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PREPARING FUTURE SPECIALISTS IN THE TOPOGRAPHIC, GEODETIC AND LAND MANAGEMENT FIELDS FOR PROFESSIONAL ACTIVITY IN THE CONTEXT OF MODERN CHALLENGES

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INTRODUCTION

In today's rapidly changing world, professional training of the future specialist is becoming a key factor in the success of both the individual and society as a whole. Innovative technologies, globalization, digitalization and new labor market requirements require a qualitative reform of educational systems. The task of professional training is to form competencies that meet modern challenges and the ability of a specialist to effectively adapt to changes.

Today, the labor market is undergoing constant changes under the influence of various factors, such as technological innovations, demographic changes, economic conditions and changes in social preferences. Understanding general trends in the labor market is important for predicting future labor needs and adapting to changing conditions.

In recent years, the world has seen an extremely intensive development of new technologies for obtaining information about the spatial characteristics of objects on the Earth's surface, in particular through remote sensing, satellite navigation, geoinformation modeling, informatization of cadastral and registration activities, land management and real estate valuation. In this context, engineering knowledge, skills and abilities are rapidly losing their relevance, and accordingly, modern education in the topographic, geodetic and land management field establishes a number of current requirements and should be implemented on the principles of operational consideration of the achievements of scientific and technological progress and practicality[1].

1. Emergence of the prerequisites of the problem and formulation of the problem

The topographic and geodetic and land management industries in Ukraine play a key role in guaranteeing rights to land and other real estate, ensuring the functioning of relevant real estate markets, spatial planning,

[1] Даценко Л. М., Тітова С. В., Дудун Т. В. Землевпорядна освіта магістерського рівня у світі та Україні: стан та перспективи розвитку. *Український географічний журнал.* 2020. № 3(111). С. 56–63.

public administration, environmental protection, ensuring technogenic safety, etc. Land surveying engineers and geodetic engineers perform surveying, topographic and geodetic, cartographic work, and also conduct several land management and land appraisal works[2]. Thanks to technological progress and the development of scientific methods, these fields are becoming indispensable tools in solving global problems such as climate change, urbanization and ensuring food security. Today, land surveyors require skills in working with modern geodetic instruments, new information technologies and modern computer programs.

The land surveying and topographic-geodetic fields, which are important for the development of infrastructure, agriculture and urban planning, have also been seriously affected by hostilities. At the same time, the COVID-19 pandemic and wartime have made adjustments, both in training specialists and obtaining a qualification certificate[3]**.**

The Law of Ukraine «On Education» defines that the purpose of education is the comprehensive development of a person as an individual and the highest value of society, his talents, intellectual, creative and physical abilities, the formation of values and competencies necessary for successful self-realization, the upbringing of responsible citizens who are capable of conscious social choice and directing their activities for the benefit of other people and society, the enrichment on this basis of the intellectual, economic, creative, cultural potential of the Ukrainian people, the improvement of the educational level of citizens in order to ensure the sustainable development of Ukraine and its European choice[4].

Professional training of a future specialist is a pedagogical process of university education, as a result of which his professional readiness is formed and developed. It manifests itself in forms of activity and determines the ability to set professional goals, choose ways to achieve them, exercise self-control over the implementation of one's own actions and predict ways to increase work productivity in a professional direction. All this is formed with

[2] Мартин А.Г., Бавровська Н.М. Організація топографо-геодезичної діяльності та землевпорядних робіт: навчальний посібник. Київ: ФОП Гуляєва В.М. 2021. 456 с.

[3] Мартин А., Бавровська Н. Землевпорядна та топографо-геодезична галузі України в умовах воєнного часу: трансформації та виклики. *Землеустрій, кадастр і моніторинг земель.* 2024. № 3. DOI: http://dx.doi.org/ 10.31548/ zemleustriy2024.03.08

[4] Про освіту: Закон України від 05.09.2017 № 2145-VIII / Верховна Рада України. URL: https://zakon.rada.gov.ua/laws/show/2145-19#Text (дата звернення: 6.11.2024).

the help of higher education standards for mastering a given specialty and the personal qualities of the student[5].

According to Andriy Martyn[6], an important task for higher education is a systematic analysis of the trends along which geodesy and land management will develop in the coming decades and the development of training and retraining programs for specialists that will allow them to remain competitive in the domestic, European and global labor markets in the future. The authors of the article[7] considered the lack of a systematic approach to financing, organizing and standardizing educational and scientific activities in the field of land management, cadastre and land assessment and protection, the expansion of specialties (specializations) related to managerial, environmental, economic, scientific and other activities in the field of land management to be among the main problems in the training, advanced training and retraining of personnel in the field of geodesy and land management.

