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INNOVATIVE TRANSFORMATIONS ACROSS COMPANIES OF HIGH-TECH INDUSTRIES

ІННОВАЦІЙНІ ТРАНСФОРМАЦІЇ ПІДПРИЄМСТВ ВИСОКОТЕХНОЛОГІЧНИХ ГАЛУЗЕЙ ПРОМИСЛОВОСТІ

Modern conditions take a toll on global economies and society – war brings destruction and devastation, energy and economic crises, hunger, and decay. All of the above are being aggravated by the COVID-19 Pandemic. Be that as it may, they present both challenges and opportunities for companies to develop and innovate. War and crisis push economic agents even more toward innovation transformation. At the same time, the question remains: whether and when those innovations would be timely and effective. And what type exactly should be chosen? In order to answer those questions, the provided paper introduces a model for transforming innovation companies based on research into the motives driving the innovation process, its patterns and efficiency, and the actual reasons behind pursuing innovation. The model is built to be used in the future to ensure real innovative development of companies and, hence, the economy as a whole in a post-war recovery.

Keywords: development, innovation, high-tech industries, innovation transformation, innovation strategy, innovation policy.

Неспровокована військова агресія російської федерації проти України завдає значного негативного впливу на суспільство – війна приносить руйнування та спустошення, опосередковує енергетичну та економічну кризи. До того ж, вищезазначене посилюється наслідками пандемії COVID-19. Тим не менш, згадані процеси створюють для економічних агентів як виклики, так і можливості, зокрема для розвитку та інновацій. Війна та криза ще більше штовхають до інноваційної трансформації. Водночас, залишається відкритим питання: коли саме і чи будуть ці нововведення своєчасними та ефективними? І яким саме інноваціям варто віддати перевагу? Дана стаття має на меті надати обґрунтовані відповіді на поставлені питання та являє модель інноваційної трансформації підприємств високотехнологічних галузей економіки, засновану на дослідженні мотивів, що рухають інноваційним процесом, його закономірностей та ефективності, а також фактичних причин впровадження інновацій. Модель побудована для використання в майбутньому з метою забезпечення реального інноваційного розвитку підприємств, а отже, її економіки в цілому в умовах післявоєнного відновлення. Загальновідомим і давно встановленим фактом є те, що гострі економічні кризи долаються шляхом впровадження нових технологій, які створюють нові виробничі можливості. А вони, у свою чергу, стають підґрунтям для майбутніх технологічних і, отже, економічних поступів і переходу до нової фази зростання. Цей технологічний поступ, або революція, здійснюється переважно власними силами економічних агентів і має стимулюватись урядом. Таким чином, метою цієї статті є аналіз мотивацій, закономірностей та ефективності інноваційних процесів підприємств, щоб зрозуміти поведінку певних економічних агентів (у нашому випадку підприємств високотехнологічних галузей економіки) під час їх інноваційної трансформації та розвитку. Також проведено моделювання інноваційної трансформації, з огляду на реальні причини впровадження інновацій. Проблема відсутності «універсального рецепту» розвитку стосується всього спектру економічних агентів, і підприємств не є виключенням. Питання вчасності та відповідності інновацій потребам розвитку господарюючих суб'єктів спонукає до переосмислення трансформаційного процесу на шляху до інноваційності. На основі досліджень про закономірності розвитку, а також причин інкрементальної інтелектуалізації підприємницької діяльності, нами запропоновано модель інноваційної трансформації підприємства на основі детермінації специфічної йому потреби в інноваціях. Дослідження свідчить, що позиція на ринку, розмір, бренд, навіть, становище «лідера інновацій» не забезпечує підприємству автоматично сталого розвитку. Гонитва за інноваційністю та/або її імітація може завдати значного удару по економічній безпеці господарюючого суб'єкта. Тому, наріжною є потреба запровадження інноваційної фінансової політики підприємства, що забезпечуватиме реалізацію інноваційної стратегії із дотриманням належного рівня фінансово-економічної стабільності.

