

Comparative Analysis of Educational Reforms in Russia Following Technical Areas of Training in the Field of Transport

Alexandra Smyk*

*Moscow Automobile and Road
Construction State Technical
University (MADI)
Moscow, Russian Federation*

Lev Zimanov

*Moscow Automobile and Road
Construction State Technical
University (MADI)
Moscow, Russian Federation*

Alexey Solntsev

*Moscow Automobile and Road
Construction State Technical
University (MADI)
Moscow, Russian Federation*

Abstract–The article reviews issues of higher engineering education reformation in Russia since the establishment of the first technical university– Institute of Railway Engineers by the Emperor Alexander I till modern technical university which provides training for country automobile and road system specialists. At different history stages, economic development in Russia was seamlessly connected with development of transport system, construction of railways, land and waterways which in turn stimulated development of engineering education. It is shown that economic modernization tasks were inseparably linked to reformation of technical engineering education that was taking place in Russia during the time of the first industrialization when the first transport institute was established (in 1809). When Russia had come to capitalist mode of production, the next stage of economic growth was closely related with increase of number of polytechnic and technology higher education institutions (1868-1900). During the time of socialist industrialization in the country (1929 – 1941) a high number of branch higher education institutions emerged as the education reforms result, including eight automobile and road institutes and Moscow Automobile and Road Construction Institute as one of them (1930). Reformation of Russian education which have started in 1990 and not completed yet is again related to tasks of overcoming technological lag and economy modernization. Curricula of engineering staff training for automobile and road transport are being analyzed. They have been developed under conditions of two reforms of national higher education – 1930s and 2000s. Referring to history of national engineering education and its reformation stages allows us to comprehend certain patterns of higher technical education and benchmark goals of present educational policy.

Keywords–transport system, Russian engineering school, branch university, technical university, curricula, education system reforms

I. INTRODUCTION

History of Russian engineering school and Russian engineering science dates back to establishment of Imperial Institute of Railway Engineers that was named by the Emperor Alexander I. Establishing of the educational institution was closely related with major task of Russian government – creation of grand railway infrastructure that

is till now the basis for development of Russia. Unique in scale, quality and scope railways system was created by efforts of Russian engineers in 19th century, it included several waterways, railways and highways [1]. Till mid 19th century the basis of higher education for technical staff training was Railway Engineers Institute, Engineering (1819) and Artillery Academies (1820), Technology University (1828) which neither in number nor in quality of education did yield to any other country in the world.

The next stage of education reformation in Russia is related with transition from feudal relations to capitalist mode of production based on machinery. After 1868 new polytechnic and technology institutes were opened all around the country, including the Imperial Moscow Engineering School, receiver of which in 21st century is Russian University of Transport (MIIT). “Russian method of training engineers” known to whole world had been developed by the beginning of 20th century; it was based on the following statements: deep studying of theoretical subjects, practical training as close as possible to real work at industrial enterprises, constant connection between higher technical school and industry. Theoretical training was based on principle “from general to specific” i.e. from general theory and through general engineering to special disciplines.

Practical training was developed “from simple to complex”, i.e. from craft to engineering tasks. Internship necessary for all technical areas of education allowed studying work of industrial enterprises in accordance with chosen specialization. Technical universities system remained in its previous pattern and continued to develop yet after 1917 when social system had changed as the result of the Socialist Revolution victory. Following the liquidation of capitalist mode of production education reformation took place in 1930 with the previous institutes dismissed and numerous branch higher education institutions established to be based on the faculties and chairs by the government decree. By that time consistency of gymnasium education had been destroyed that led to drop of training quality of higher education applicants. By mid of 1930s secondary school graduates traditional system had been restored, mathematics teaching was improved,

physics and chemistry programs hours were increased. Higher technical educational institutions were separated from universities and had five or five and half years' program for each specialty.

