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THE EFFECTIVENESS OF THE SYSTEM OF INTRA-FIRM TECHNOLOGY TRANSFER OF INDUSTRIAL ENTERPRISE

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Purpose. This article summarises the internal and external environmental factors that influence the development of a technology transfer system as an important tool for the promotion of innovation within an enterprise. The concept of technology transfer for a machine building enterprise as a set of goals, objectives, functions and factors of knowledge and information transfer has been identified in this article. **Methodology.** The authors have determined the effectiveness of technology transfer on the basis of an evaluation of system effects of this process, manifested in various spheres of activity of the entity. **Originality.** This approach provides an opportunity to consider the openness and complexity of the system of technology transfer, determining its ability to provide significant flexibility and adaptability in a changing enterprise environment. **Practical value.** The ability of the proposed methodical approach in evaluating the effectiveness of the transfer and commercialization of innovative technologies has been demonstrated. References 10, tables 2, figures 3.

Key words: transfer of technologies, adaptability, innovation development, effectiveness.

ЕФЕКТИВНІСТЬ СИСТЕМИ ВНУТРІШНЬОФІРМОВОГО ТРАНСФЕРУ ТЕХНОЛОГІЙ ПРОМИСЛОВОГО ПІДПРИЄМСТВА

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У статті узагальнено фактори внутрішнього та зовнішнього середовища, що впливають на розвиток системи трансферу технологій як важливого інструмента активізації інноваційної діяльності підприємства. Сформовано концептуальну схему системи трансферу технологій на машинобудівному підприємстві як сукупність цілей, завдань, функцій та чинників процесу передачі знань та інформації. Авторами запропоновано визначати результативність трансферу технологій на підставі оцінювання системи ефектів цього процесу, що проявляються у різних сферах діяльності господарюючого суб'єкта. Даний підхід надає можливість урахувати відкритість і складність системи трансферу технологій, визначити її спроможність забезпечувати високу адаптивність і гнучкість підприємства в умовах мінливого зовнішнього середовища. Обґрунтовано адекватність і багатоаспектність запропонованого методичного підходу до оцінювання ефективності процесу передачі та комерціалізації інноваційних технологій.

Ключові слова: трансфер технологій, адаптивність, інноваційний розвиток, ефективність.

PROBLEM STATEMENT. Today, technology transfer is an important tool in accelerating the innovation process, increasing the effectiveness of technology commercialization, solving problems such as innovation management during the replacement of technological processes, aiding decision making whilst assessing the practicality of introducing new technologies, protection of the intellectual properties of the technologies and the implementation of the innovation policy for the company as a whole.

Technology transfer occupies a "grey zone" between the internal and external environment of a company. To form a new intellectually developed and continuously progressive economy modern enterprises have to enhance their investment and innovation

activity, upgrade and diversify their commodity portfolio, bring their production and technology base up to date and improve the qualifications of their staff. This approach is key to successful and profitable development of an enterprise in the modern context of globalization and active innovation development of the economy. Many economists have focused their attention on the features of the organization of internal and external technology transfer within an enterprise, including: H. Androshchuk, Y. Goncharov, V. Denisyuk, V. Yevdokimov, A. Zhytenko, P. Izhevskyy, M. Yohna, C. Kovalchuk, O. Orlov, A. Rzhavsky, B. Salikhova, V. Stadnyk, T. Trotsikovskyy, L. Fedulova, N. Fonshteyn, R. Foster, D. Henatra, N. Chukhrai, A. Shaposhnikov and others.

However, questions regarding the evaluation of the effectiveness of technology transfer within machine building enterprises have not been sufficiently studied until now.

EXPERIMENTAL PART AND RESULTS OBTAINED. Given the openness of the system of technology transfer, its operation and development are under the permanent influence of internal and external environmental factors (Fig. 1). At the macro-level the main factors that negatively affect the development of a technology transfer system within domestic industrial

enterprises are: imperfection of the legislation which defines and protects the intellectual property rights of the participants involved with the innovation process, the financial and credit system crisis, high lending rates, low level of innovation market's and investment-innovation infrastructure development in the country, a decrease in domestic demand for products of domestic producers, and an insufficient level of government support to stimulate innovation activity of enterprises [7].