Ключові слова: розвиток, інноваційність, високотехнологічні галузі економіки, інноваційна трансформація, інноваційна стратегія, інноваційна політика.

Problem statement. The war, started by the Russian Federation against Ukraine and the whole civilized world, brought death and destruction, hunger threats, and an energy crisis, brought mostly by sabotage and blackmail, as well as stagflation and currency fluctuations [1]. And all of the above take a hard toll on global society and people throughout a number of nations. Moreover, the consequences of this war are further aggravated by the COVID-19 pandemic. That is reminiscent of the Global Influenza Pandemic on the verge of WWI [2]. And history has taught us that no matter the devastation created by previous wars, society and, hence, the economy will eventually recover and enter a new stage of development [3; 4]. And it is our job today to ensure said development by all means necessary.

Analysis of the latest studies and publications. It is a well-known and long-established fact that heavy economic crises are being overcome with the introduction of new technologies that create new production opportunities. And those, in turn, become the ground for future technological and, hence, economic breakthroughs and transition to a new stage of growth [5; 6; 7]. That technical breakthrough or revolution is led foremost by companies and assisted by the government.

Formulation of article goals. Thus, the purpose of the given paper is to analyse the motives behind companies' innovation process, its patterns, and efficiency in order to understand how particular economic actors (in our

case, companies) act when it comes to their innovation transformation and development. We will also attempt to model said innovation transformation, looking back on the real reasons behind the pursuit of innovativeness. Hopefully, the model could be used in the future to ensure real innovative development of companies and, hence, the economy as a whole.

Main Results. 1. The ruthlessness of the development. The problem of lacking a "universal development recipe" substantiated in our previous studies, applies to the entire spectrum of economic agents, and enterprises are no exception. The "ruthlessness of development", and in particular, innovation development, results in the massive expenditure of time, money, and resources, partly leading to the opposite effect: innovation initiatives quite often fail, and innovation leaders are unable to maintain their positions in the long term (Table 1). Lightning transformations of the economic environment and economic mechanism lead to an almost constant catch-up transformation of economic agents, which in the current economic conditions often turns out to be too late. The issue of timeliness and conformity of innovations to the development needs of business entities prompts a rethinking of the transformational process on the way to innovativeness.

From Table 1 we can conclude, that the size, experience, brand recognition, high technology (some of the companies mentioned above were considered to be the leaders of innovation), the company's value and its position on the

Table 1

Notable threats to the economic security of companies as a result of contradictory innovation activity

Name	Established	Peak value	Year of legal entity's termination / bankruptcy	Reason / s
Kodak	1881	31 USD billion	2012	Failure to define a new niche; lack of strategic creativity; lack of organizational agility, lack of financial opportunities for the innovation process as a result
Nokia	1865 (1997)	300 USD billion	2013	Failed development of the operating system; lack of timely response to consumer needs; loss of financial liquidity as a result; impossibility of financing further innovations
IBM	1888	32 USD billion	1999 (bankruptcy process started), 2010 (on the verge of bankruptcy)	Failed company's "strategic imperatives"; unrewarded investments in cloud computing technologies and business services based on Watson artificial intelligence
Blockbuster	1985	8,4 USD billion	2010	Lack of timely response to changes in consumer needs; rejection of innovations; late innovations
Vertu	1998	297 USD million	2017	Slow implementation of innovations; lack of response to consumer needs; loss of liquidity
Hummer (brand) and General Motors	1979 (1908)	262 USD billion	2010	Detroit Crisis; insufficient market flexibility; failed innovation financial policy
Enron	1985	101 USD billion	2001	Dotcom crisis; failed financial policy in the sphere of investments and innovations; inconsistency of the announced level of innovation with the actual implementation
Toshiba	1875 (1939)	3,3 trillion yen (3,2 USD billion)	2017	Controversial financial and accounting policies that caused a scandal worth USD 1.2 billion in net losses in 2015 and failure to respond in time to financial losses from a nuclear program, related to said business: the company lost more than USD 9 billion due to the failed design of nuclear reactors by a subsidiary of Westinghouse

Source: built by authors based on [9–11]

market, even diversification, etc. do not in fact guarantee the elimination of economic threats up to the point of bankruptcy due to controversial managerial decisions in the field of implementation and financing the innovations. For example, some companies from the list above turned out to be too "heavy" to quickly react to changes in consumer attitudes and needs, some, on the contrary, "innovated" too confidently and too aggressively, and in

both cases, all of it resulted in the same expected effect – some companies changed owners, some were forced to resort to merger, repurposing (sometimes radical), and the rest, unfortunately, became history.