The era of branch universities formation in our country fell on 1930s when by decrees more than 150 higher education institutions were created for all of them to be transferred under direct management by corresponding branch commissariats and establishments. To implement five year development plans of national economy and to create enterprises equipped with new technology in the bulk quantities of specialists were required for new industries such as tractor, automobile, machine tools, chemical industry, aviation, agricultural engineering. In short terms soviet higher education reform was carried out, it allowed throughout the country to establish "the production of new "proletarian specialists" [2]. In course of it the higher education reform in 1930s was solving tasks to meet the national economy various sectors requirements in highly specialized engineering staff, new intelligentsia rooted to people, "proletarianization of universities" [3].

In the end of XX century technocracy education, i.e. mastering of knowledge capacity, skills, abilities, and people training for professional activities gave the way to new educational paradigm: formation of man as an individual. New reform of education was provided for many reasons including changed demands of society and industrial production. Many known branch universities, Moscow Aviation, Automobile and Road Construction, Mining, Steel and Alloys, Chemical Engineering, Power Engineering and others had become technical universities in 1990s. A technical university by its concept is not only the center of science and highly qualified specialists' training but also educational institution, which creates conditions to meet individual requirements for professional, cultural and moral self-development, free implementation of creative opportunities. Institute reformation strategy into technical university is long time process, which requires reformation and improving all areas of its activities [4]. However, after 20 years of education system reformation various professional associations and students express dissatisfaction of its results. In 2016, there were 818 educational institutions in higher education system in Russia [5]. In 2000s, there was a wide renaming of institutes in universities and increase of lawyers, economists and other non-core specialists' graduates in technical higher education institutions due to lowering interest to engineering specialties. Along with it engineers' graduation growth is going on. Currently its number in Russia is higher than average number in other countries. Excessive production of specialists with higher technical education leads to a decrease in the prestige of engineering work. All these factors are the reasons for continuation of Russian higher education system reformation. Numerous works by both individual authors and major scientific pedagogical schools are devoted to these questions [6].

This article brings up comparison of training curricula for automobile and road transport higher engineering staff developed under conditions of two reforms of national higher education – 1930s and 2000s. The curriculum is a major document to define education process structure, list, amount of education subjects, and sequence of its studying, kinds and terms of training and production practices. Questions of greatest interest are related to identification of continuity in these educational plans as well as innovations corresponding to definite period of education reform. In the area of higher technical education the ones are the most relevant and require additional research.

The major source of current research is based on documents from the State Archive of the Russian Federation which stored documents related to activity of All-Union Committee on higher technical education in the Central Executive Committee of USSR. It also studied works devoted to history of development of Emperor Alexander I Railway Engineers Institute as well as activities of the Ministry of Railway Transport from 1798 to 1898. Significant contribution in the current research was done by soviet and present Russian scientists works related to issues of national higher technical education. In the current work it uses data from educational plans of specialists' training in Moscow Automobile and Road Construction State Technical University (2013 and 2018).

II. CURRICULUM FOR MECHANIC ENGINEER TRAINING IN THE BRANCH UNIVERSITY

In 1930 education reform was caused by tasks of getting higher technical education "technocracy". The country dramatically lacked specialists, on the eve of reform accounting of 50.8 thousands technical engineering staff was held, it revealed ratio of only 2.4 specialists per 100 workers in the whole industry. Among counted at that time 39.2% of specialists didn't have at all any graduated technical education, they were so-called practitioners. Radical restructuring of educational institutions to prepare "proletarian staff specialists" was launched by USSR CEC (Central Executive Committee) and CPC (Council of People's Commissars) resolution on January 13, 1930 "On reorganization of technical staff in the agricultural industry" and USSR CEC and CPC resolution on July 23, 1930 "On reorganization of higher educational institutions, colleges, workers' education Faculties"[7]. The job of "sharp specialization" was given to Automobile and Road Construction Institutes, engineers graduated from the Institutes must have one and only one specialty. In 1930 the curriculum of Leningrad Automobile and Road Construction Institute (LADI) on road engineer training special subjects took 52% of the whole curriculum, major technical disciplines (construction mechanics, geodesy, descriptive geometry) - 18%, and general education subjects – 30% [8]. Curricula of higher technical universities were reviewed with a purpose for all general scientific, technical and special subjects to make up not less than 80-85% of all education time not counting work practice. Since 1933 the criteria for curricula and subjects

programs have been developed. When making programs it was recommended to avoid its over granularity so that professors' and teachers' staff have an opportunity to correctly use time dedicated to subject. The most flexibility must be provided in subjects special programs for Head of Chair to be able to re-fill programs with newest materials from the field of latest achievements in science and technology.

