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## ANALYSIS OF THE UKRAINIAN MARKET OF ENGINEERING SERVICES

**The aim** of the research is to identify the types of engineering services provided to pharmaceutical companies, to analyze the market of engineering services, as well as to develop a map of opportunities to accelerate the use of industrial engineering in pharmaceutical production. Statistical materials, regulatory documents, methods of analysis and synthesis were used in order to achieve the objective of the research.

**Results.** The essence of engineering and types of engineering services are determined according to the results of analytical review of information sources. The directions of activity of engineering firms are studied. The decrease of innovative activity of domestic industrial enterprises, low dynamics of use of engineering services is revealed. In addition, the analysis of the market of engineering services of pharmaceutical profile revealed the presence of successfully operating companies, the activity of which provides engineering support of key technological processes of pharmaceutical production. The obstacles and matters of engineering implementation are analyzed, the prospects and ways of dealing with the revealed matters are studied in order to accelerate the use of engineering in pharmaceutical production.

**Conclusions.** It is proved that engineering involves a significant number of operations. Engineering services include market situation research, design and development of working technical documents, technical support of project implementation, consulting on production maintenance of the project; business operations and business processes improvement, marketing complex improvement, qualified personnel selection, financial consulting, etc. It is established that the provision of engineering services on the Ukrainian market is carried out by companies specializing in the provision of engineering, construction, consulting, research services. As a rule, engineering companies have a clearly defined specialization both in the types of services provided and in the industrial orientation. The peculiarity of pharmaceutical engineering is the design, construction of pharmaceutical (biotechnological) productions, comprehensive validation according to GMP rules and ISO standards.

*Key words:* engineering; engineering service; engineering company; industrial engineering

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### АНАЛІЗ УКРАЇНСЬКОГО РИНКУ ІНЖИНІРИНГОВИХ ПОСЛУГ

**Метою** роботи є виявлення видів інжинірингових послуг, що їх надають фармацевтичні компанії, аналіз ринку інжинірингових послуг, а також розроблення карти можливостей прискорення застосування промислового інжинірингу в умовах фармацевтичного виробництва. Для досягнення мети дослідження використано статистичні матеріали, нормативно-правові документи, методи аналізу, синтезу.

**Результати.** За результатами аналітичного огляду джерел інформації визначено сутність інжинірингу та види інжинірингових послуг. Досліджено напрямки діяльності інжинірингових фірм. Виявлено зниження інноваційної активності вітчизняних промислових підприємств, низька динаміка використання інжинірингових послуг. Разом із тим, аналіз ринку інжинірингових послуг фармацевтичного профілю виявив наявність фірм, що працюють успішно й забезпечують інжиніринговий супровід ключових технологічних процесів фармацевтичного виробництва. Для прискорення застосування інжинірингу в умовах фармацевтичного виробництва проаналізовано перешкоди й проблеми його впровадження, досліджено перспективи й шляхи подолання виявлених проблем.

**Висновки.** Доведено, що інжиніринг передбачає значну кількість операцій. Інжинірингові послуги охоплюють дослідження ринкової ситуації, проектування та розробку робочих технічних документів, технічний супровід реалізації проекту, консультування щодо виробничого обслуговування проекту; поліпшення ведення бізнесу й бізнес-процесів, удосконалення комплексу маркетингу, підбір кваліфікованого персоналу, фінансове консультування тощо. З'ясовано, що надання інжинірингових послуг на ринку України здійснюють компанії, що спеціалізуються на наданні інженерних, будівельних, консультативних, дослідницьких послуг.

Як правило, інжинірингові фірми мають чітко виділену спеціалізацію як за видами наданих послуг, так і за галузевою спрямованістю. Особливістю фармацевтичного інжинірингу є проектування, будівництво фармацевтичних (біотехнологічних) виробництв, комплексна валідація згідно з правилами GMP та стандартами ISO.