In contrast, timely and sometimes "anticipatory" innovations are able not only to add economic efficiency to an economic agent but also to become the basis of a new stage of its development (Table 2).

Table 2

Notable examples of timely innovations

Name	Established	Peak value	Innovation / s	Reason / s
Nintendo	1889	18,4 USD billion	Attempts: since 1949, the new management expanded the range of goods and services, in particular: taxi services, instant rice, vacuum cleaners and small household appliances, etc. Successful innovation: games and toys. Nintendo launched Japan's first home video game console, the Magnavox Odyssey. The most famous product is Super Mario Bros	The company has been selling playing cards since its foundation. However, after some time, the Japanese government cancelled restrictions on producing this type of a product, and the market first became competitive, and later oversaturated. Nintendo was on the verge of bankruptcy.
Netflix	1997	261 USD billion	Successful innovation: 1. In the era of rental movies, the founders of Netflix chose a business model based on postal delivery of rental DVDs, thereby competing with traditional rental services at that time. 2. In 2000, in response to the information revolution, the service underwent a digital transformation, once again acquiring a unique value proposition. 3. In 2010, due to the appearance of competitors in the form of streaming services of television channels, Netflix began production of its own original content.	1. The evolution of the Internet and the decline of DVD media. 2. Emergence of streaming services of original content from AMC, CTV, HBO, etc.
Apple	1976	2,5 USD trillion	Successful innovations: 1. Release of iMac in 1998 – the first "stylish" personal computer. 2. Portable iPod multimedia player, which favourably differed in size, design and functionality from analogues. 3. In 2007, the iPhone, estimated to be responsible for the lion's share of the company's current value, it also became the foundation of the " App Economy ". 4. The Apple Watch smart watch combines a number of functions that interact with the iPhone. The latest innovation, which has led to an increase in active demand for watches during the Covid-19 pandemic and the need for personal protective equipment, which has caused inconvenience in the performance of a number of functions, including payments, verification, etc. The phone's operating system has received an extension that allows facial recognition in a medical mask, but it is mandatory to have an Apple Watch in order for it to work.	In 1996, Apple found itself on the verge of bankruptcy, having suffered significant financial losses, losing the competitive battle with IBM and Hewlett Packard
USG	1901	6,1 USD billion	Successful innovation: Project Avalanche is an ultra-light, durable plasterboard under the SHEETROCK UltraLight brand, which is 35% lighter than SHEETROCK's flagship product. The new product made it possible to conquer new markets, particularly in South Asia, due to its lightness and moisture resistance properties.	The financial crisis of 2008 – the collapse of the housing market
Ørsted (Danish Oil and Natural Gas)	1972/2017 (new name)	66,8 USD billion	Transformation: Board hires ex-LEGO executive Henrik Poulsen as new CEO, transforming company from black to green energy producer. As of 2020, Ørsted is the world's largest producer of offshore wind power – 29% of the market.	Financial crisis for the company in 2012 due to a 90% drop in the price of natural gas

Source: built by the authors based on [12–14]

Two conclusions are obvious from the table: firstly, companies that are successful in overcoming crises and threats are characterized by the recursive nature of the innovation process, without stopping innovative and technological development with the achievement of stability; second, overcoming a crisis sometimes requires radical innovative transformation, as in the cases of Nintendo and Ørsted. At the same time, interestingly, the latter chose a radical innovative path in contrast to the rest of the state energy monopolies.