Curriculum of Moscow Automobile and Road Construction State Technical University (MADI) for specialty of automobile road and road transport mechanic engineer along with higher military training (HMT) was approved in April 23, 1933 [9]. The term of education on this specialty made up 5 years and 5 months. The education term during 1st, 2nd and 5th year of education was 48 six day weeks. Time plan was approved to be in six day weeks. The extended curriculum regulated cycles of training according to subjects and its time consumption in hours. General education cycle was 529 hours. The cycle of physics and mathematics disciplines was 1057, while the special cycle was 2003 hours. Theoretical training in MADI classrooms was the longest in the first year, in the second and third year this period was significantly

decreased due to military training, in the fourth year theoretical training decreased due to work practice which was four months in the fifth year.

Credits sessions were 3 weeks in year of study and only in the fifth year the session decreased to two weeks due to extended work practice. Applicants to automobile and road institutes in USSR (Leningrad, Moscow, Kharkov, Siberia, and Samara) took entrance exams on the following disciplines: USSR peoples history and USSR Constitution, Russian language (written essay, grammar, literature); mathematics; physics, chemistry; foreign language (English, German, French per applicant's choice). Fig. 1 shows number of students in MADI since the first graduation in 1935 up to 2018. Leningrad Institute of Engineers of Railway Transport (LIERT) became the successor of the Imperial Institute of Railway Engineers in 1930. Number of students studying there in 1970s and 1990s corresponding with data [10] as well as monitoring data on educational institutions of Russian Federation for 2013 are shown in Fig.1. In 2013 the educational institution was given back its historical name – “Emperor Alexander I. St. Petersburg State Transport University”

TABLE 1. TIME PLAN ON SPECIALTY OF MECHANIC ENGINEER FOR AUTOMOBILE AND ROAD TRANSPORT IN SIX DAY WEEKS (1933)

Year of study	Theory	Work practice	Credits	HMT*	Graduation diploma project	Breaks	Total
1	45	-	3	-	-	12	60
2	37	-	3	8	-	12	60
3	37	-	3	12	-	8	60
4	32	9	3	-	-	16	60
5	18	28	2	-	-	12	60
6	-	-	1	-	24	-	25
total	169	37	15	20	24	60	325