*Ключові слова:* інжиніринг; інжинірингова послуга; інжинірингова компанія; промисловий інжиніринг

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#### **АНАЛИЗ УКРАИНСКОГО РЫНКА ИНЖИНИРИНГОВЫХ УСЛУГ**

**Целью** работы является выявление видов инжиниринговых услуг, предоставляемых фармацевтическим компаниям, анализ рынка инжиниринговых услуг, а также разработка карты возможностей ускорения внедрения промышленного инжиниринга в условиях фармацевтического производства. Для достижения цели исследования использованы статистические материалы, нормативно-правовые документы, методы анализа, синтеза.

**Результаты.** По результатам аналитического обзора информационных источников определена сущность инжиниринга и виды инжиниринговых услуг. Исследованы направления деятельности инжиниринговых фирм. Выявлено снижение инновационной активности отечественных промышленных предприятий, низкая динамика использования инжиниринговых услуг. Вместе с тем, анализ рынка инжиниринговых услуг фармацевтического профиля выявил наличие успешно функционирующих фирм, деятельность которых обеспечивает инжиниринговое сопровождение ключевых технологических процессов фармацевтического производства. Для активизации инжиниринга в условиях фармацевтического производства проанализированы препятствия и проблемы его внедрения, исследованы перспективы и пути преодоления выявленных проблем.

**Выводы.** Доказано, что инжиниринг включает значительное количество операций. Инжиниринговые услуги охватывают исследования рыночной ситуации, проектирование и разработку рабочих технических документов, техническое сопровождение реализации проекта, консультирование по производственному обслуживанию проекта; усовершенствование ведения бизнеса и бизнес-процессов, совершенствование комплекса маркетинга, подбор квалифицированного персонала, финансовое консультирование и др. Установлено, что предоставление инжиниринговых услуг на рынке Украины осуществляют компании, специализирующиеся на предоставлении инженерных, строительных, консультативных, исследовательских услуг. Как правило, инжиниринговые фирмы имеют четко выделенную специализацию как по видам предоставляемых услуг, так и по отраслевой направленности. Особенностью фармацевтического инжиниринга является проектирование, строительство фармацевтических (биотехнологических) производств, комплексная валідація согласно правилам GMP и стандартам ISO.

*Ключевые слова:* инжиниринг; инжиниринговая услуга; инжиниринговая компания; промышленный инжиниринг

#### **STATEMENT OF THE PROBLEM**

The difficulty of technological processes of manufacturing medicinal product is associated with the complexity of requirements for quality, safety, efficacy of pharmaceutical products. Compliance with the requirements of a significant number of standards, rules, guidelines requires constant improvement of management processes, implementation of the latest management concepts. Pharmaceutical enterprise, as a technically complex object, is interested in provision of services in carrying out pre-design works, scientific researches and inventions, preparation of technical documentation during planning, implementation and analysis of project execution, post-design services in carrying out consulting and author's supervision of equipment, marketing researches, economic and financial consulting, consulting services in information support imple-

mentation. The specified range of engineering services is the basis for effective management of project activities of a modern pharmaceutical enterprise.

#### **ANALYSIS OF RECENT RESEARCHES AND PUBLICATIONS**

A definition of the essence and features of engineering implementation expands with its development. In the most common sense, engineering is a set of techniques and methods that a company, enterprise, firm uses to design its activities [1]. The works of K. E. Nasurlaieva [2], A. A. Breus, A. V. Lobza [3], N. V. Shvets, O. O. Khandiy [4] are devoted to the study of the peculiarities of engineering implementation. With regard to the essence of the activity area, the engineering is considered as a field of entrepreneurial activity associated with the creation of industrial enterprises, infrastructure facili-

ties, construction facilities, carrying out of engineering-consulting and engineering-construction activity based on the use of intellectual property rights, experience in their implementation or commercialization of legal forms of the latter.

The multidimensionality of engineering also reflects the variety of engineering services, which can be grouped as follows:

1) pre-design, design, post-design and special services that provide production projects or processes (market situation research, design and development of working technical documents, technical support of project implementation, consulting on production maintenance of the project);

2) services that ensure the operation of an existing project or aimed at meeting the needs of an effective product sales process (for example, business operations and business processes improvement, marketing complex improvement, qualified personnel selection, financial consulting, etc.).