The described cases of successful innovations, in our opinion, should be considered innovation transformations rather than innovation activities. And such an innovation transformation has an evolutionary or revolutionary character, based on the needs, situation and peculiarities of the development of economic agents. Examples of innovation transformations are presented in the Table 3.

Each of the listed companies developed a new activity, going beyond the usual sector of specialization, and for some, this new direction became a priority, forming the basis of not only stable profitability but also strategic development. As mentioned in Table 2, Netflix, owing to the idea of streaming original content, tripled its own revenue, profit increased 32 times, and the compound annual growth rate reached the mark of 57% [14]. Therefore, the basis of business success today is "anticipatory" innovativeness, departure from traditional but moderately effective types of activities, revision of the mission, search for business opportunities beyond established success, etc., i.e., innovation transformation.

2. Innovation activity and innovation transformation. When talking about innovations, analysing them, evaluating them, they mostly talk about "innovation activity". At the same time, we believe that it is appropriate to distinguish between "innovation activity" and "innovation transformation", since they are similar at first glance, they relate to different aspects of the movement and development of the system: the former mainly concerns the adaptation of the enterprise to innovations and the latter – the generation and adaptation of innovations to the needs of the enterprise. Some cases listed in the table can serve as an example of the first. 1, as an example of the second – the timely innovations described above in the Table 2.

Transformation, in contrast to innovation activity, is a comprehensive systemic process and should include an innovation strategy with an innovation policy within its framework, as well as an innovative financial policy, which is entrusted with the function of not only financing innovations but also preserving the stability of the economic agent, the proper level of its economic and financial security (Fig. 1). That is, innovation activity becomes successful only when it is part of a complex innovative system of transformation of an economic agent.

The problem of converting an innovation activity into an innovation transformation and directing it in a productive direction is solved by the formation of an adequate innovation strategy, which should be based on the determination of the enterprise's need for innovations and the possibility of these innovations' adoption by the business entity.

Strategic planning is a well-known and widely accepted practice in enterprise management. A strategy is essentially a set of consistent and complementary policies aimed at achieving a set goal. And companies regularly develop, implement, alternate and improve business strategies with a clear idea of how the supporting subsystems of finance, marketing, R&D will contribute to its implementation. At the same time, although innovative activities are considered as part of the overall business strategy, they are sometimes not sufficiently coordinated [15–16].

Without an innovation strategy, efforts to improve innovation can easily become a repository of popular best practices: the division of R&D into decentralized autonomous teams, support for internal entrepreneurial initiatives (intrapreneurship), the establishment of corporate venture funds and angel investments in projects, the creation of external alliances, open innovation and crowdsourcing, collaboration with customers and implementing rapid prototyping and a whole range of others. There is nothing wrong with any of these practices. The problem is that an organization's innovative capacity derives from an innovation system: a consistent set of interdependent and complementary processes and structures that dictates how a company formulates new problems and seeks and implements solutions, synthesizes ideas into a business concept and brings them to life, and also

Table 3

Notable examples of innovation transformations

Name	A new source of income	CAGR* since the base year	Exchange index change
Netflix	Original content: 44%	59% since 2012	S&P 500: +10%
Adobe	Digital experience **: 27%	26% since 2009	S&P 500: +10%
Amazon	Web services: 39%	39% since 2009	S&P 500: +10%
Microsoft	Cloud platform Intelligent Cloud: 29%	17% since 2009	S&P 500: +9%
Alibaba	Fintech, sports, entertainment: 14%	8% since 2013	NYSE: +1%
Ørsted	Offshore wind power: 37%	30% since 2017	OMX Copenhagen: +0%
Neste	Renewable fuels: 70%	24% since 2009	OMX Helsinki 25: +7%
Siemens	"Digital Factory": 26%	8% since 2012	DAX index: +8%
Fujifilm	Medical imaging: 18%	7% since 2010	Tokyo Exchange: +6%
Dell	Infrastructure and security: 51%	29% since 2013	S&P 500: +11%
Phillips	Health care: 65%	6% since 2014	S&P 500: +6%
Cisco	Subscription Add-ons: 43%	9% since 2010	S&P 500: +9%
Ecolab	Energy services: 44%	16% since 2011	S&P 500: +9%

