The State Policy of Managing the Image of Engineering Professions in Young People’s Mind

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Abstract. The research seeks to address the disagreement between the government policy aimed at boosting innovation economic development and statistical indicators presenting the decreasing demand for engineering professions in general and power and electrical engineering professions in particular among university entrants in the context of an aggravating demographic decline. The paper presents the research into a current image of engineering professions in the mind of young people: grounds for choosing an engineering academic major, employment perspectives for future engineers, job remuneration, etc. Media monitoring services enable authors to investigate the engineering profession's image by evaluating the density of the news agenda and the most significant events in the media space. The article includes the analysis of the current state policy in the field, namely its legislative base and ongoing measures introduced by the Russian government to alleviate the shortage of engineering occupations as a global trend. The data on enterprise employees’ attitudes to their professional activities facilitates to develop an employee value job proposition.

1. Stating the problem
Exercising regional or world leadership, any state aims at building a modern innovative economy integrated into the global economic space. The task can be accomplished by technological modernization of key industries in the country and regions. The task seems extremely relevant for the old industrial territories of Russia, namely the Urals and Perm Krai as its integral part.

Investments in technological modernization in Russia require professionals who are ready to engage in the transformation process. Therefore, a personnel reserve for the future economy has to be established since any innovative product begins with a radical modernization of both the technologies used in its production and the human capital involved in the process.

A stable innovative economy can be developed hand-in-hand with the professionals of an engineering profile. However, the current state of the Russian labor market does not meet the demand. Recent graduates of technical universities and vocational schools, who could replenish the ranks of new engineers, make career choices outside the engineering occupation. A study on university entrants’ preferences made by the Ministry of Science and Higher Education of the Russian Federation revealed that engineering sciences are less marketable compared to human sciences.

In 2017, the Ministry of Education and Science [1] named three top most popular qualifications for school graduates. They were economics, political and international relations, and media
communications. The maximum competition rate amounted to 21, 20.5, and 19.4 applicants per place, respectively. For comparison, the average competition rate for pedagogical qualifications was several times lower - 7.3 applicants per place. Engineering and technical occupations were in the group of outsiders as the demand for the profession reached only 7.2 people per place (we mean so-called “budget places” where students do not pay for their education as the studies are subsidies by the government).

Moreover, engineering field suffers from significant demographic decline. Over 11 years, from 2005 to 2015, admission to undergraduate and specialty programs fell by 38.2%, training programs for mid-level managers by 18.2, and training programs for skilled workers and employees by 42.5% [2].

The official demographic statistics is overshadowed by the emotional state and lifestyle of modern Russian young people. Manuylova [Manuylova A. 2018] argues that NEET level in the group aged 20-24 accounts for 17%. The Russian indicator is close to Poland (20%), Estonia (16%), and Belgium (18%). Moreover, Tatyana Golikova, Deputy Prime Minister concludes that “every second unemployed person in Russia is a young person aged 20 to 30 which makes 48.7% of the total unemployment rate” [3].

Graduates with engineering qualification work in other industries, thereby not contributing to the increase in the number of potential employees in the industrial sector of the Russian economy. Recent evidence [4] reveals that the number of employees in the industrial sector of the Russian economy is decreasing. Fig. 1 presents the decline from 99.9% in 2011 to 93.8% in 2015. Experts argue that the trend will continue in the future.

![Figure 1. Industrial production dynamics and the number of employees in a company (2010 = 100%).](image)

The research conducted by “Internet Recruiting Portal” in 2018 [5] revealed that active young Russian job seekers look for such vacancies as a sales assistant, administrator, courier, etc., and only 0.9% applicants are interested in the engineering career.

Generational differences make an impact on young people’s perception of the profession and its future. For example, job seekers born between 1981 and 1995 experience communication difficulties with choosing a workplace, have excessive salary expectations, concentrate on the working environment in a company, and the personality of a manager. This is largely the result of their upbringing and educational background, a change in a value paradigm, and their attitude to work. For
a young generation, work has become a way of life that should not occupy too much time and at the same time should provide income and be enjoyable [6].

In general, about 25 million people in Russia hold engineering qualifications according to the Higher School of Economics’ study which accounts for the third of all economically active citizens. Most often, skilled workforce and engineers are engaged in transport and communications (15.3% of all manpower), construction (15.1%), and trade (14.7%). The average age of Russian workers is 42.5 years which does not exceed the average age of workers in other sectors of the economy (41.9 years) [7].