Education is the greatest investment we can make during war. The success of no state is possible without investments in the development of human capital, namely in education, skills and science. But education also faces a number of challenges.

Therefore, land management faculties of higher educational institutions should not only be an educational center, but should also become an intellectual and expert-analytical center of the industry, a platform for testing and practical adaptation of advanced technological solutions, a platform for professional discussions and practical training.

2. Analysis of existing methods for solving the problem and formulating the task for optimal development of technology

With the declaration of independence of Ukraine, the emergence of private ownership, and the beginning of land reform, the issue of training specialists in the field of geodesy, cartography, and land management became acute. Specialties were combined into directions, among which the direction «Geodesy, Cartography, and Land Management» was determined. As of 2013, there were 36 higher education institutions in Ukraine training bachelors, specialists, and masters in the direction 6.080101 “Geodesy, Cartography, and

[5] Шульга Л.В., Бражник Л.В., Вакуленко Ю.В. Підвищення якості університетської освіти: професійна та практична підготовка фахівців. *Наукові праці Полтавської державної аграрної академії.* Полтава: ПДАА, 2013. Вип. 1 (6). Т. 2. С. 335–338.

[6] Мартин А. Вища освіта з геодезії та землеустрою: час змінювати пріоритети навчання? *Землевпорядний вісник*. 2018. № 2. С. 30–36.

[7] Третяк А.М., Третяк В.М., Пендзей Л.П. Стан та проблеми підготовки, підвищення кваліфікації і перепідготовки кадрів у сфері землеустрою. *Землеустрій, кадастр і моніторинг земель.* 2016. № 1-2. С. 128–135.

Land Management". In 2016, there was a transition to a single specialty 193 «Geodesy and Land Management». From 01.09.2017, training at the educational and qualification level of "specialist" was discontinued[8].

The strategic importance of specialty 193 «Geodesy and Land Management» is evidenced by its presence in the list of branches of knowledge and specialties[9] in which applicants for higher (first (bachelor's), second (master's) and third (educational and scientific) degrees) and professional pre-higher education are trained and who have repeatedly been provided with special state support in training in the field of professional pre-higher education.

The goal of the educational and professional program of specialty 193 «Geodesy and Land Management» is to form in the future specialist the ability to dynamically combine knowledge, skills, communication skills and abilities with autonomous activity and responsibility when solving tasks and problematic issues in the field of geodesy and land management.

Approved state standards of higher education: Standard of higher education of the first (bachelor's) field of knowledge 19 Architecture and construction in the specialty 193 «Geodesy and land management» and Standard of higher education of the second (master's) field of knowledge 19 Architecture and construction in the specialty 193 «Geodesy and land management» take into account existing trends and promising directions in accordance with the obvious paths of development of the industry[10] [11].

[8] Беспалько Р., Казімір І., Гуцул Т. Проблемні моменти підготовки та становлення фахівців за спеціальністю 193 «Геодезія та землеустрій». *Технічні науки та технології: науковий журнал.* Національний університет «Чернігівська політехніка». 2021. № 1(23). С. 198–208.

[9] Про затвердження переліку галузей знань і спеціальностей, за якими здійснюється підготовка здобувачів вищої та фахової передвищої освіти: Постанова Кабінету Міністрів України від 29.04.2015 № 266 / Верховна Рада України. URL: https://zakon.rada.gov.ua/laws/show/266-2015-%D0%BF#Text (дата звернення: 6.11.2024).

[10] Стандарт Вищої освіти першого (бакалаврського) рівня галузі знань 19 «Архітектура та будівництво» спеціальності 193 «Геодезія та землеустрій». Наказ Міністерства освіти і науки України № 517 від 11.05.2021. Київ: Міністерство освіти і науки України. URL: http://surl.li/eynz

[11] Стандарт Вищої освіти другого (магістерського) рівня галузі знань 19 «Архітектура та будівництво» спеціальності 193 «Геодезія та землеустрій». Наказ Міністерства освіти і науки України № 835 від 10.07.2023. Київ: Міністерство освіти і науки України. URL: http://surl.li/divxt

As of 2024, 44 higher educational institutions in Ukraine are training applicants for the specialty 193 «Geodesy and land management», including 41 state and 3 private.