The international practice includes the following types of engineering companies:

- engineering-consulting – provide technical consulting services;
- engineering-construction – may provide a full range of services related to the creation of industrial and other facilities on a turnkey basis;
- advisory – provide services in enterprise management, computer technology, organization of production, sales, finance, etc.;
- engineering-research – specialize in the development of technological processes and new production technologies (creation and use of intellectual property objects) [5-6].

Usually, engineering companies have a clearly defined specialization both in the types of services provided and in the industrial orientation.

#### IDENTIFICATION OF ASPECTS OF THE PROBLEM UNSOLVED PREVIOUSLY

Despite the spread of engineering, the matter of analyzing the fields of activity of domestic engineering companies in pharmaceutical production, the study of the experience of using a wide range of potential engineering services by pharmaceutical enterprises is still pressing. Obstacles and matters of engineering implementation in the activities of pharmaceutical companies need to be identified.

#### OBJECTIVE STATEMENT OF THE ARTICLE

The aim of the research is to identify the types of engineering services provided to pharmaceutical companies, to analyze the market of engineering services, as well as to develop a map of opportunities to accelerate the use of industrial engineering in pharmaceutical production. Statistical materials, regulatory documents, methods of analysis and synthesis were used in order to achieve the objective of the research.

#### PRESENTATION OF THE MAIN MATERIAL OF THE RESEARCH

Traditionally, the high level of engineering development is directly related to the innovative development of the country [7]. Analyzing the internal innovation activity of Ukrainian industrial enterprises (Fig. 1), it should be emphasized a significant decrease in the volume (as a percentage) of innovative products in total sales (in 2018 – only 0.8 %).

As it is seen from the aforementioned data, a part of innovatively active enterprises in the total number of industrial enterprises in Ukraine decreased from 18 % to 16.4 % since 2000 till 2018. The dynamics of expenses of domestic industrial

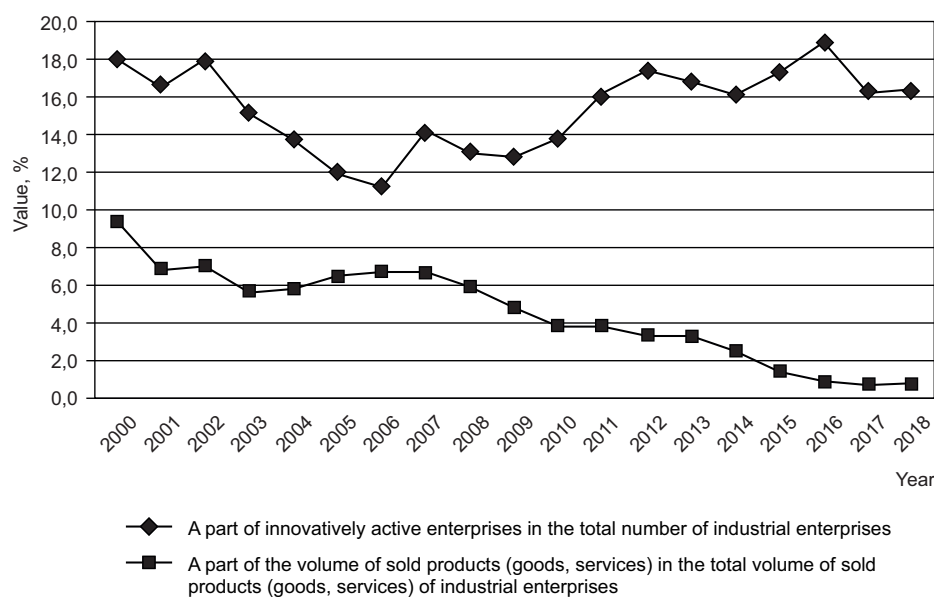
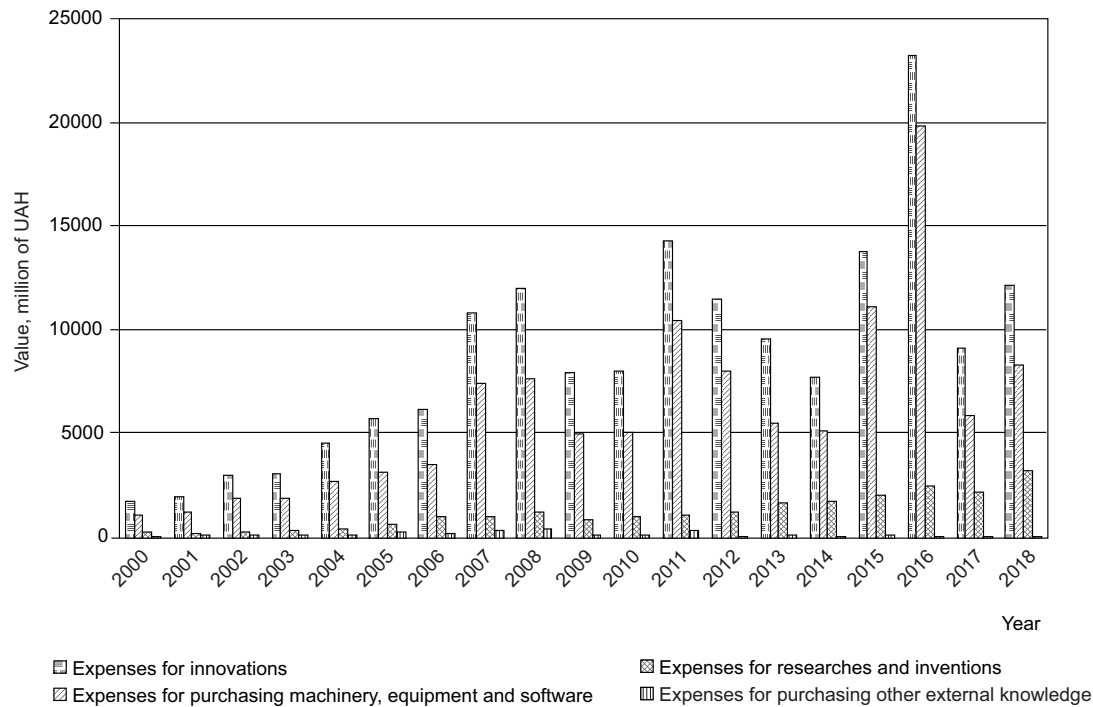