Noteworthy, not only Russia experiences the deficiency in engineering personnel and problems with their replenishment; this is far from being a local phenomenon. Similar trends are defined in several world-leading and developing economies [8]. In particular, the UK leading national publications regularly throw limelight on this urgent problem [8]. According to a survey conducted by one of the local headhunting agencies in the 4th quarter of 2017, 22% of the country’s engineering companies will experience a shortage of skilled engineers in the next few years. The aerospace and aviation industries suffer from a particularly acute personnel deficit: 42% of the leading companies in these industries consider the issue as one of the most significant [9].

Thus, 2018 was declared the “Year of Engineering” by the UK government which confirms the nationwide nature of the problem. Understandably, the promotion campaign was aimed at younger British generation [10].

The shortage of engineering labor in industrial companies in many countries including the developed ones is proved by the presence on the international market of agencies exclusively engaged in recruiting technical specialists (for example, VHR, RISEtechnical Michael Page, etc.). Agencies’ official websites identify the problem of staff shortages as the most acute and formidable.

2. Research methodology and results

A sociological study was conducted to analyze the current image (perception) of engineering professions among Perm residents aged 14 to 30. A questionnaire was chosen as a research method. Respondents were offered to fill in one of two types of questionnaires (face-to-face or email) which included questions related to the choice of a major at university, opinion about employment perspectives and salaries of engineers, etc. The survey was conducted from September to December 2018; the results were interpreted in February 2019.

Researchers applied quota sampling (students and young workers in Perm) of different types: single, one-step (a quota from the general population), and heterogeneous (gender and age quotas). The general population sample consisted of 178 670 people aged 14 to 30 years living in Perm. The accumulative sample included 254 respondents with a 5% margin of error.

The results of sociological research demonstrate a generally positive perception of engineering professions among young people. Thus, 44.8% of the respondents believe that “an engineer” is a modern and promising profession today, and only 13.6% consider it old-fashioned. 57.8% deem that the prestige of the profession remains high, while 42.2% note its decline. 83.1% of respondents have parents, relatives, and acquaintances in their environment whose activities are related to engineering or blue-collar job. 42.9% are confident that after graduating from a technical university they can easily find a job with an average (50%) or above average (37%) salary.

Young people think that their decision to find a job in the field of engineering is influenced by a combination of factors: salary (76%), career opportunities (74%), and innovative infrastructure of a company (40.3%). The prestige of the profession has a less noticeable impact (27.3%).

In the opinion of potential employees, HR departments in industrial companies should promote engineering professions and develop attractive for young people communication campaigns: entertaining events related to engineering (73.4%), engineering exhibitions (34.4%), trade fairs (34.4 %), and company open days (32.5%). However, only 24% of respondents said they could be interested in taking part in engineering scientific conferences. At the same time, young people have rather low awareness of the prospects and current events in the engineering field: 47.4% of respondents read such
information in the media less often than once a month, and only 10% receive it once a week or more often.

Media monitoring carried out by “Medialogia”, media data monitoring system, enables to investigate the image of engineering professions. The information agenda is established mainly at the regional level (4,035 messages), and to a lesser extent at the federal level (1,836 messages). The primary communication channel is the Internet (78.8%), followed by newspapers (12%), news agencies (3.8%), and blogs (3.4%) (Figure 2).

**Figure 2.** Communication channels broadcasting on engineering topics.

Publications on engineering topics have a stable index (Figure 3).

**Figure 3.** Number of messages between May 14 - December 14, 2018.

In the news, the engineering topic is presented mostly under the headings “science and education” (2,103 posts), “issues of public administration” (1,194 posts), “regional news” (718 posts), “public and social spheres” (638 messages). To a lesser extent, citizens are informed about the events in the field under the headings related to legal issues (112 messages), high technologies (96 messages), labor relations (58 messages), transport (51 messages), industry (13 messages).

Concerning the readership and the number of messages, the most significant events for the specified period were “Quantorium”, children's technology parks. They are positioned as innovative
platforms of a new format for additional education in science and technology for school children to develop engineering thinking and implement technical ideas. The news received 1.5 million readership coverage and 432 related posts.