*HMT – higher military training

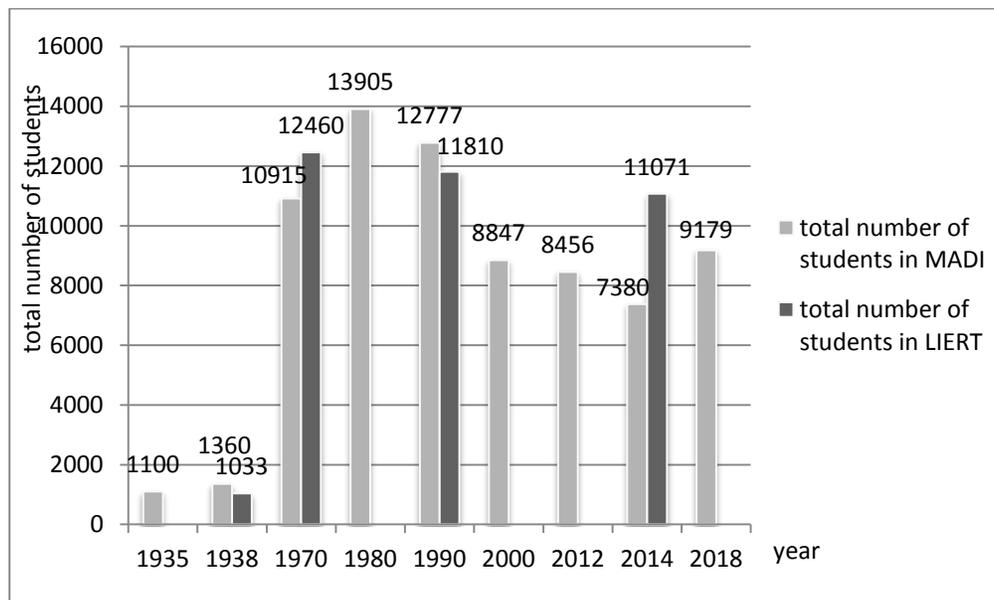


Figure 1. The total number of students in MADI and LIERT

III. CURRICULUM OF SPECIALISTS TRAINING ON SPECIALTY OF “LAND TRANSPORT AND TECHNOLOGY VEHICLES”

In 1992 along with development of humanities fields of studies MADI received status of state technical university. Since 1993 according to the state education standard enshrined multi-level specialists education system, “engineer” qualification stopped granting to graduates of institutes technical specialties to change to Bachelors and Masters training and Specialists training for a number of specialties. The first large graduation of Bachelors,

Specialists and Masters took place in 2014; it was reflected in the total number of students as shown in Fig.1. In MADI specialists are educated on specialty of “Land Transport and Technology Vehicles” with specialization in ‘Automobile equipment in transport technologies’. Term of tuition in this field is 5 years. In MADI in 2013 curriculum of specialists’ training for this specialty makes it possible to deliver time plan shown in Table 2 in seven day weeks. Curriculum also contains forms of study checks – credits (57 for the whole term of tuition) and exams (total number is 38). Military training is excluded from curriculum and carried out in the time free from the rest of classes.

TABLE 2. TIME PLAN OF SPECIALIST TRAINING ON SPECIALTY OF “LAND TRANSPORT AND TECHNOLOGY VEHICLES” (2013) IN SEVEN DAY WEEKS.

Year of studying	Theoretical studies	Exams session	Studies’ practice	Work practice	Graduation diploma project	Breaks	Total
1	35	6	2		-	9	52
2	35	6	4		-	7	52
3	35	6	-	4	-	7	52
4	35	6	-	3 1/3	-	7 2/3	52
5	25	3+2/3	-	-	13 1/3	10	52
total	165	27 2/3	6	7 1/3	13 1/3	40 2/3	260

TABLE 3. COMPARATIVE TABLE OF DISCIPLINES COVERED BY CURRICULA OF MADI IN 1933 AND 2013

№	Name of discipline	Curriculum,1933 y. (classroom hours)	Curriculum,2013 y. (classroom hours)
	General education cycle		
1	Foreign language	201	210
2	Philosophy	-	72
3	Dialectical materialism	72	-
4	History	-	68
5	Leninism	60	-
6	Marxist technology theory	30	-
7	Political economics	109	-
8	Enterprise economics	-	54
9	Theory of the Soviet economy	57	-
	Physics and mathematics cycle		
1	Mathematics	355	350
2	Physics	192	210
3	Chemistry	135	68
4	Theoretical mechanics	241	140
5	Computer science	-	105
	Professional cycle		
1	Strength of materials	260	140
2	Thermodynamics	111	54
3	Hydrodynamics	57	-
4	Hydraulics and hydraulic and pneumatic actuator	-	70
5	Descriptive geometry and plotting	211	106
6	Machinery	201	72
7	Electrical engineering	111	85

Cycles of training changed its name compared to curriculum of 1933, but it remained unchanged to make three cycles of studying. The present name of general education cycle is “humanitarians, social and economic cycle” to take 705 hours of classes. Physics and mathematics and technical disciplines cycle was named modern name of mathematical and natural science cycle to take 1316 hours of classes. The most intensive is professional cycle that takes 2554 hours of classes in educational curriculum. Increase in classroom hours is

witnessed on all training cycles in 2013 curriculum compared to 1933 curriculum. So humanitarian, social and economic cycle increased by 33%, mathematical and natural science – by 24% and 28% professional cycle increase. Increase of hours in each cycle is related to additional subjects’ inclusion in the curriculum with theoretical studies to have led to a number of significant changes. A number of disciplines increased to take exams by students during the session which in turn increased length of the sessions and decreased students’ summer

break, work practice length and graduation diploma projecting time. In professional cycle only basis disciplines are 25 (versus 7 disciplines in curriculum in 1933) and also it contains variable part with additional list of disciplines.