Fig. 1 Dynamics of innovation implementation at industrial enterprises of Ukraine



**Fig. 2** Dynamics of total expenses by areas of innovation activity of industrial enterprises of Ukraine

enterprises on innovation (Fig. 2) is unstable, periods of acceleration of investment in the innovation process (2000-2008, 2011, 2015-2016) are replaced by periods of decline (2009-2010, 2012-2014, 2017) due to the instability of economic and political fluctuations.

Analyzing the structure of expenses by areas of innovation activity, the dominance of expenses for purchasing machinery, equipment and software should be emphasized (from 55 % in 2005 to 85 % in 2016). The expenses that characterize the development of consulting engineering, namely the expenses for researches and inventions, expenses for purchasing other external knowledge, constitute much smaller part from 7 % to 26 % and from 0.2 % to 6 % respectively. This indicates low innovation activity of Ukrainian industrial enterprises, low use of engineering services, despite the growing of demand for the latter.

Engineering services belong to class 71.12 "Activity in the field of engineering, geology and geodesy, the provision of technical consulting services in these fields" according to KVED-2010 (Classifier of Economic Activity Types) [8]. This class includes:

- engineering design (ie application of laws and principles of engineering in the design of machines, selection of materials, tools, structures, processes and systems) and consulting in the following fields: design of mechanical engineering, industrial construction; projects for the construction of engineering structures, hydraulic structures and transport construction; water sources management projects; projects

in the field of electronics and electrical engineering, mining engineering, chemical technology, mechanical engineering, organization of production, systems engineering, safety regulations;

- development of air conditioning and cooling systems projects, engineering developments on control of sanitary condition and environmental pollution, noise control, etc.;
- geophysical, geological and seismic surveys;
- activity in the field of geodesy: measurement of land plots and their boundaries; hydrological exploration works; works on the underground layers study; cartographic activity and activity in provision of data on spatial parameters.

It should be noted that, despite a quite wide range of activities, the Ukrainian market of engineering services is difficult to recognize as developed. Thus, for example, only 18 engineering companies indicated engineering as the main type of activity in class 71.12 out of 100 engineering companies according to the data of the analytical system for compliance, market analysis, business intelligence and investigations YouControl [9].