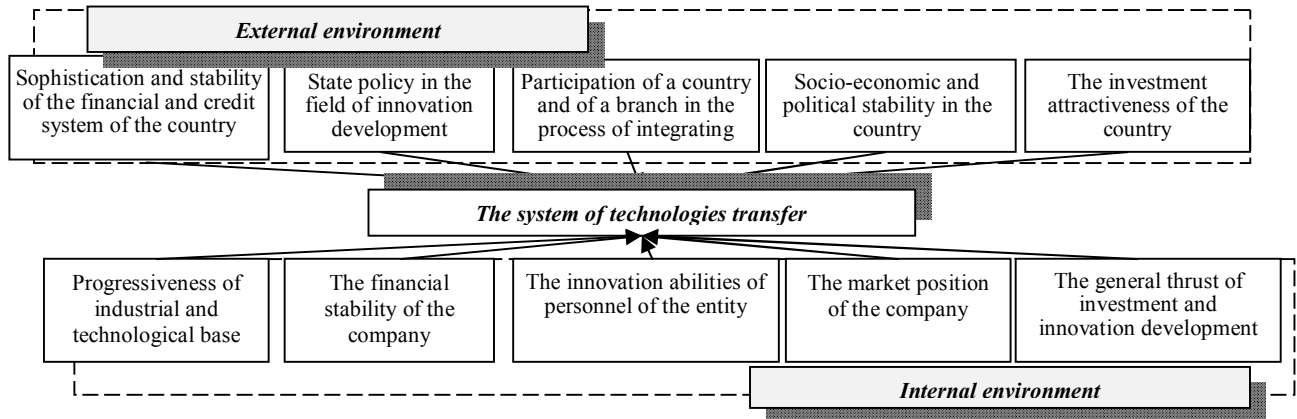


Figure 1 – Internal and external factors of development of technologies transfer (author's elaboration)

Therefore, important prerequisites of active innovative development within a domestic industry, the achievement of high indexes of knowledge-intensive GDP and the safeguarding of the effectiveness of technology transfer process within machine building enterprises are: the development of public financing mechanisms, tools and instruments to support innovation activity, the formation of a legal framework in the field of innovation, the co-operation of science, education, manufacturing, financial and credit sectors to promote innovation, and the promotion of the development of an innovation infrastructure etc. [2].

Examination of other countries teaches us that active government support of innovation and the stimulation of innovation through preferential taxation, loans, the development of research and innovation infrastructure provides a favourable investment environment for the innovation. It provides innovation a position of leadership in the country (Table 1) [9].

Technology transfer in an enterprise has a number of problems: market analysis to identify the main trends for development, ensuring the control of the dynamics of attitudes and tastes of consumers, monitoring the activities of competitors; meeting the consumer's demand with the latest modified products; update the companies commodity portfolio according to modern market trends; enhancement of the modernization of equipment, technologies and raw materials (production assets of the company); promotion of the development of the qualifications of the staff, maintaining its ability to innovation activity; improvement of the mechanism of economic management of enterprises through the introduction of modern approaches to the adoption and implementation of organizational decisions.

Table 1 – Peculiarities of innovative development of world leaders of innovation activity [9]

Country	Peculiarities of innovative development
1	2
Switzerland	1. networks of competence in the Universities of Applied Sciences, increasing of the value of knowledge, promoting of the dialogue between science and society highlighted as priority areas of science and economy; 2. direct public investments are not subject to commercialize of innovations; 3. the instruments of innovation policy are focused on applied research; 4. innovative technologies are introducing in the industry by means of modern forms of support for enterprises
Great Britain	1. the existence of a large number of innovation centres; 2. the promotion of regional development of investment processes; 3. focus on the private initiative
Sweden	1. the operation of an extensive system of organizations whose primary purpose are the development of business: the Innovation Bridge; ALMI Business Partner; the Industrial Fund; the Invest in Sweden Agency, ISA; 2. stable political system that promote the development of innovation system; 3. the well-organized and efficient work of state institutions in the implementation of innovative processes; 4. high qualifications and constant updating of the personnel in the field of innovative technologies and processes; 5. the large number of universities and students which propose and implement innovations. At the same time, innovative idea, under the law, belongs to the researcher; 6. universities oriented on the introduction of researches and on the implementation of their products on the market

Continue of table 1

1	2
Netherlands	1. predominant place in the development of innovative processes takes regional level; 2. active participation in international programs of innovation cooperation, that is coordinated by the ministries and agencies; 3. the involvement of small and medium enterprises to participate in international innovation projects; 4. developed scientific and educational complex, which includes a system of student support, system of technologies transfer in the scientific sector, developed network of research universities with state funding
USA	1. the close interaction between the state and private business; 2. emphasis on the transfer of federal technologies; 3. by using a large-scale targeted projects state regulation of innovative processes is made in the direction of stimulating the creation of venture capital firms and research centres of innovative small and medium enterprises; 4. there are two major inter-agency bodies: American Science Foundation, which coordinates the areas of basic research, and the American Research Council, which represents the interests of industry and universities in science and technology policy. The Ministry of Defence and the National Agency for Aeronautics and Space (NASA) play the most important role in public research programs/

