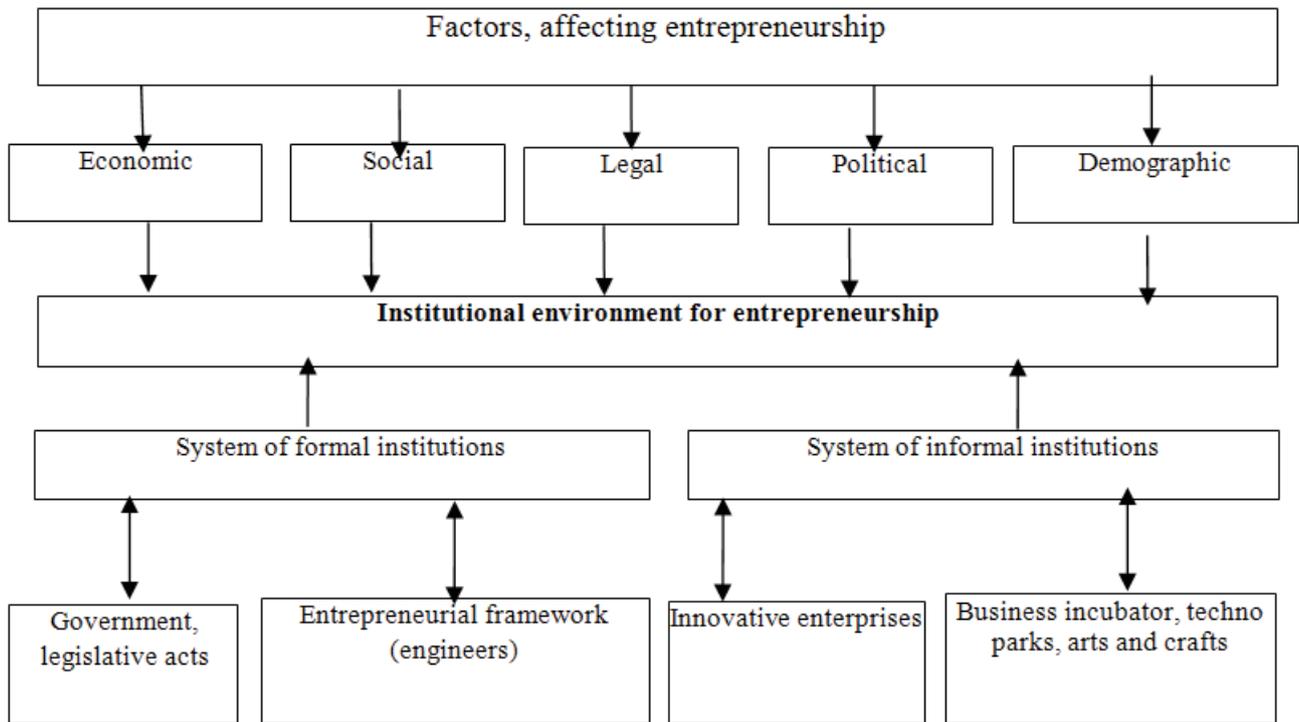


Figure 1: The main components of the institutional environment for entrepreneurship

neership encompasses affecting factors, as well as the system of formal and informal institutions (Fig. 1). Engineers are seen both as an object and a subject of the institutional environment, since an entrepreneur is an innovator or an organizer of production, who decided upon the strategy and tactics for technological modernization.

Priority is given to small and micro enterprises in a market economy, whose number has grown by 38.7% and by 41.3% in the Republic of Mari El over the past seven years. Moreover, the republic takes the 6th place out of 14 republics and regions of the Volga Federal District (Fig. 2) in the number of small enterprises per 1000 population.

The most common business activities are manufacturing, commercial, financial, intermediary and insurance. According to the authors, the most frequent and relevant is manufacturing entrepreneurship, which is associated with the production of goods or providing services that have some value for consumers. Author's monitoring showed that the largest number of Mari EL medium (29.2%) and small (15.7%) enterprises run in manufacturing as well as in construction, 18.9% and 11.1%, respectively.