Note: * CAGR – compound annual growth rate; **Digital experiences – interaction between the user (client, partner or employee) and the organization, which is possible only due to digital technologies

Source: built by the authors based on [14]

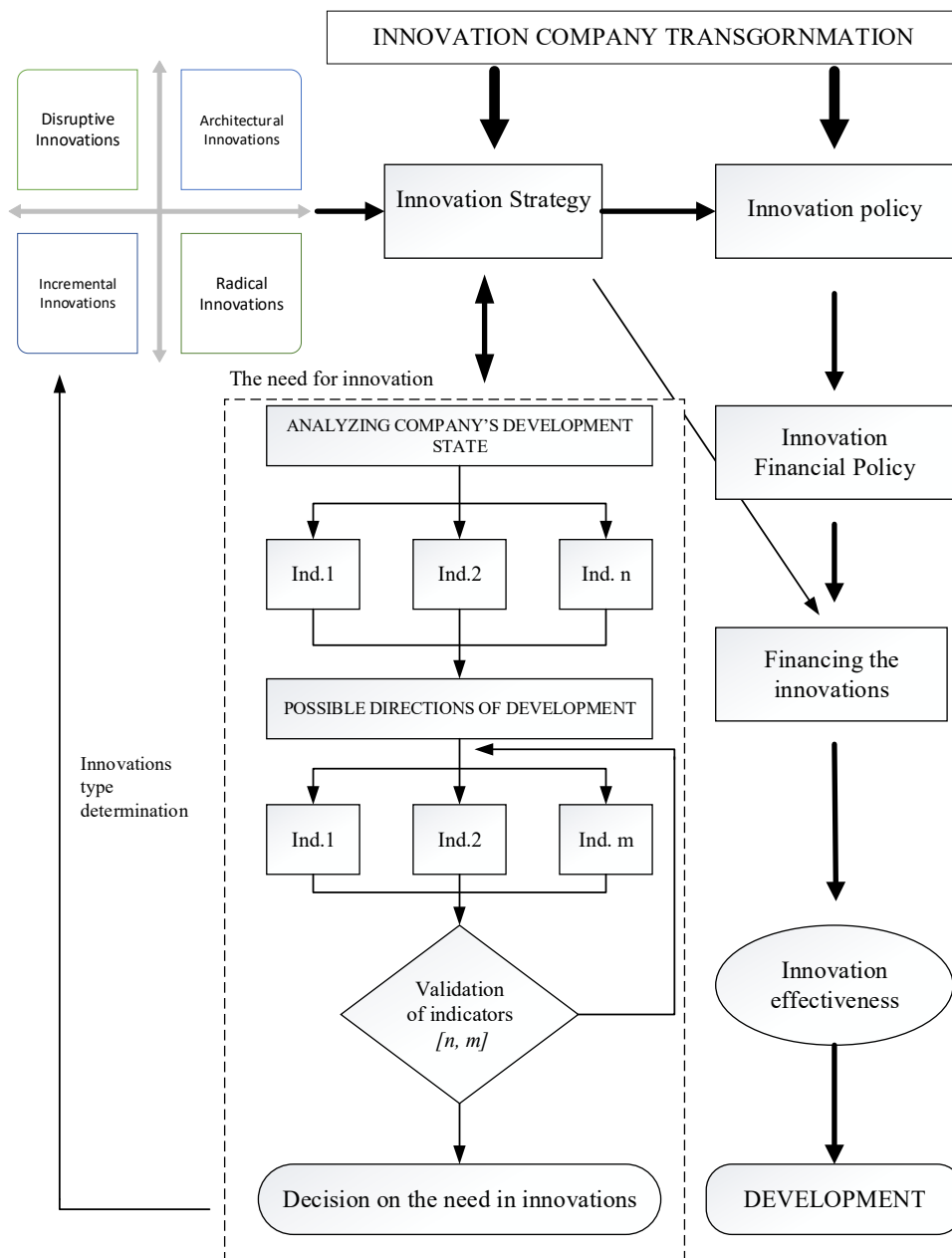


Figure 1. Innovation company transformation

Source: developed by the authors, the matrix for choosing the innovation type from [15]

selects projects for financing and ensures the accumulation of resources.