Therefore, we can determine the following functions of technology transfer as the main tool of innovation development of an enterprise:

1. the commercialization of technologies – ensuring high effectiveness of the conversion process of intellectual labour's results in the commodity market

for profit or other market benefits;

2. adaptive – providing the capacity of an enterprise to quickly adapt to the dynamics of internal and external environment, high-speed of reactions to variations at the macro level;

3. marketing – the development of the system of marketing competences of the company taking into account innovative trends in the dynamics of the market;

4. communicative – forming stable relationships with the environment, providing information processes with all counterparties for further innovation development;

5. emergent – the formation of special innovative features of the system as a result of permanent and synergetic interaction of all units and elements of the system of technologies transfer;

6. benchmarking – implementation of systematic search and ensure of the implementation of best management practices, production techniques and approaches to business which will lead company to more advanced forms.

Thus, the system of technology transfer is a complex and open system that is in constant contact with the environment, providing a high level of adaptability and flexibility for the enterprise, is a prerequisite for intensive development and allows the formation of a system of modernized competitive advantages as a result of effective interaction of innovative business opportunities (Figure. 2).

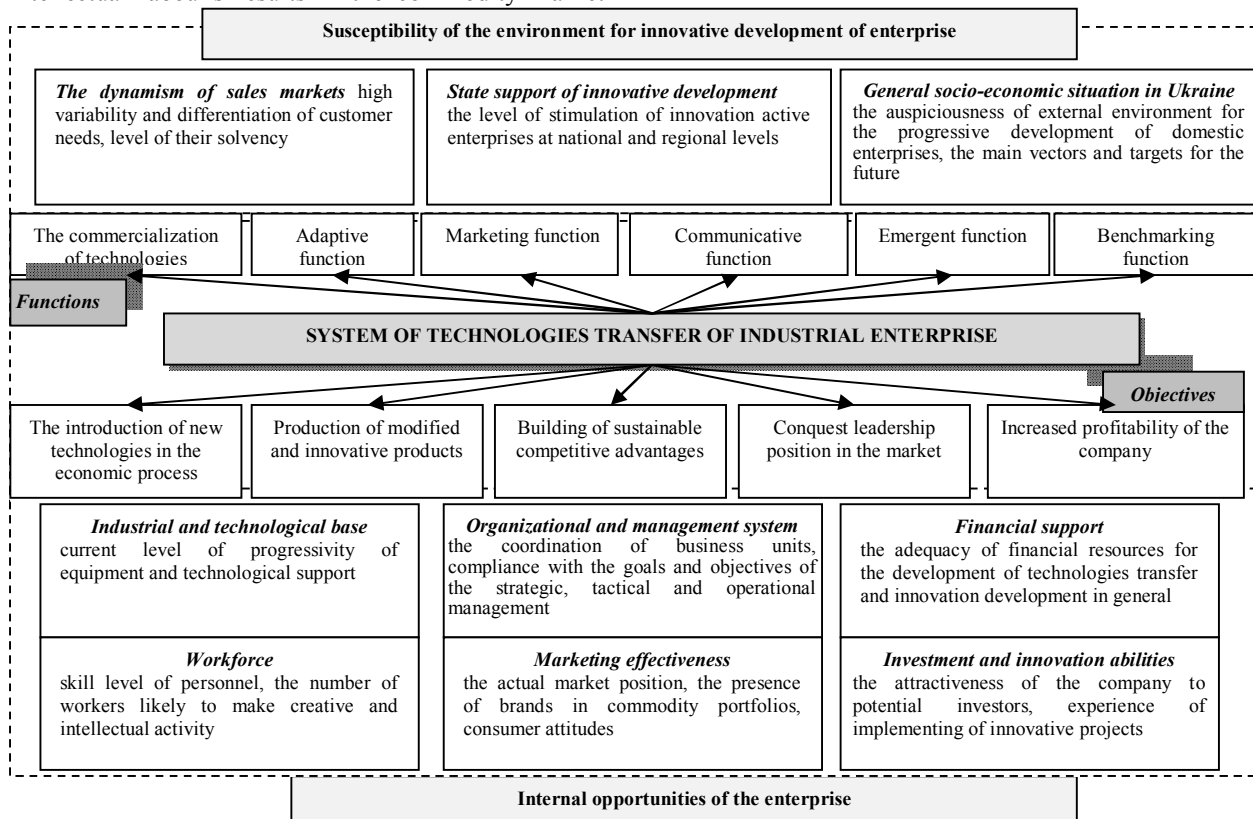


Figure 2 – The conceptual diagram of the transfer of technologies in an industrial enterprise (author's elaboration)

Successful implementation of the objectives of technology transfer is possible if there is a quantitative

and qualitative resource base and an efficient management system.