According to the results of the 2024 admission campaign, a total of 3,723 applications were submitted to state universities for the specialty «Geodesy and Land Management» of the Bachelor's degree: (303 – Lviv Polytechnic National University, 264 – National University of Life and Environmental Sciences of Ukraine, 212 – Taras Shevchenko National University of Kyiv, 210 – Lviv National Environmental University, 193 – Kyiv National University of Construction and Architecture). The volume of the state order for the training of specialists in the specialty «Geodesy and Land Management», approved by the government, for applicants based on complete general secondary education (PZSO) is 585 places for full-time and 45 places for part-time study. According to the results of the targeted placement of the state order for school graduates, the top three popular leaders among applicants who received the largest number of places were Taras Shevchenko National University of Kyiv (51), National University of Life and Environmental Sciences of Ukraine (48), Lviv Polytechnic National University (48). (Fig. 1).

For the Master's degree program in «Geodesy and Land Management», according to the results of the 2024 admission campaign, 1,216applications were submitted from applicants (Ivano-Frankivsk National Technical University of Oil and Gas – 108, Lviv National Environmental University – 99, National University of Life and Environmental Sciences of Ukraine – 86. The volume of the state order for training higher education applicants in 2024 for the Master's degree in «Geodesy and Land Management» was 318 places for full-time and 4 places for part-time study. The top five leaders in popularity among applicants who received the largest number of state places were the National University of Life and Environmental Sciences of Ukraine (42), Taras Shevchenko National University of Kyiv (25), O.M. Beketov National University of Urban Economy in Kharkiv (24), Lviv Polytechnic National University (23), Kharkiv National Automobile and Highway University (17) (Fig. 2).

Training of specialists in specialty 193 Geodesy and land management should be based on the practical orientation of qualification requirements, taking into account the labor market situation and world experience. Therefore, an important task for higher educational institutions is a systematic analysis of trends that will develop in the future in the topographic and geodetic and land management industries.

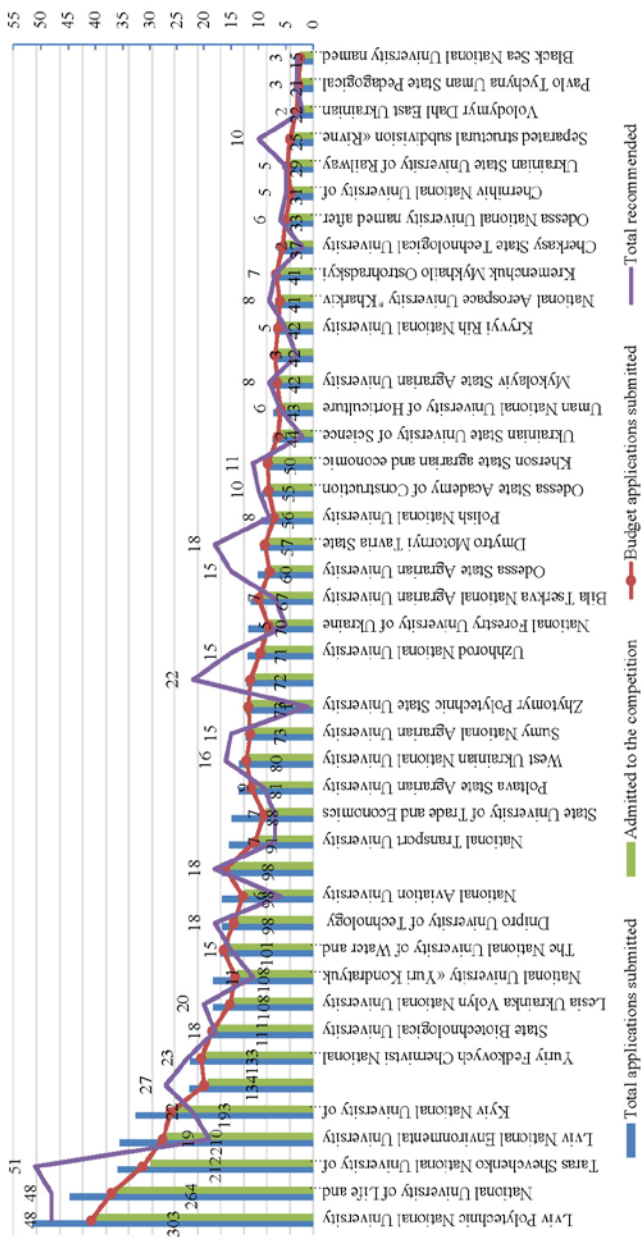

Fig. 1. Indicators of targeted placement of state orders in 2024 for the Bachelor's degree program in specialty 193 Geodesy and land management[12]

