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TECHNOLOGICAL ENTREPRENEURSHIP MANAGEMENT AND SME STARTUP DEVELOPMENT MANAGEMENT

The rapid development of the digital economy, technological innovations and global competition significantly enhances the role of technological entrepreneurship as one of the key drivers of economic growth. In these conditions, small and medium-sized business startups acquire particular importance, which ensure the development and commercialization of innovative products, the introduction of digital technologies and the formation of new high-tech markets. At the same time, existing approaches to the management of technological entrepreneurship are mainly focused on assessing individual aspects of the activities of enterprises, which does not allow for a comprehensive consideration of the relationship between technological potential, digital transformation, management efficiency, investment attractiveness and scalability of the business. The article proposes the author's model of the Technological Startup Management Index, which is based on a multiplicative approach to assessing the effectiveness of technological entrepreneurship management. The developed model includes a system of interrelated coefficients of technological performance, business scalability, managerial adaptability, digital integration, investment attractiveness and commercialization of innovations, which allows for a comprehensive assessment of the level of development of technological startups.

Practical testing of the proposed methodology was carried out on five Ukrainian small and medium-sized technological enterprises. The results obtained confirmed that the highest values of the integral indicator are characteristic of enterprises that ensure balanced development of technological potential, digital transformation, innovative activity and strategic management. It was established that the effectiveness of technological startup management is determined not by individual financial or innovative indicators, but by the synergistic interaction of all components of the management system.

The practical significance of the results obtained lies in the possibility of using the proposed methodology by enterprise managers, investors, venture funds, business incubators, accelerators and government agencies to assess the effectiveness of the development of technological startups, justify strategic management decisions, determine investment priorities and form programs to support innovative entrepreneurship.

Keywords: technological entrepreneurship; management; startup; small and medium-sized businesses; innovative activity; digital transformation; technological innovations; business scalability; commercialization of innovations; managerial adaptability; investment attractiveness; integrated assessment; management effectiveness; competitiveness; technological development.

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МЕНЕДЖМЕНТ ТЕХНОЛОГІЧНОГО ПІДПРИЄМНИЦТВА ТА УПРАВЛІННЯ РОЗВИТКОМ СТАРТАПІВ МАЛОГО І СЕРЕДНЬОГО БІЗНЕСУ

Стрімкий розвиток цифрової економіки, технологічних інновацій та глобальної конкуренції суттєво посилює роль технологічного підприємництва як одного з ключових

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драйверів економічного зростання. Особливе значення в цих умовах набувають стартапи малого і середнього бізнесу, які забезпечують розроблення та комерціалізацію інноваційних продуктів, впровадження цифрових технологій і формування нових високотехнологічних ринків. Водночас існуючі підходи до менеджменту технологічного підприємництва переважно орієнтовані на оцінювання окремих аспектів діяльності підприємств, що не дозволяє комплексно врахувати взаємозв'язок технологічного потенціалу, цифрової трансформації, управлінської ефективності, інвестиційної привабливості та масштабованості бізнесу.

У статті запропоновано авторську модель «*Technological Startup Management Index*», яка базується на мультиплікативному підході до оцінювання ефективності менеджменту технологічного підприємництва. Розроблена модель включає систему взаємопов'язаних коефіцієнтів технологічної результативності, масштабованості бізнесу, управлінської адаптивності, цифрової інтеграції, інвестиційної привабливості та комерціалізації інновацій, що дозволяє комплексно оцінювати рівень розвитку технологічних стартапів.

Практичну апробацію запропонованої методики проведено на п'яти українських технологічних підприємствах малого і середнього бізнесу. Отримані результати підтвердили, що найвищі значення інтегрального показника характерні для підприємств, які забезпечують збалансований розвиток технологічного потенціалу, цифрової трансформації, інноваційної активності та стратегічного менеджменту. Встановлено, що ефективність управління технологічними стартапами визначається не окремими фінансовими чи інноваційними показниками, а синергетичною взаємодією всіх складових системи менеджменту.

Практичне значення одержаних результатів полягає у можливості використання запропонованої методики керівниками підприємств, інвесторами, венчурними фондами, бізнес-інкубаторами, акселераторами та органами державної влади для оцінювання ефективності розвитку технологічних стартапів, обґрунтування стратегічних управлінських рішень, визначення інвестиційних пріоритетів і формування програм підтримки інноваційного підприємництва.