Thus, the development of innovative products requires advanced equipment and technologies, advanced intensive renewal of fixed assets (i.e. sufficient funding), market promotion of new or modified products (i.e. the application of modern marketing methods, and effective approaches to developing the brand in order to win customer loyalty. Especially important is the intellectual level creativity of staff; their ability to perform innovative activity, develop new ideas and implement them.

At the same time, technology transfer is an effective tool for the development of the resource base of a company, further innovation development of its

industrial and commercial activities, advanced training of personnel, ensuring the modernization process of making organizational and management decisions.

Due to the complexity and multidimensional nature of the process of technology transfer, a wide range of criteria based on complexity and consistency must be considered when evaluating its effectiveness. Technology transfer should provide a number of effects: innovative activity for the enterprise, a progressive industrial and technological base, high financial effectiveness, performance of investment and innovation activities, development of personnel, marketing, communication and environmental effectiveness (Figure 3).

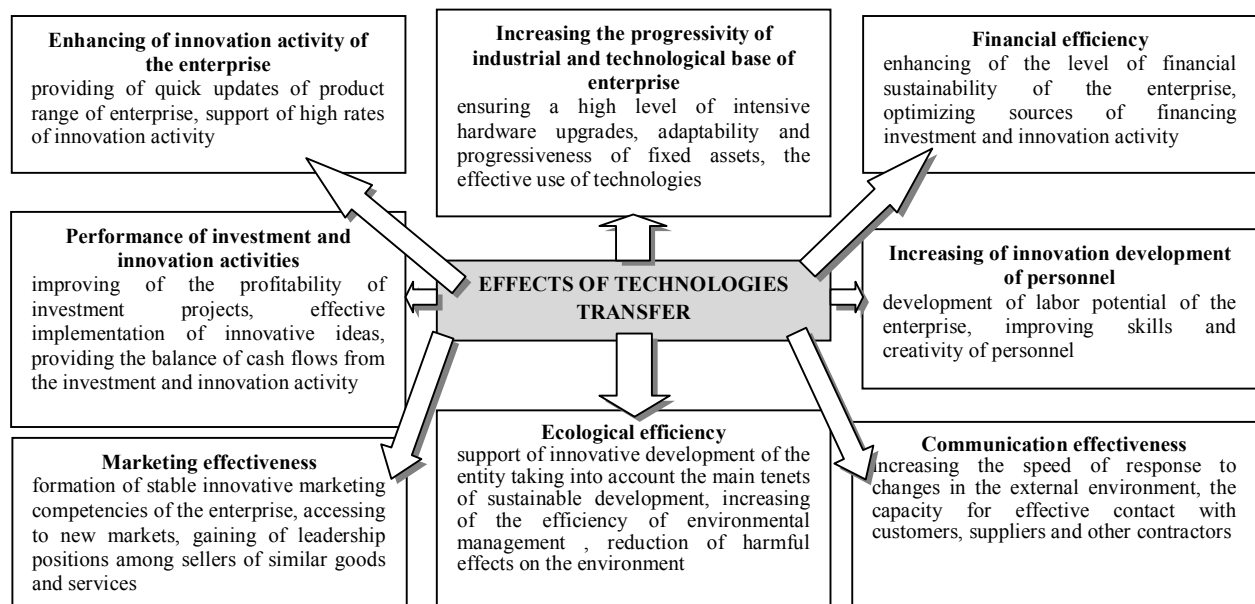


Figure 3 – The system of effects of technologies transfer at the machine building enterprise (author's elaboration)

It is advisable to pay attention to the communicative effectiveness of technology transfer, as it results in the ability of a machine building enterprise to adequately respond to changes in the external environment, reflects increasing capabilities of acceptance, understanding, learning, use and transfer of information, willingness and ability to communicate with potential customers and the public, influence them

and allows a push for appropriate action to reflect changes at the macro scale. So, for a comprehensive evaluation of the effectiveness of technology transfer it is proposed that a system of performance indicators are used, they are a combination of the functional components and reflect the success of all tasks performed during a technology transfer (Table. 2).