Another important event was a series of publications related to the business demand for training engineers at universities. For example, the online portal in Yekaterinburg tried to determine how higher education in Russia adapts to the realities of business, including technical ones: “factories are doing everything today to bring the prestige of the working professions to a new level. They organize engineering competitions for students of colleges, technical schools, and universities (the most “promoted” is WorldSkills). They hold Innoprom and other exhibitions to display innovative machines for everyone, including a future technician or an engineer, to find out how they work”. According to Medialogia, the total number of messages amounted to 166 materials, with total coverage of 1.1 million views.

To continue, there have been publications about the prospects of people with an engineering diploma. The most noticeable was the publication “Time to Change Jobs” in Komsomolskaya Pravda which made 22 reprints with 1 million readers’ coverage. The authors of the materials state: “There is a constant battle on the personnel market for engineers, designers, technicians. They are practically not interviewed, get job offers, and are asked only one question: “What salary do you have on mind?” [11].

The event that had the least number of reprints but covered a huge readership (3 million views) was the article about the reorganization of the Russian Academy of Sciences published in “Argumenty i Fakty” (“Arguments and Facts”). According to the academician Sergeev, the President of the Russian Academy of Sciences: "Young people will go in for science when it acquires its prestige again” [12].

An additional factor that contributes to the image of engineering professions is relationships with young employees at an industrial company. Opportunities and prospects for young production workers and engineers can be analyzed by a case study method based on specific situations.

As part of the study, the experience of JSC “Aviadvigatel”, United Engine Corporation (UEC), the part of “Rostec” State Corporation has been analyzed. The corporation is an integrated structure specializing in the development, serial production, and service of engines for military and civil aviation, space programs and navy, and oil and gas and energy industries.

The enterprise is one of the leaders in the Russian market for the production and implementation of gas turbine power plants used by gas producing companies. In addition this corporation is a leading developer of the fifth-generation engines (in particular, PD-14) for a short-medium-haul aircraft of MS-21 type and industrial gas turbines. The launch of the PD-14 engine into serial production is one of the priorities of the State Program of the Russian Federation “Development of the Aviation Industry for 2013-2025”.

As of 2018, the average age of employees in the company is 41 years and the total number of young professionals under the age of 35 is 42%. The company's management is interested in attracting young specialists, including in the field of power and electrical engineering, and reducing their layoffs. Thus, the company developed and launched the program "Young specialists”.

Since 2009, the corporation has been implementing a recruitment program and supervising the Department of Aircraft Engines at Perm National Research Polytechnic University (PNRPU). The company invests its funds in the development of the material and technical base of the Department, and attracts funds for federal target programs. It installed full-size engine models and purchased licensed modern design software which is used at JSC UEC “Aviadvigatel”. New equipment has been purchased and used for gas turbine building research projects conducted by professors and students of the department.

UEC “Aviadvigatel” provides vocational training and internship for the students from Perm Polytechnic University.

The company has a "target enrollment program" scholarship for freshmen who have 200 and higher scores at the state exams. Students who are enrolled in the program have guaranteed employment at
“UEC Aviadvigatel” after their graduation. The company develops educational programs for schoolchildren.

JSC “UEC Aviadvigatel” is an official sponsor of a regional exhibition “Education and Career” (held at “Perm Fair”, a regional exhibition center), cooperates with the INSTIL engineering camp, organizes tours to company’s premises for schoolchildren, and holds a championship in physics “Build a Career in UEC”.

The company’s collective bargaining contract provides special 3-year conditions for new employees who graduate from technical universities with an engineering major and who apply for a job within the first year after graduation.

Under the program “Young Specialists”, the management appoints a personal mentor, who is a skilled employee with more than 3-year work experience, to a young specialist in their first year at work. There is also an induction program, a “Young Fighter Course”, which includes meetings with management, lectures by Deputies of a Principal Designer and Heads of the departments, company tours, workshops, and test stands tours.

The company also provides opportunities to get postgraduate education, training, and professional development for employees. The corporation encourages employees to participate in specialized exhibitions, salons (including international ones), conferences, forums, seminars, training, etc. Additional social support for young specialists includes a marriage bonus, partial compensation for renting an apartment for non-Perm residents.