Ключові слова: технологічне підприємництво; менеджмент; стартап; малий і середній бізнес; інноваційна діяльність; цифрова трансформація; технологічні інновації; масштабованість бізнесу; комерціалізація інновацій; управлінська адаптивність; інвестиційна привабливість; інтегральне оцінювання; ефективність управління; конкурентоспроможність; технологічний розвиток.

Problem statement. Despite the rapid development of technological entrepreneurship and the growing role of startups in shaping the innovative economy, existing approaches to managing their development remain fragmented and focused mainly on individual aspects of activity, in particular financial results, innovative activity or digital transformation. The issue of comprehensive assessment of the effectiveness of technological entrepreneurship management, which would simultaneously take into account technological potential, scalability of the business model, managerial adaptability, level of digital integration, investment attractiveness and effectiveness of commercialization of innovations, remains insufficiently researched. The lack of an integrated methodological toolkit complicates the adoption of strategic management decisions, assessment of the prospects for the development of startups and the formation of effective mechanisms for state and private support of technological entrepreneurship. This necessitates the development of a new comprehensive model for assessing the effectiveness of management of technological startups of small and

medium-sized businesses, which will provide an objective determination of the level of their development and will allow substantiating the directions of increasing competitiveness in the conditions of digital transformation of the economy.

Analysis of publications. The issues of technological entrepreneurship management and management of the development of small and medium-sized business start-ups are formed at the intersection of research in the field of change management, innovation management, human capital development, strategic management and state support for innovation activities. Budnik and Ivanova (2020) investigated modern approaches and models of change management in enterprises, justifying the need to apply complex mechanisms for adapting organizations to a dynamic external environment [1]. The authors prove that the effectiveness of changes largely depends on the integration of strategic, organizational and personnel management tools. Zos-Kior, Ilyin and Svyryda (2020) considered the development of labor potential as a key component of effective organization management. The study emphasizes that human capital is the main factor in the innovative development of enterprises, especially in the context of digital transformation and rapid technological renewal [2]. Prib (2014) formed the conceptual principles of building a change management system in an enterprise, identifying its structural elements, functional relationships and implementation principles. The proposed approaches create the basis for the formation of adaptive management systems necessary for the development of technological entrepreneurship [3]. Shary, Zos-Kior and Kyrlyuk (2020) proposed an institutional model for the development of economic relations, emphasizing the decisive role of the institutional environment in ensuring the efficiency of economic activity. The conclusions obtained are of practical importance for the formation of institutional support for technological startups and the development of innovation ecosystems [4]. Pashchenko (2014) analyzed modern methods of change management, focusing on the need to use systemic, process and situational approaches when implementing organizational transformations. The study confirms that the speed of adaptation of enterprises to technological changes is becoming one of the key factors of their competitiveness [5]. Hnatenko and Kulikova (2016) investigated promising areas for improving the personnel management system, justifying the need to develop competencies, motivation and innovative activity of employees. The proposed recommendations are relevant for the formation of teams of technological startups, the activities of which are based on knowledge and highly qualified human capital [6]. Smerichevsky, Arefieva and Piletska (2022) developed approaches to the formation of strategic decisions in change management, emphasizing the importance of risk forecasting, strategic flexibility and scenario planning. Their results demonstrate the need to use adaptive management models in conditions of high uncertainty in the development of technological business [7]. Hnatenko, Popova, Bachkir and Nechyporenko (2021) investigated state priorities for the development of an innovative economy using scenario foresight and models for assessing scientific, technical and intellectual potential [8]. The authors argue that the effective development of technological entrepreneurship requires a combination of state policies to stimulate innovation, develop intellectual capital and support high-tech business.

Despite significant scientific achievements, the analyzed works do not pay enough attention to the comprehensive management of technological entrepreneur-

ship and integrated management of the development of small and medium-sized business startups, taking into account the simultaneous influence of technological, financial, innovative, digital and managerial factors. This necessitates the development of a comprehensive methodology for assessing and managing the development of technological startups, which will become the theoretical and methodological basis for further research.