The analysis of the experience of engineering using in the conditions of pharmaceutical production (Table 1) revealed a certain number of specialized engineering companies, whose activity is directly related to the provision of relevant services to pharmaceutical enterprises [10-22]. Most of these companies specialize in services in purchasing, installation of equipment, intermediary and construction services, production automation services, etc.

**ANALYSIS OF THE FIELDS OF ACTIVITY OF DOMESTIC ENGINEERING COMPANIES  
IN PHARMACEUTICAL PRODUCTION**

| Company name  | Field of activity  |
|---|--|
| “LAB AND PHARMA ENGINEERING” LLC (Prague, subsidiary company in Kyiv) | Pharmaceutical engineering of companies covers the full range: design; pharmaceutical risks analysis; projects qualification; construction and author’s supervision; development of specifications of user requirements; acceptance tests control; supply and installation of frameworks of clean rooms according to GMP, technological equipment and clean environments, engineering systems; start-up and adjustment works; comprehensive validation; technical audits; process optimization, service, repair, maintenance; staff training and consulting  |
| “FAVEA ENGINEERING KYIV” LLC (Prague, subsidiary company in Kyiv)     | Design and construction of pharmaceutical and biotechnological productions, medical centers and healthcare facilities, pharmaceutical engineering (according to GMP and ISO)   |
| “Farminzhener” LLC (Kyiv)   | The company performs works in design, supply of technological equipment and “clean rooms”, staff training and validation of pharmaceutical enterprises for compliance with international GMP standards. It develops conceptual project, specifications, working project, documentation for requests to suppliers; control over the project implementation  |
| “Validation Center” Company (Kharkiv)                                 | Wide range of engineering services: development of specification of user requirements; development of conceptual, basic and detailed projects; technological design; design of clean environment systems; design of pharmaceutical production; laboratory design; design, supply and installation of heating, ventilation and air conditioning systems; conducting technical audits of heating, ventilation and air conditioning systems; design, supply and installation of clean rooms, technological equipment, engineering systems, automation and monitoring systems; qualification and expert evaluation of project; construction works and author’s supervision; control during acceptance tests; commissioning and validation; project support |
| ZETA LLC (Graz, Austria, branch in Vinnytsia)                         | ZETA develops engineering solutions for liquid and aseptic processes. Range of services: support in the development of production process technology; creation of working drawings for the production of technological equipment; manufacture of industrial production equipment, laboratory and pilot units; services in repair and maintenance of developed equipment  |
| “ENGINEERING AND PRODUCTION COMPANY “LEOKON GROUP” LLC (Kyiv)         | Engineering and production company, supplier and manufacturer of elements, frameworks for “clean rooms”. Complex of performed works: design works in formation of the construction task for the preparation of premises and supply of utilities; supply of technological equipment; reception of premises, final assembly of equipment, engineering systems, connection of internal engineering systems; start-up and adjustment works and object attestation  |
| “Simenkom Engineering” Private Enterprise (Khmelnyskyi)               | Services provision in technological processes automation   |
| “SVS-ARTA” LLC (Cherkasy)   | Engineering company that carries out the construction of clean rooms on a turnkey basis of varying degrees of complexity for pharmaceutical production   |
| “SAT Engineering” (Sumy)  | Turnkey project management – from conceptual idea to commissioning; complex installation works; technological processes automation; production of capacitive equipment for pharmaceutical, chemical and food industries; installation of air conditioning and ventilation systems  |
| “Art Engineering” LLC (Kyiv)  | The company offers the following services for pharmaceutical companies: design works in automation, dispatching, electrical engineering; production of automatic switchboards of any complexity; full range of works in installation of ventilation and air conditioning systems; service maintenance of ventilation and air conditioning systems; production and installation of power electrical installations; installation of local power networks; supply of components and cable and wire products, trays, conduits; design and installation of lightning protection and grounding systems; waterproofing; heat insulation   |
| “Stimeks Engineering Group” Company (Kremenchuk)                      | The company offers services in inspection, design, engineering of steam condensate systems, and also energy saving projects for conditions of pharmaceutical production  |
| “InterResurs” LLC   | Specialized engineering company, providing comprehensive services in construction and maintenance of modern engineering systems for industrial production, full range of services in the field of supply of industrial enterprises of Ukraine with engineering equipment and components from leading European manufacturers  |
| “VNIKHIMPROEKT” LLC (Institute “VNDIKHIMPROEKT”)                      | Engineering center VNIKHIMPROEKT provides design of pharmaceutical plants and factories, warehouses, auxiliary enterprises of the pharmaceutical industry taking into account the requirements of safety and cleanness of production (development of working documentation; functional solutions; work plan; economic calculations and technical nuances)  |