[12] https://vstup.edbo.gov.ua/statistics/konkurs-universities/

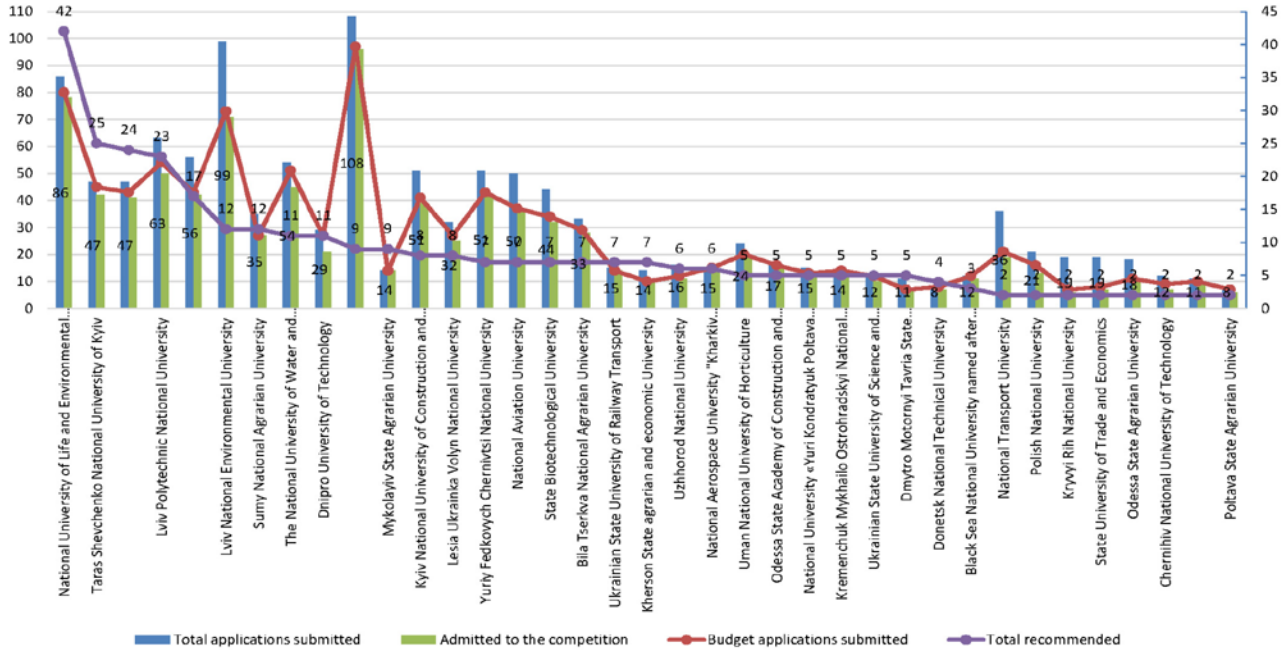

Fig. 2. Indicators of targeted placement of state orders in 2024 for the Master's degree program in specialty 193 Geodesy and land management[13]

[13] https://vstup.edbo.gov.ua/statistics/konkurs-universities/

Article 66 of the Law of Ukraine «On Land Management»[14] stipulates that faculties of land management profile of higher educational institutions of the appropriate level of accreditation can carry out the training of land management engineers.

The profession of a surveying engineer and land surveyor is especially important in the conditions of martial law and the post-war reconstruction of the country. Today, the demand for such types of work as topographic and cartographic support for military affairs has increased in army units, knowledge of military topography is especially needed, there is a high demand for drone pilots, for work related to aerial reconnaissance and fire correction using unmanned aerial vehicles, it is necessary to be able to accurately determine coordinates on the ground using remote sensing materials, et

Professional activities in the field of land management may be carried out by persons who have higher education in specialties and qualifications in the field of land management knowledge, have work experience in the specialty of at least one year and have passed the qualification exam and received a certificate and registered in the State Register of Certified Land Surveyors. Only certified land surveyors may be responsible for the quality of land management work and topographic-geodetic and cartographic work when carrying out land management[15] [16].