A study at the mesoeconomic level showed that innovative entrepreneurship has a number of advantages:

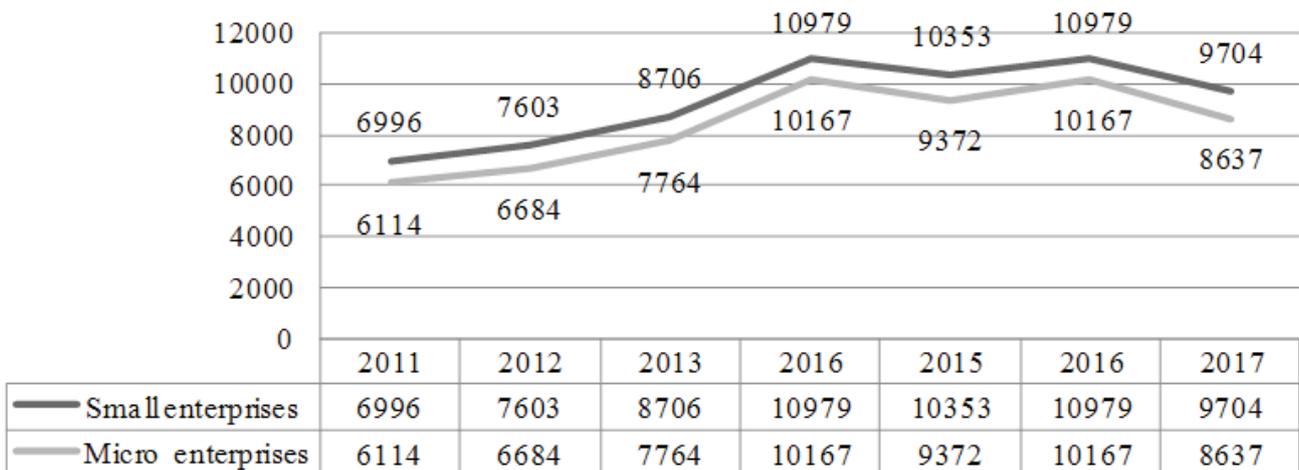


Figure 2: Dynamics of the number of enterprises in Mari El Republic, units [11]

1. it contributes to job creation. Thus, the average number of employees in small business increased by 6.14% in Mari El Republic (Fig. 3). Hence, in 2019 it is expected to create 2,000 jobs on the territory of the republic as a result of the implementation of 30 investment projects.
2. it improves the material well-being of the employed:
3. it improves the investment climate. In 2017 the volume of investments in small and medium enterprises increased by 6.1% and 1.84% [5] (Fig. 5).
4. it contributes to financial stability of enterprises: the revenue from the sale of goods and services in 2017 was more than 440 million euros.

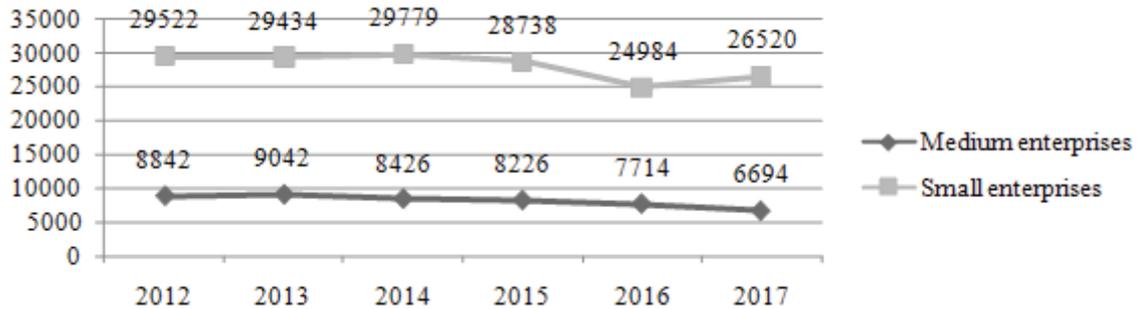


Figure 3: Dynamics of the average number of employees in Mari El Republic, pers. [11]