Individual best practices involve compromises. And the adoption of a specific practice, as a rule, requires many additional changes to another innovative system of the organization. A company without an innovation strategy will not be able to make compromise decisions and choose all elements of the innovation system [11]. At the same time, the adaptation of someone else's working strategy in the vast majority of cases does not lead to a positive result because each economic agent is characterized by its own needs and problems, peculiarities and patterns of development, and the possibility of perception and implementation of certain innovations.

The use of the acquired experience and well-known practice is undoubtedly important in the formation of a

successful innovation strategy; however, it should be the first of the special tasks for each specific organization. In addition, a clearly formulated innovation strategy ensures the coherence of all components of a multifaceted system, eliminating the risk of them pursuing conflicting priorities, taking into account their need to ensure their own interests that do not conflict with the overall business strategy. Thus, a successful innovation strategy calibrates the system, directing it to the optimal development trajectory.

The world practice of management includes a wide range of methods and practices, tools for managing innovation transformation in economic systems, in particular, scientific and technical, innovative, industrial policy, which are implemented by a system of mechanisms: the organization of innovative activities, the development, and implementation of innovations, the transfer of

technologies, the realization of intellectual property, the interaction of participants in the innovation process, their motivation, control, stimulation of innovative activity, etc. At the same time, resource provision of an innovation process is the cornerstone for the successful implementation of any innovation strategy. That is why, along with innovation policy, innovation financial policy should be developed. The latter is aimed at ensuring the financial stability of an economic actor while it undergoes the innovation transformation [11].

3. The need to innovate and what innovations exactly. However, an innovation strategy, even if developed with a coherent innovation and financial policy, will fail if the need for innovation is misidentified. The algorithm for determining this need (Fig. 1) provides for the validation of indicators of two orders based on the analysis of the state and patterns of the development of the enterprise and the analysis of possible directions of development. In case of unsatisfactory validation, it is necessary to redefine the indicators for the purpose of re-comparison. The number of indicators may vary, depending on the needs of the economic agent. To determine the level of innovation implementation, it is advisable to use the following indicators:

At the same time, innovation transformation involves the implementation of innovation activity at all levels. Only its nature will be different: evolutionary – from upward to downward or vice versa (that is, operational innovations will gradually lead to product innovations or product innovations will develop over time to organizational innovations) or revolutionary – simultaneous innovation transformation of the economic agent at all levels.

Depending on the determined need for innovation and the nature of transformation, the next step is to choose the type of innovation (Table 5).

The choice of the type of innovation does not mean that there is no possibility of a gradual transition between them, on the contrary – with the right innovation strategy, the evolution of the types of innovations will take place

in a natural way: disruptive – incremental – architectural. At the same time, the transition between types can have a shuttle-type movement, or, depending on the level of diversification and the scale of business, different types of innovations can exist without crossing each other (Fig. 2).

Radical innovations are the rarest of all types and will not necessarily have the greatest long-term impact. A recent example of such innovations can be the iPhone and the "App Economy" described above, in a more global sense –airplane and aircraft design, aircraft construction and air transportation. The emergence of a new market as a result of an innovation does not provide its owner with an automatic monopoly position, at least for in a long run, but, at the same time, it causes a positive effect on scientific, technical, economic and social development, opening up new opportunities and a field for further innovations.