There is a Youth Council supervised by the management which aim is to unite young employees, involve them in active professional, social and creative activities. The management sets the council’s priorities as assistance to young employees in adaptation to work conditions, creation a favorable environment for their self-actualization in their professional sphere.

In 2009, “the unique youth policy of OJSC “Aviadvigatel” was recognized and approved at the federal level. “Aviadvigatel” became the winner of the All-Russian competition “Employer of the Year of Youth: Engineering Personnel for Innovative Russia” in the nomination “Master Class” for support of and cooperation with educational institutions.

Building internal communication is a multifaceted process. The researchers conducted a sociological study to identify the factors that enhance the intrinsic motivation of engineering personnel and workers in a company. The study was carried out at one of the largest industrial enterprises of the Perm region, which is a significant manufacturer of equipment for the industrial electric power industry. In compliance with ethical principles and rules, the article does not disclose the name of the company where the study was carried out. The respondents were asked to evaluate the employee policy, satisfaction with remuneration package, corporate culture, management, working conditions, and labor organization. The general population consisted of 3,061 employees, whereas a research sample included 205 workers and 263 engineers, totaled to 468 employees. Interviews and interpretation of results were conducted between December 2017 and January 2018.

The results showed that employees considered the company a reliable employer. Engineers, technicians, and workers evaluated highly the personnel policy in the company, namely, the induction, professional development, and training programs (Figure 4).
Figure 4. Satisfaction with the personnel policy of a large enterprise-manufacturer of equipment for industrial energy.

The majority of employees reported their satisfaction with the induction (84% workers vs 94% engineers) and training (85% workers vs 86% engineers) programs in the company. However, both groups of respondents mentioned limited career opportunities in the industrial sector. This index received the lowest score though engineers had better chances for promotion compared to workers: 63% engineers vs 55% workers.

Against the backdrop of a global decline in demand for technical occupations, respondents reported that the industrial enterprise fulfilled its social obligations to employees. The respondents rated highly the remuneration package in the company (Figure 5).
Figure 5. Satisfaction with the remuneration package provided by the company.

The respondents rated social investment package higher than salaries and wages (75% engineers vs 65% workers), payroll fairness (64% engineers vs 54% workers), and awareness of salary rules (76% engineers of vs 66% workers).

The study revealed the employment disadvantages of working for the industrial company. Thus, the main reasons for engineers' and technicians' resignations were low salary (64%), absence of career growth (29%), and conflicts with an immediate supervisor (28%). Workers reported similar reasons for leaving the job. They were low wages (62%), personal problems (46%), conflicts with a manager (21%), and lack of career growth opportunities (19%). Additionally, workers reported other factors: long commutes to work (35%) and unfair bonuses (29%).

The study determined the advantages and benefits of the engineering profession. The most rated among engineers and technicians were guaranteed salary (51%), job stability (46%), and job challenges (31%). Workers value similar advantages: guaranteed wage (44%), job stability (48%). The social investment package (33%) was rated high among this category of employees. The identified advantages can be used for creating the employer value proposition.

The value proposition, if drawn up in accordance with HR-brand rules, can hypothetically affect applicants’ choice of an engineering profession, maintain a graduate's job profile, change NEET social group’s emotional spirit, and offer a place of work to an active young applicant.

3. Research methodology and results State priorities and activities aimed at popularization of engineering and technical professions

Attracting and retaining young specialists in the industrial sector remains the task of national importance. Pinpoint measures implemented at regional and local levels fail to accomplish the task. Today's conditions require adopting a purposeful and consistent federal policy. Sharkov argues that labor market regulation begins with the investment in the training of the required number of personnel of the required profession and level [13].

The state policy in the field of development of human resources for engineering professions is defined in the Russian President's Decree “Measures on implementation of state social policy”. In accordance with the adopted document, the Government was instructed to increase the number of engineers so that it would have made up at least a third of the total number of qualified workers by
2020. To achieve the goal, the government adopted measures to popularize the professions of workers, technicians, and engineers among citizens and especially young people, and to create conditions for sustainable professional development.

“Concept of long-term socio-economic development of the Russian Federation for the period until 2020” highlights the priority role of human potential in the development of the innovative socially oriented type of economy.

The document states that national competitiveness can be increased by the development of high-tech industries (aviation and rocket and space construction, radio-electronics, shipbuilding, nuclear power industry, power engineering, and information and communication technologies).