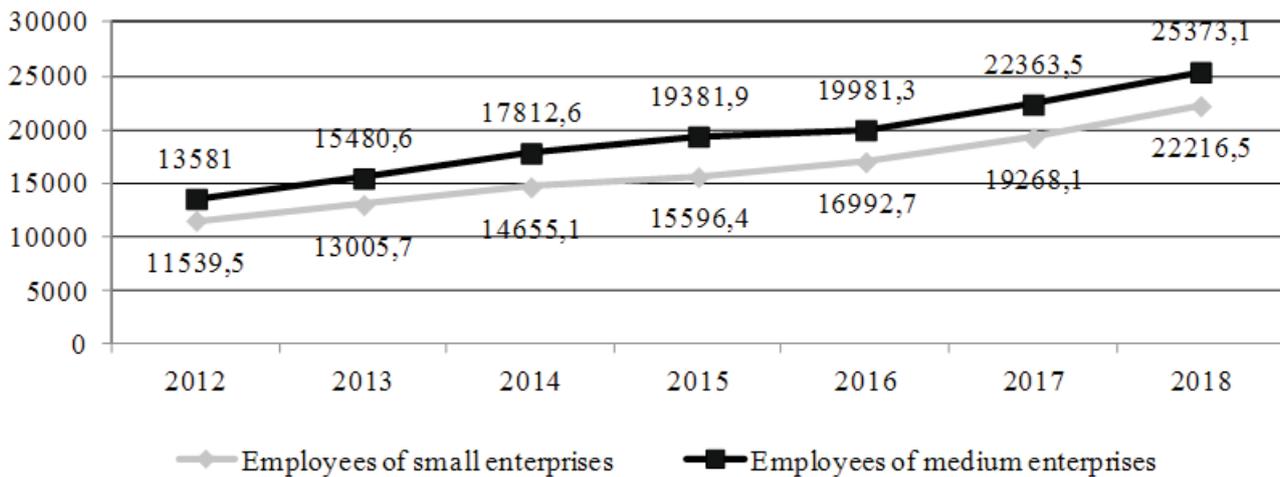


Figure 4: Dynamics of average monthly wages of employees of medium and small enterprises in Mari El Republic, thousand rubles [11]

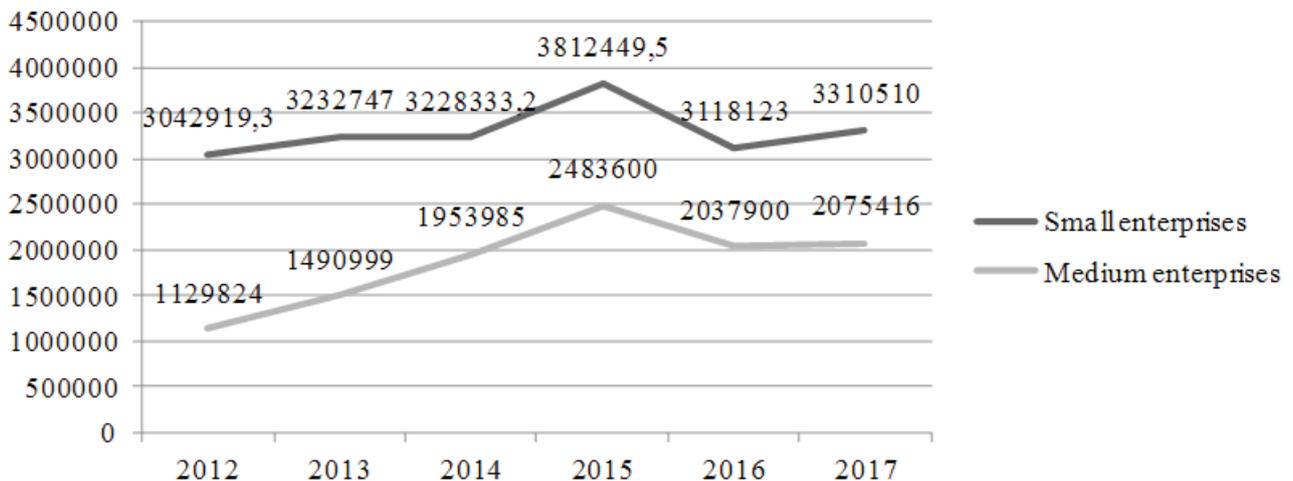


Figure 5: Dynamics of investments in the core assets of medium and small enterprises, Mari El Republic, thousand rubles [11]

5. it strengthens personnel potential of enterprises by graduates in engineering from Volgatech, as students play an important role in the development of innovative enterprises (Table 1).

The implementation of the strategic task on strengthening the linkage between science and production in technical educational institutions, which is Volgatech, contributes to successful development of entrepreneurship at the mesoeconomic level. Thus, the university has become an engineering and technology center. This can be evidenced by 22 small innovative enterprises that run at Volgatech and are good examples of research sites. We shall name only a few of them. The research and production center "Search-Volgatech" focuses on developing vacuum-coating systems. In its manufacturing process the center uses its own software, magnetron spraying systems, and vacuum process control units. Hence, such an approach makes it possible to cut down prices for work performed and to compete with leading Russian and foreign manufacturers of vacuum equipment. The center's products are utilized by some Russian companies, such as: the Scientific Development and Production Center Radioelectronics (Kazan), the Perm Scientific Center for Powder Material Engineering, the Mari Machine Building Manufactory (Mariyski Mashinostroitelni Zavod), and the Special Design Bureau Chromatech (Yoshkar-Ola) [12].