Table 2 – The system of indicators for estimating the efficiency of technologies transfer at the enterprise

Effects	Indexes
1	2
Enhancement of innovation activity of the enterprise	1. Growth rate of revenue from sales from enterprise innovation
	2. The turnover coefficient innovation resources
	3. Indicator inventive (innovative) activity of employees
Increasing the progressivity of industrial and technological base of enterprise	1. The coefficient of technology updates
	2. The coefficient of fixed assets of the enterprise
	3. The coefficient of adaptability of equipment
	4. The coefficient of equipment necessary for the innovation sphere
	5. The level of scientific resources
	6. The performance of fixed assets
	7. The index of progressivity technology
Financial efficiency	1. Increased return on assets
	2. Increased profit margin
	3. Increased return on equity

1	2
Financial efficiency	4. Coefficient of autonomy
	5. The coverage coefficient
	6. Absolute liquidity coefficient
	7. Financial stability coefficient
	8. Beaver coefficient
Performance of investment and innovation activities	1. ROI
	2. The coefficient of balancing cash flows
	3. Return on investment in innovation
	4. Share of profit from innovation in net profit
Increasing of innovation development of personnel	1. Growth rate of middle level workers
	2. The growth rate of labour productivity
	3. The proportion of employees who improved their skills in the current period
	4. The coefficient innovative development personnel (employees the ability to innovate)
	5. Value of engineering and scientific support (the ability of staff to solve engineering and scientific and applied problems)
	6. Indicator of educational level of personnel
Marketing effectiveness	1. The rate of increase in market share of the enterprise
	2. The proportion of spending on marketing and advertising in the total innovation expenditures
	3. Update ratio of enterprises
Ecological efficiency	1. The growth rate of the number of energy saving technologies in the enterprise
	2. The coefficient reducing production waste product innovation
	3. Return on environmental innovation component
	4. Ratio of environmental product innovation
Communication effectiveness	1. The inventory turnover coefficient
	2. Return of products
	3. The growth rate of net income from sales
	4. Relative release of working capital
	5. The level of ICT
	6. The level of partnerships
	7. The level of customer loyalty

CONCLUSIONS. Thus, the system of technology transfer of an industrial enterprise gives economic, scientific, technical, environmental, organizational and communication benefits. Development and commercialization of new technologies provide additional profit for an economic entity as a result of the implementation of modernized production, improved product quality through the use of improved or new production and organizational management methods. A manifestation of the successful functioning of technology transfer is the development of the scientific and technological capacity of the entity, intensive upgrade of logistics, introduction of new production lines, the use of advanced equipment, modernization and improvement of production process.

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An important aspect is to reduce the burden on the environment as a result, therefore the introduction of energy saving technologies, modern utilization and processing plants, which is especially relevant within contemporary vector for sustainable economic development is required. Accordingly, the evaluation of the effectiveness of the of technology transfer should be based on a comprehensive consideration of the results of its functioning, increasing innovation activity, progressivity industrial and technological base, cost-effectiveness, efficiency of investment and innovation, increase innovation personnel, marketing effectiveness, environmental effectiveness, communicative effect.

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ЭФФЕКТИВНОСТЬ СИСТЕМЫ ВНУТРИФИРМЕННОГО ТРАНСФЕРА ТЕХНОЛОГИЙ ПРОМЫШЛЕННОГО ПРЕДПРИЯТИЯ

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В статье обобщены факторы внутренней и внешней среды, влияющие на развитие системы трансфера технологий как важного инструмента активизации инновационной деятельности предприятия. Сформирована концептуальная схема системы трансфера технологий на машиностроительном предприятии как совокупность целей, задач, функций и факторов процесса передачи знаний и информации. Авторами предложено определять результативность трансфера технологий на основании оценки системы эффектов этого процесса, проявляющихся в разных сферах деятельности хозяйствующего субъекта. Данный подход позволяет учитывать открытость и сложность системы трансфера технологий, определять ее способность обеспечивать высокую адаптивность и гибкость предприятия в условиях меняющейся внешней среды. Обоснована адекватность и многоаспектность предложенного методического подхода к оценке эффективности процесса передачи и коммерциализации инновационных технологий.

Ключевые слова: трансфер технологий, адаптивность, инновационное развитие, эффективность.

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