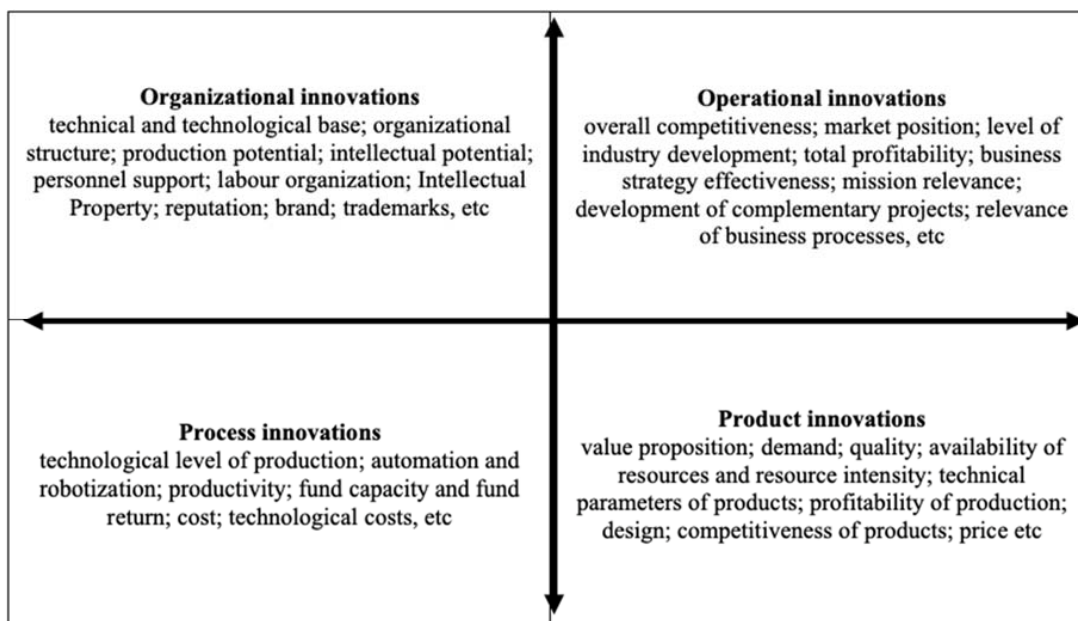
To choose the best innovation strategy, it is important to identify the innovation need and type first. There are two types of innovation strategies: active and passive. The active strategy is based on technological development, while the passive strategy involves making changes to the marketing strategy. Both strategies rely on the economic agent's intellectual capital but have different structures and organizational nature (Fig. 3, Table 6).

It is worth noting that the choice of an active type of innovation strategy does not automatically mean a radical innovation transformation since its implementation can be based on secondary modernization. At the same time, we consider the innovation process built on following, imitation, and unfair competition to be one that does not meet the conditions of innovation transformation, as it does not correspond to its essential nature. In addition, secondary modernization and innovation activity's imitation turn out to be quite ineffective when it comes to development in the long run and may also pose a threat to the company's economic and financial security.

The analysis shows that it is recursive organic modernization, i.e., real innovativeness, that is the basis of

Indicators Matrix to determine the level of innovation transformation

Table 4



Source: developed by the authors

Table 5

Matrix of innovation types

<p>Disruptive innovations <i>New technologies, existing market</i> Mainly related to the application of new technologies, processes or disruptive business models in existing industries.</p>	<p>Architectural innovations <i>Existing technologies, new market</i> Expanding the customer base due to experience, technology and skills in your field and applying them in another market.</p>
<p>Incremental innovations <i>Existing technologies, existing market</i> The goal is to improve the existing value proposition by adding new features, changes in design, quality, service, etc.</p>	<p>Radical innovations <i>New technologies, new market</i> Involve the creation of technologies, services and business models that open completely new markets and are the rarest of all.</p>

Source: adapted from [15]