Small innovative enterprise Mechatronic Systems specializes in designing and manufacturing cycloidal gears, and turntables mechanisms. Its activities rely on intangible assets, and have high innovative potential - 12 patents for inventions in the sphere of drive engineering. Such mechanisms can be applied in aerospace systems, land-based and sea-based unmanned vehicles, robotics, machine-tool construction, power engineering, and

medical equipment [13]. Students' design bureaus are crucial in creating the infrastructure of small enterprises. For example, engineers and students of the Mechatronic Systems laboratory designed a working sample of the Remotion (medical exoskeleton), and the White Cat - pilotless snowmobile model. The exoskeleton developers implemented a whole set of innovative functions: complete modularity of the design, 20 channels of functional electrostimulation and 20 channels of electromyography, voice notification, convenient quick-release batteries and much more.

## RESULTS AND DISCUSSIONS

Students and teachers in engineering are members of small enterprises that were established in partnership with Volgatech.

Moreover, Volgatech runs a program "New personnel of the military-industrial complex" which gave impetus for successful adaptation of 480 highly qualified engineers - graduates in engineering.

Special educational modules are being developed at the university along with partner enterprises, among which there are such enterprises as AO Mariyski Mashinostroitelni Zavod, AO Zavod Poluprovodnikovikh Priborov, Federal State Unitary Enterprise October, Kazan Aviation Plant named after S.P. Gorbunov, Russian Federal Nuclear Center and other high-tech enterprises.

Volgatech is the country's leader in sustainable environmental management with the use of nano-, bio-, energy-saving and info-communication technologies [14].

Engineers are involved in developing republic innovative technologies. In October 2018 D.Yu. Andrianov (a 3rd year student of the Institute of Mechanics and Machine Building) was awarded with the Mari EI State Youth Prize

Table 1: Employment of graduates in engineering of Volga State University of Technology

Code of major / field of study	Name of the profession, qualification, study program	Name of the employer	Number of graduates employed			
			2015	2016	2017	2018
09.04.04	Information Systems Software	AO Mariyski Mashinostroitelni Zavod (Mari EI, Yoshkar-Ola)	5	4	6	6
03.06.01	Radio Physics	AO Zavod Poluprovodnikovikh Priborov (Mari EI, Yoshkar-Ola)	6	5	7	1
15.06.01	Standardization and Product Quality Management	ZAO Special Design Bureau Chromatech (Mari EI, Yoshkar-Ola)	7	6	8	2
11.03.03	Design Engineering and Technology of Electronic Devices	AO Zavod Kopir (Mari EI, Kozmodemyank)	8	7	9	2
15.02.08	Machine Building Technologies	OOO Petentsial (Mari EI, Kozmodemyank)	9	8	10	3

in 2017-2018 for “Development of theoretical background and creation of intellectual property objects of unmanned snowmobile amphibious transport platforms” [15].

The experience acquired by students at the University allows them to participate in international festivals of innovation, knowledge and creativity. Thus, in 2018 the university projects won four gold, two silver medals and a Grand Prix at the TESLA FEST (Novi Sad, the Republic of Serbia) [16].

Another factor that affects the educational process of engineers at Volgatech is the European educational and research area. Within the scope of the Erasmus+ program (supported by the EU), Volgatech opened an international Jean Monnet Center for Excellence “European Expertise and Technology for Environment Protection and Sustainable Forestry”. In 2018 the Center for Excellence got financial support for a new Joint Project in Capacity Building in the Higher Education “GIS and Remote Sensing for Sustainable Forestry and Ecology”. Among European partners there are such universities and enterprises as BOCU University (Austria), Aristotle University of Thessaloniki (Greece), European Forest Institute (Finland), University of Eastern Finland, Arbonaut Ltd. (Finland) and Diberaiter (Austria), and Asian partners - Fuzhou and Zhejiang Universities (People’s Republic of China).

## CONCLUSION

Innovative entrepreneurship is a dynamic and active element of business, it is seen as an economic category, a type of economic management and lifestyle. The study showed that further development of entrepreneurship is primarily associated with the involvement of engineers in real sector of economy, which will increase the share of non-resource exports and provide favorable conditions for entrepreneurial initiatives of an engineer as an object and a subject of innovative inventions. According to the authors, the development of innovative entrepreneurship is possible when the following conditions are met: there is an innovative infrastructure at a university; the number of intellectual property objects increases; there is clear linkage between science and real sector of economy, and, finally, students in engineering are taught entrepreneurial thinking.

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