**DIRECTIONS DETERMINATION OF ACCELERATION OF ENGINEERING APPLICATION  
IN PHARMACEUTICAL PRODUCTION**

| Direction of matters of engineering implementation in the activity of pharmaceutical enterprises | Specification  |
|--|--|
| Obstacles to implementation  | Structural deformations in the country's economy, political and economic crisis; lack of developed infrastructure of the domestic market of engineering services; imperfect institutional component of regulating the activity of engineering companies; low intensity of innovation activity development of most pharmaceutical enterprises   |
| Problematic aspects of engineering implementation  | Imperfection of the legislation of Ukraine concerning implementation of engineering services, in particular the inconsistency of statutory regulations regarding the conclusion of engineering contracts in various fields; inconsistency of the legislative base of Ukraine with the world experience of engineering; slow formation of the engineering services market; non-formation of tools for protection of rights (intellectual, legal, financial, etc.) of participants in the process of engineering services provision  |
| Prospects for engineering development  | Stability of the industry, sustainable development of the pharmaceutical market; development of industrial clusters, innovation infrastructure; implementation and functioning of good practices, observance by domestic pharmaceutical enterprises of international quality standards (certification), dissemination of the international experience application in the formation of organizational and technical procedure for the processing of conceptual foundations of engineering   |
| Ways to overcome obstacles and matters of engineering implementation                             | Creation of conceptual bases of the organization and operation of engineering in pharmaceutical production; adaptation of international experience of provision of engineering services to the conditions of the market infrastructure of Ukraine and the peculiarities of the domestic pharmaceutical market, stimulating the implementation of engineering in the activities of companies (preferential lending, legislative support); activation of innovative development of pharmaceutical enterprises; training of qualified personnel for the creation and operation of a multi-directional engineering system at pharmaceutical enterprise; development of an effective system (algorithm) of support of engineering works performance |

Thus, the analysis of the Ukrainian market of engineering services allows us to say that domestic pharmaceutical enterprises are quite active in cooperating with engineering companies and have experience in the successful implementation of such projects.

Within the justification of the implementation of engineering, attention should also be paid to the analysis of matters, obstacles, and, accordingly, ways to overcome them. A generalized map of opportunities of acceleration engineering application in pharmaceutical production is given in Table 2.

**CONCLUSIONS AND PROSPECTS  
FOR FURTHER RESEARCH**

1. It is revealed that the essence of the concept of "engineering" is interpreted as a field of entrepreneurial activity related to the creation of industrial enterprises, infrastructure facilities, construction facilities, implementation of engineering-consulting and engineering-construction activity based on the use of rights to intellectual property objects, the experience of their implementation.

2. The results of the analysis of internal innovation activity of Ukrainian industrial enterprises revealed a significant decrease in the volume of innovative products in the total volume of sold products (up to 0.8 %). The analysis of the structure of expenses by areas of innovation activity showed the dominance of expenses for purchasing machinery, equipment and software (from 55 % to 85 %).
3. The analysis of the experience of using engineering in pharmaceutical production revealed a certain number of specialized engineering companies, whose activity is directly related to the provision of relevant services to pharmaceutical enterprises. Most of these companies specialize in services in purchasing, installation of equipment, intermediary, construction, automation services, etc.

The matters of development of the concept, stages and algorithm of implementation of engineering in practice of the domestic pharmaceutical enterprises need further study.

**Conflict of interests:** authors have no conflict of interests to declare.

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Надійшла до редакції 25.10.2020 р.