Certified land surveyors are responsible for the quality of land management work and certify the compliance of land management documentation with the provisions of regulatory legal acts by signature (by applying a qualified electronic signature) and personal seal. In accordance with the Law of Ukraine on Land Management, developers of land management documentation may be legal entities or individuals in whose composition a certified land surveyor works at the main place of work.

As noted by the authors of Article[17] according to the register of certified land surveying engineers, as of 01.03.2024, 6062 certified land surveying engineers were registered in Ukraine who received a qualification certificate

[14] Про землеустрій. Закон України від 22.05.2003 № 858-IV. / Верховна Рада України. URL: https://zakon.rada.gov.ua/laws/show/858-15#n753 (дата звернення: 6.11.2024).

[15] Там само.

[16] Про топографо-геодезичну і картографічну діяльність. Закон України від 23.12.1998 № 353-XIV/ Верховна Рада України. URL: https://zakon.rada.gov.ua/laws/show/353-14#n43 (дата звернення: 6.11.2024).

[17] Мартин А., Бавровська Н. Землевпорядна та топографо-геодезична галузі України в умовах воєнного часу: трансформації та виклики. *Землеустрій, кадастр і моніторинг земель*. 2024. № 3. DOI: http://dx.doi.org/10.31548/zemleustriy2024.03.08

during 2013–2024, and as of 01.11.2024, their number increased to 6128 people.

Regarding the register of certified surveying engineers who received a qualification certificate during 2013 – 2024, as of 01.03.2024, 1735 people were registered in Ukraine in the register, and as of 01.11.2024, their number increased by 46 people. The largest number of employed people is in Kyiv city, and also Kyiv, Lviv, Odesa, and Dnipropetrovsk regions (Fig. 3).

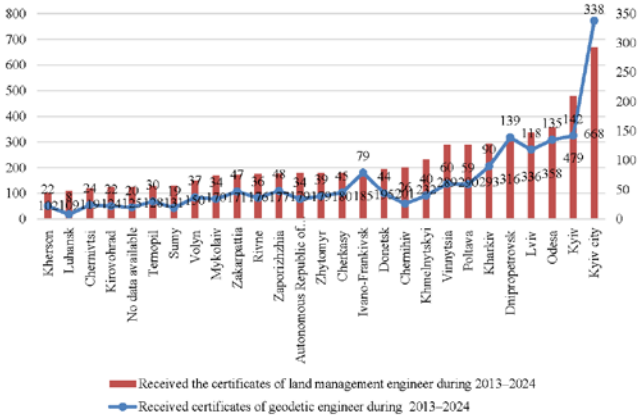

Fig. 3. Statistics of obtaining certificates by land surveying engineers and geodetic engineers during 2013–2024[18] [19]

In modern conditions, the demand for skills and competence of workers in the field of geodesy and land management is changing so rapidly that in the near future our students will most likely face completely different challenges and tasks.

In the future, according to A. Martyn, there will be a need to structure land management works according to their main purpose with the allocation of independent areas of professional activity:

1) formation and registration of land plots and other real estate;
2) territorial planning and development of real estate;
3) resource management in nature management.

[18] Державний реєстр сертифікованих інженерів-геодезисті. URL: https://data.gov.ua/dataset/6130efbe-eceb-4f78-beb6-3152dd3d8c36 (дата звернення: 6.11.2024).

[19] Державний реєстр сертифікованих інженерів-землевпорядників. URL: https://data.gov.ua/dataset/f5e3730e-0196-452a-8d43-746825e4dfbb (дата звернення: 6.11.2024).

The land management and topographic and geodetic industry has undergone many changes in recent years, and in particular, professional land managers have become independent and have received greater responsibility for the performance of land management and topographic and geodetic works.

A modern land surveyor and geodetic engineer performs a wide range of surveying, topographic and geodetic, cartographic works, and also conducts all types of land surveying and land appraisal works. In conditions of martial law, the demand for such types of works as topographic and cartographic support for military affairs, works related to aerial reconnaissance and fire correction using unmanned aerial vehicles, operational mapping using UAVs, etc. has increased.

The COVID-19 pandemic and wartime have significantly impacted the land management and topographic geodetic industries and have introduced serious changes in the training and recruitment of new professionals through certification procedures. There is a growing need to apply remote sensing technologies to ensure the functioning of cadastral systems, spatial planning, and control and supervision activities in the field of environmental management, which requires the adaptation of educational programs and advanced training of engineers[20].