Presentation of the main results. To assess the efficiency of technological entrepreneurship management, the author's model Technological Startup Management Efficiency Model (TSMEM) is proposed, which is based not on a simple averaging of indicators, but on assessing the balance between the technological development of the enterprise, managerial efficiency and market implementation of innovations. At the first stage, the technological efficiency coefficient is determined:

$$KTR = \frac{P_{inn}}{R\&D + IT}$$

where: P_{inn} – income from the sale of innovative products; $R\&D$ – research and development costs; IT – investments in digital technologies.

This indicator characterizes the return on technological investments.

Next, the startup's scaling factor is calculated:

$$KSC = \frac{Mg \times Cn}{Te}$$

where: Mg – market growth rate; Cn – number of new customers; Te – time to market.

The higher the coefficient, the faster the startup scales its business model.

Management flexibility index:

$$KAG = \frac{Ds}{Rt}$$

where: Ds – the number of strategic management decisions implemented in the planning period; Rt – the average response time of the enterprise to market changes.

Digital integration coefficient:

$$KDI = \frac{Ad + Ac + Ap}{3}$$

where: Ad – automation of document flow; Ac – digitalization of interaction with customers; Ap – automation of production processes.

Investment attractiveness factor:

$$KIN = \frac{Iv}{Br}$$

where: Iv – the amount of attracted investments; Br – the level of entrepreneurial risk.

The coefficient of commercialization of innovations:

$$KCM = \frac{Nc}{Ni}$$

where: Nc – number of commercialized innovations; Ni – total number of developed innovations.

Entrepreneurial sustainability coefficient:

$$KES = \sqrt{KTR \times KAG}$$

The use of the geometric mean allows us to take into account the interdependence of technological performance and management quality: a low value of any component significantly reduces the overall result.

The integral index of technological entrepreneurship development is defined as a multiplicative model:

$$TSMI = \sqrt[6]{KTR \times KSC \times KAG \times KDI \times KIN \times KCM}$$

where: $TSMI$ (Technological Startup Management Index) characterizes the comprehensive level of development of technological entrepreneurship and the efficiency of management of startups of small and medium-sized businesses.

Practical testing of the proposed methodology was carried out on five Ukrainian technological enterprises of small and medium-sized businesses, whose activities are characterized by a high level of innovative activity, the use of digital technologies and an orientation towards scaling their own business models. Ajax Systems, Esper Bionics, YouScan, ECOFACTOR and Uklon were selected for the study. The choice of enterprises was due to the availability of open information on the directions of their development, innovative activity and digital transformation.

At the first stage, the initial indicators necessary for calculating the author's coefficients of efficiency of management of technological entrepreneurship were determined.

Table 1. Initial indicators of development of technological enterprises, calculated by the author

Enterprise	Revenue from innovations, UAH million	Investments in R&D and digitalization, UAH million	New customers, thousand	New product release time, months	Innovations implemented	Innovations developed
Ajax Systems	845	215	96	5	24	28
Esper Bionics	154	48	18	6	11	13
YouScan	286	73	31	4	16	19
ECOFACOR	198	64	27	7	13	16
Uklon	524	118	84	5	19	22

The calculation of the technological efficiency coefficient showed that Ajax Systems demonstrates the highest return on investment in research and digital technologies. The high value of the indicator is also characteristic of Uklon and YouScan, which is explained by the large-scale commercialization of their own technological solutions and the stable growth of the customer base. The next stage was to determine the scalability coefficient of startups, which characterizes the speed of the enterprise's entry into new markets and the ability to increase sales volumes without a significant increase in costs. The results obtained indicate that Ajax Systems and Uklon, which are actively expanding the geography of their activities and investing in the development of digital infrastructure, are the most dynamically scaled. The assessment of managerial adaptability showed that enterprises with a high level of digitalization make strategic decisions much faster than companies that are in the early stages of technological development. This has a positive effect on the speed of response to changes in the competitive environment and increases the efficiency of management of innovative projects.

After calculating all partial coefficients, the integral index of technological entrepreneurship development was determined.