The implementation of the state policy requires the participation of young specialists who are the most promising, economically active category of labor resources, who have the potential for innovative development. Thus, a program "Development of an integrated system for providing highly qualified personnel to the enterprises of the defense industry of the Russian Federation in 2016-2020" was developed and adopted. The monitoring of the state plan in 2008-2015 revealed that, on average, about 50% of students who graduated with the corresponding major were employed in the defense industry. This situation proves the urgent need for highly qualified personnel who are technically knowledgeable and demonstrate specialized technical and communicative competencies.

In this respect, a range of tasks for training qualified engineering personnel has been outlined. On May 20, 2009, Decree of the President of the Russian Federation created a commission for the modernization and technological development of the Russian economy in support of engineering specialties and technical education. The Russian Federation Government adopted corresponding measures aimed at popularizing skilled workers and engineering professions (approved by the Government of the Russian Federation Order of March 5, 2015, No. 366-r).

The recent events at the regional and federal levels show a variety of ways to popularize engineering professions, including forums, festivals, exhibitions, etc. They include annual national championships of skilled workers held in different cities of the country by the WorldSkills methodology, Innoprom (Yekaterinburg), the international industrial exhibition, Perm Engineering, and Industrial Forum, “Best in Profession” the all-Russian competition of professional skills, “Profi”, a national career guidance festival, All-Russian Forum of Working Youth, the international competition for the best system of working with youth at enterprises, “Engineers of the Future” the international youth industrial forum, etc.

Experts say that the popularization of the engineering profession is a multi-stage process that includes "vocational guidance of children and adolescents, the orientation of engineering and technical students in the labor market, securing young engineers in production and creating a favorable public opinion about engineering professions" [14].

Nevertheless, the problem of engineering personnel deficit is much more complex and is not limited to the absence of young people’s interest to receive the appropriate specialized education and to take a career path in engineering in the future. The foreign experience of engineers and technicians’ selection and training shows that the issue has other reasons. In Great Britain, school impedes pursuing engineering and technical career for young people. Specialists in recruiting engineering personnel in this country believe that it happens due to the fact that most teachers do not have a background in engineering. As a result, they are not equipped with the knowledge to promote engineering as a career path to their students even to those who are prone to engineering and technical knowledge.

However, Nigeria, the largest and fastest-growing economy on the African continent, is confronted with a more urgent problem. In the condition of rapid demographic growth, the country experiences a shortage of high-quality trainers and teachers in higher education who are capable of teaching future engineers. [15].

The specific problems in the local markets are also relevant to modern Russia. Zolotareva claims that managing information about the industry and raising public awareness about its achievements will enhance its efficiency and thereby will form a positive image of technical professions and raise the
prestige of Russia in the world community [16]. In our opinion, the management of information flows may not bring the desired result due to two reasons. On the one hand, the Russian higher education faces the problem of aging professors who teach future engineers. On the other hand, vocational counseling at school does not guide students to enroll in technical universities and colleges with an engineering major.

4. Conclusion
Many developed and developing countries experience the problem of engineering personnel shortage. Its urgency is proved by the fact that even the most prosperous and industrially developed countries are adopting government programs to support the system of higher and secondary engineering education and to promote the image of industrial and technical professions. In fact, we are talking about the increased global and intercountry competition for skilled engineers. The evidence points to the existence of job agencies in Western Europe engaged exclusively in recruiting personnel for industrial enterprises.

In this regard, Russia and foreign countries should strengthen measures to further promote engineering professions among young people. This activity should be stimulated at schools apart from colleges and universities. Schools form a child's genuine interest in the technical field which can be seen as both a profitable and promising profession and also a vocation that ensures true self-actualization in the future. All educational institutions - universities, colleges and schools, and industrial enterprises should integrate into the system of continuous personnel training, be involved in relevant state programs, and seek the most effective ways to carry out this work at the local level. The successful practices of such cooperation presented in the current study may enhance future development in the field. The following questions remain open: what should be the structure of such collaborations? What is the role of each link (enterprises, universities, colleges, specialized departments, etc.) in the chain? Who defines the rules of the game? Who is a resource provider? Who acts as an integrator combining all elements of the chain into a single coherent scheme that provides the best result?

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