The major educational programs changed the concept of educational process in which education goal is not only mastering volume of knowledge, skills but building out of wide profile competencies including professional and general culture competencies. Has this task been solved? Today it is noticed at all levels incompliance of the results and expectations of different parties: students themselves, production (employers), society and the state. The happened changes in education haven't driven to its quality improvement. Table 3 presents comparison of hours' amount for disciplines which have literarily same names in curricula that are eighty years old.

As seen from Table 3 the number of hours dedicated to studying of foreign language, philosophy that was taught as dialectical materialism, enterprise finance management (or theory of Soviet economy management in 1933) practically unchanged. Among new requirements to educational activity it is often said about correspondence of specialists' curricula with modern industry economy level. Bringing higher education in compliance with labor market requirements is the task that hasn't been solved positively. Cycles of specialists' education and cycles of technologies change are not matching in principle, moreover they diverge. Obviously, in the so rapidly changing technology environment new methods of educational programs projecting must be used to integrate academic and professional education at its future place of work. [11]

IV. SUMMARY

Comparison of curricula of mechanics engineers training in Moscow Automobile and Road Construction Institute (1933) and specialists in the field of "Land Transport and Technology Vehicles" in Moscow Automobile and Road Construction State Technical University (2013) showed that they kept established yet in XIX century tradition of fundamental physics and mathematics Russian engineering education. At the same time in both Branch University MADI and Technical University MADI there has been and continued a way of development by increasing the total number of hours and disciplines to study. Today high general level of professional education in modern Russia is impossible to hold by method of extensive development through increasing of already huge amount of studies workload. It requires continuing education reformation towards a direction of intensifying of human resources development. Methods of teaching must change and such methods like projects, simulators and live case studies, education by experience must be developed and implemented. Projects, initiated in cooperation between higher education institutions and enterprises are necessary to include in curriculum of higher education in the field of transport.

REFERENCES

- [1] History of Emperor Alexander I Railway Engineers Institute for the first hundred years of its existence 1810 – 1910 / A.M. Larionov St.Pet., 1910.
- [2] A.F. Smyk, From Imperial Engineers' College to industry transport institutes (1810 – 1910) (J) MADI Bulletin, 2014, Ed. 2, (37), p.3-14.
- [3] A. F. Smyk Historical experience of engineering education reformation in Russia (J) Issues of natural sciences and technology history, 2015. T.36. N3 P. 537-558.
- [4] Formation and development of university technical education system in Russia/ Ed. I. B. Fedorov and V. K. Balyan. (M) Moscow, Bauman MSTU, 2007.
- [5] Russia in numbers. 2017: Brief statistical compendium, Moscow, 2017.
- [6] T. L. Klyachko Education in Russia: major challenges and possible solutions [M] Moscow: "Delo" Publishing House, RANEP, 2013.
- [7] The State Archive of the Russian Federation. Fund 8060. Inventory 3. Case 118.
- [8] A. F. Smyk, L. L. Zimanov, Educational Plans for engineers education preparation mirrored by education reforms [J], Ed. 1 (40) p. 23-29.
- [9] The State Archive of the Russian Federation. Fund 8060. Inventory 2. Case 54.
- [10] E. I. Kraskovsky LIRE on its way – [M] Moscow, 1990.
- [11] N. G. Khokhlov, M. Y. Rachkov. Technology Education Integration Experience in European countries and Russia. [J] Engineers Education challenges, 2005, N3, p.41-51.