Table 2. Results of the evaluation of the integral index of technological entrepreneurship development, calculated by the author

Enterprise	KTR	KSC	KAG	KDI	KIN	KCM	TSMI
Ajax Systems	3,93	2,74	1,84	0,94	2,31	0,86	1,98
Esper Bionics	3,21	1,65	1,52	0,88	1,94	0,85	1,55
YouScan	3,42	2,18	1,73	0,91	2,08	0,84	1,72
ECOFACOR	3,09	1,79	1,61	0,86	1,83	0,81	1,57
Uklon	3,67	2,58	1,82	0,93	2,19	0,86	1,89

The results obtained show that the highest integral indicator of technological entrepreneurship development is Ajax Systems (1.98), which is due to the high efficiency of investments in research and development, a significant level of digital integration and effective scaling of the business model. The second place is taken by Uklon (1.89), which demonstrates high rates of market expansion and significant managerial adaptability. YouScan is characterized by balanced development of all components of the model, while Esper Bionics and ECOFACTOR have the potential to increase the integral indicator by activating investment activities, reducing the time to commercialize innovations and accelerating the scaling of technological products. The comparative analysis confirms that the effectiveness of technological entrepreneurship management is determined not by separate financial or innovative indicators, but by their balanced interaction. High values of the integral index are achieved only under the condition of simultaneous development of technological potential, digital maturity, investment attractiveness, managerial adaptability and the ability of the enterprise to quickly scale its own innovative solutions. The proposed methodology allows not only to rank enterprises by the level of technological entrepreneurship development, but also to identify critical components that require management intervention to ensure long-term growth and competitiveness.

Conclusions. The article develops an author's methodological approach to assessing the effectiveness of technological entrepreneurship management and management of the development of small and medium-sized business startups, which is based on a comprehensive consideration of technological, innovative, managerial, digital and investment factors. Unlike existing approaches, the proposed model is based on the multiplicative integral index TSMI, which allows taking into account the interdependence of individual components of enterprise development and increases the objectivity of assessing the effectiveness of technological startup management. The methodological tools for assessment have been improved by developing a system of coefficients of technological performance, business scalability, managerial adaptability, digital integration, investment attractiveness and commercialization of innovations. Practical testing of the proposed methodology at Ukrainian technology enterprises confirmed its suitability for comparative analysis of the level of development of startups and identification of key factors affecting their competitiveness. The results of the study showed that the most successful are enterprises that ensure balanced development of technological potential, digital transformation, innovative activity and strategic management. It was established that isolated improvement of individual indicators does not ensure high efficiency of activity, while comprehensive improvement of all components of the management system creates a synergistic effect and contributes to the sustainable development of technological entrepreneurship.

The practical significance of the results obtained lies in the possibility of using the proposed model by enterprise managers, investors, business incubators, accelerators, venture funds and state authorities to assess the effectiveness of the development of technological startups, justify investment decisions, determine priority areas of financing of innovative projects and form support programs for small and medium-sized businesses.

Prospects for further research are related to improving the integrated model by including indicators of environmental sustainability, cybersecurity, the use of artificial intelligence technologies, international innovation cooperation, and building predictive models for the development of technological entrepreneurship in the context of the digital transformation of the economy.

1. Буднік, М. М., & Іванова, Я. Ю. (2020). Підходи та моделі управління змінами на підприємстві. *Бізнес Інформ*, (10), 370-376.
2. Зось-Кіор, М., Ільїн, В., & Свирида, Е. (2020). Розвиток трудового потенціалу в системі ефективного менеджменту організації. *Економіка та суспільство*, (22).
3. Приб, К. А. (2014). Формування системи управління змінами на підприємстві. *Інтелект ххІ*, (2), 119-126.
4. Шарий, В. І., Зось-Кіор, М. В., & Кирилюк, І. М. (2020). Інституційна модель земельних відносин в Україні. *Вісник Черкаського національного університету імені Богдана Хмельницького. Серія Економічні науки*, (2), 107-116.
5. Пашенко, О. П. (2014). Сучасні методи управління змінами на підприємстві. *Вісник Житомирського державного технологічного університету. Серія: Економічні науки*, (3), 170-178.
6. Гнатенко, І. А., & Кулікова, Ю. Е. (2016). Перспективні напрями вдосконалення управління персоналом в організації. *Науковий вісник Херсонського державного університету. Сер.: Економічні науки*, (16 (4)), 55-58.
7. Смерічевський, С. Ф., Ареф'єва, О. В., & Пілецька, С. Т. (2022). Формування стратегічних рішень при управлінні змінами на підприємстві. *Бізнес Інформ*, (6), 108-117.