With the beginning of the post-war reconstruction of the country, the need for our specialists in the land management and topographic and geodetic industries will also increase significantly, especially in the process of successful implementation of the decentralization reform, land reform, civil protection of the population, and the reconstruction of territories destroyed during hostilities, by developing comprehensive plans for the spatial development of the territory of the territorial community.

A modern specialist must be able to set professional goals, choose ways to achieve them, exercise self-control over the implementation of his own actions, and predict ways to increase work productivity in a professional direction.

The model of a modern specialist is a set of interconnected parts: external factors of the international labor market, which requires the independence of the specialist; internal factors of state influence regarding compliance with the requirements of the state standard; requirements of the profession, which provide for a certain set of skills. The authors of the article proposed a diagnostic tool for professional activity to check the formation of readiness of future specialists in geodesy and land management and

[20] Мартин А., Бавровська Н. Землевпорядна та топографо-геодезична галузі України в умовах воєнного часу: трансформації та виклики. *Землеустрій, кадастр і моніторинг земель*. 2024. № 3. DOI: http://dx.doi.org/ 10.31548/ zemleustriy2024.03.08

formulated the tasks of training future land surveying engineers for the needs of the field of geodesy and land management, including:

1) education in future specialists of a motivational and value attitude to activities aimed at the needs of the field of land management;

2) mastering a holistic system of theoretical knowledge, special skills, practical skills necessary for professional activity;

3) formation of professionally important personal qualities necessary for the application of acquired knowledge, skills and abilities in the field of land management;

4) formation of a conscious need to assess one's own level of readiness for professional activity, forecasting and further adjustment of this readiness[21].

The integration of Ukrainian science into the European research space should provide the opportunity to develop advanced scientific ideas, participate in interdisciplinary projects focusing on promising ideas, technologies and innovations, which should be reflected in the educational programs for training specialists in specialty 193 «Geodesy and land management».

Higher education in geodesy and land management in the context of globalization and European integration should be carried out taking into account:

- professional training of a specialist, including the acquisition of integral competence: the ability to solve problems of an applied, research or innovative nature in the field of geodesy and land management; general and special competences, taking into account theoretical training, practical skills, development of soft skills;
- trained specialists should have critical thinking skills, teamwork and digital literacy and be competitive in the labor market in the future;
- in the post-war period, educational and professional programs should take into account the influential changes in economic, social, demographic and migration reality, which would correspond to modern technologies;
- taking into account international standards and global trends in professional activity when training specialists;
- introduction of digital technologies in education, project-based learning;
- formation of students' skills of continuous learning that guarantees their competitiveness in the future.

[21] Русіна Н., Люльчик В. Модель підготовки фахівців галузі геодезії та землеустрою в умовах інформатизації, глобалізації та євроінтеграції. *Інформаційні технології і засоби навчання*. 2020. Т. 80, № 6. С. 176–187. DOI: doi:10.33407/itlt.v80i6.2981

CONCLUSIONS

Education in the field of geodesy and land management is not only a sectoral education within the framework of the education system of Ukraine, but also a tool for the development of this industry. Geodetic and land management production is an industry that has specific differences from other industries. These differences must be taken into account when forming educational services and ensuring the quality of education. In addition, the specified production forms the labor market for persons who have received geodetic and land management education.

Professional training of a future specialist should be comprehensive, take into account modern challenges and trends. Integration of theoretical knowledge, practical skills and development of soft skills will ensure a high level of qualification and adaptability of graduates to dynamic changes in the professional environment.

SUMMARY

The current trends in the training of specialists in geodesy and land management are analyzed, taking into account the development prospects in the field of topographic and geodetic and land management, their impact on the education system, European integration and globalization processes. The authors emphasize the critical role of the topographic and geodetic and land management industries in ensuring rights to land and real estate, spatial planning, land resource management, and ensuring technogenic and environmental safety. In particular, a detailed analysis of the indicators of targeted placement of state orders in 2024 for the Bachelor's and Master's degree programs in specialty 193 «Geodesy and land management» was carried out. The authors also studied the dynamics of certification of land surveying engineers and surveyors for the period 2013–2024, which makes it possible to assess the state of the topographic and geodetic and land management industry, taking into account both economic and social challenges. The professional training of a future specialist is considered as a pedagogical process of university education, the result of which is the formation and development of his professional readiness and the process of forming a specialist at the production level. Problematic points in the training and formation of specialists in the specialty 193 «Geodesy and land management» are given.

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