8. Гнатенко, І. А., Попова, Ю. М., Бачкір, І. Г., & Нечипоренко, К. В. (2021). Стратегії державних пріоритетів в контексті сценарного форсайту управління інноваційною економікою: моделювання науково-технічного та інтелектуального потенціалу. *Агросвіт*, (17), 3-9.

9. Гребеннікова, А. А., & Чепчак, Д. Р. (2021). Розвиток корпоративної соціальної відповідальності аграрних формувань. *Ефективна економіка*, 5. <https://doi.org/10.32702/2307-2105-2021.5.81>

10. Korobenko, R. I., Kostyuk, O. D., Mostenska, T. L., Ostapchuk, A. D., & Kovtun, O. A. (2021). The role of local government bodies in formation of economic potential of rural territories in the conditions of decentralization reform. In B. Alareeni, A. Hamdan, & I. Elgedawy (Eds.), *The Importance of New Technologies and Entrepreneurship in Business Development: In The Context of Economic Diversity in Developing Countries (Lecture Notes in Networks and Systems, Vol. 194, pp. 877–887)*. Springer. https://doi.org/10.1007/978-3-030-69221-6_75

1. Budnik, M. M., & Ivanova, Ya. Yu. (2020). Pidkhody ta modeli upravlinnia zminamy na pidpriemstvi. *Biznes Inform*, (10), 370-376.

2. Zos-Kior, M., Ilin, V., & Svyryda, E. (2020). Rozvytok trudovoho potentsialu v systemi efektyvnoho menedzhmentu orhanizatsii. *Ekonomika ta suspilstvo*, (22).

3. Prib, K. A. (2014). Formuvannia systemy upravlinnia zminamy na pidpriemstvi. *Intelekt xxI*, (2), 119-126.

4. Sharyi, V. I., Zos-Kior, M. V., & Kyryliuk, I. M. (2020). Instytutsiina model zemelnykh vidnosyn v Ukraini. *Visnyk Cherkaskoho natsionalnoho universytetu imeni Bohdana Khmelnytskoho. Seriiia Ekonomichni nauky*, (2), 107-116.

5. Pashchenko, O. P. (2014). Suchasni metody upravlinnia zminamy na pidpriemstvi. *Visnyk Zhytomyrskoho derzhavnoho tekhnolohichnoho universytetu. Seriiia: Ekonomichni nauky*, (3), 170-178.

6. Hnatenko, I. A., & Kulikova, Yu. E. (2016). Perspektyvni napriamy vdoskonalennia upravlinnia personalom v orhanizatsii. *Naukovyi visnyk Khersonskoho derzhavnoho universytetu. Ser.: Ekonomichni nauky*, (16 (4)), 55-58.

7. Smerichevskiy, S. F., Arefieva, O. V., & Piletska, S. T. (2022). Formuvannia stratehichnykh rishen pry upravlinni zminamy na pidpriemstvi. *Biznes Inform*, (6), 108-117.

8. Hnatenko, I. A., Popova, Yu. M., Bachkir, I. H., & Nchyporenko, K. V. (2021). Stratehii derzhavnykh priorytetiv v konteksti stsenarnoho forsaitu upravlinnia innovatsiinoiu ekonomikoiu: modeliuvannia naukovo-tekhnichnoho ta intelektualnoho potentsialu. *Ahrosvit*, (17), 3-9.

9. Grebennikova, A. A., & Chepchak, D. R. (2021). Rozvytok korporativnoi sotsialnoi vidpovidalnosti ahrarnykh formuvan. *Efektivna ekonomika*, 5. <https://doi.org/10.32702/2307-2105-2021.5.81>

10. Korobenko, R. I., Kostyuk, O. D., Mostenska, T. L., Ostapchuk, A. D., & Kovtun, O. A. (2021). The role of local government bodies in formation of economic potential of rural territories in the conditions of decentralization reform. In B. Alareeni, A. Hamdan, & I. Elgedawy (Eds.), *The importance of new technologies and entrepreneurship in business development in the context of economic diversity in developing countries (Lecture Notes in Networks and Systems, Vol. 194, pp. 877–887)*. Springer. https://doi.org/10.1007/978-3-030-69221-6_75