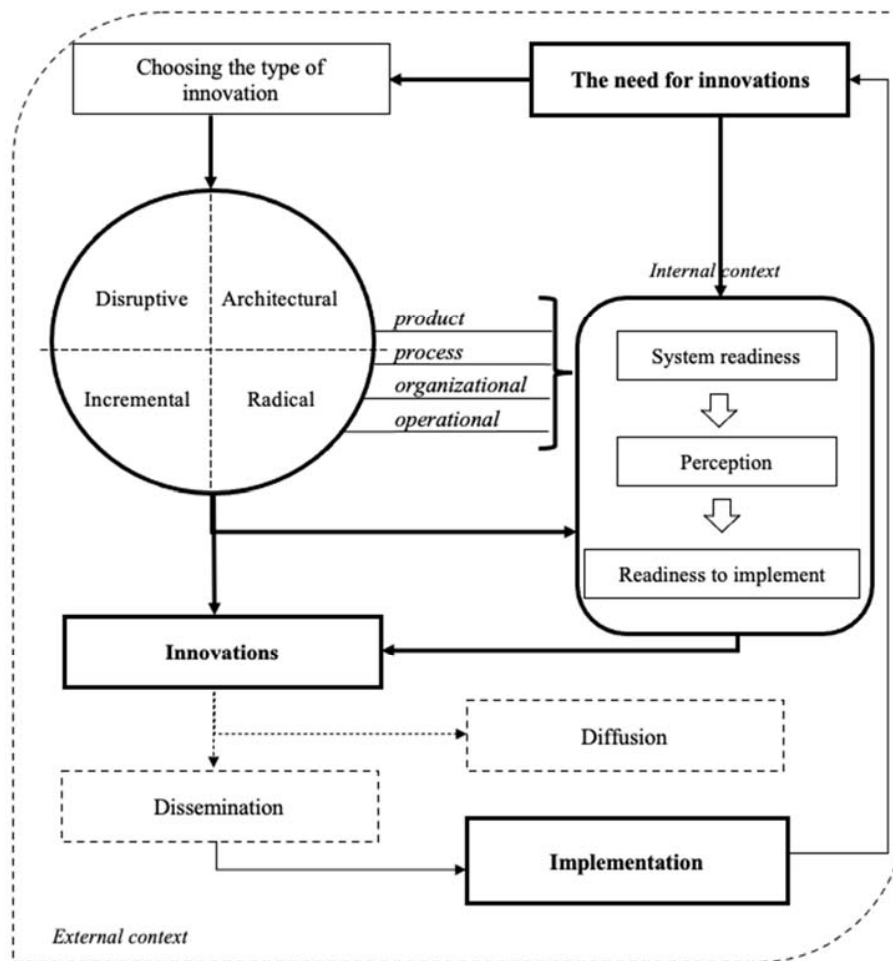


Figure 2. Innovation model within the strategy

Source: updated by the authors from [17], innovation type selection matrix from [15]

Table 6

Innovation activity depending on the type of innovation strategy – notable examples

Innovations	Essence	Examples
Structural and auxiliary processes	Provide a combination of assets and "talents", ensuring effective implementation of key processes	Siebel, Amazon, Microsoft, Linux
Process	Special "brand", unique processes, key to operational activity	GE Capital, Moderna, USG corporation
Product performance characteristics	Features of the product that give it competitive characteristics	iPhone, Intel Pentium, Boeing, Netflix
Product system	Systems, products, platforms, lines that comprehensively solve tasks and/or satisfy needs	Microsoft Office, Azure, AppStore, Virgin, Google
Product uniqueness/novelty	Products that have no analogues and/or are developed for new needs	Google Classroom, Microsoft Office, Zoom
Service	Complementing the value proposition and supplementary services related to the product	Bentley, FedEx, Amazon, Deutsche post
Networks	Value-creating relationships of the external environment	Walmart, Auchan, IKEA
Channels	Provide coverage of consumer segments and form the necessary pool of customers	Lego, Disney, Nestle
Brand	Part of the value proposition, company representation, the basis of trust and reputation, as well as competitive advantages based on forementioned factors	Tesla, Chanel, Virgin, Boeing, Harvard
Consumer experience	Excellent, special customer relationships that form part of the value proposition and provide competitive advantage	Deutsche Bann, Starbucks, coffee, Turkish airlines

Source: adapted and supplemented by the author from [18–19]

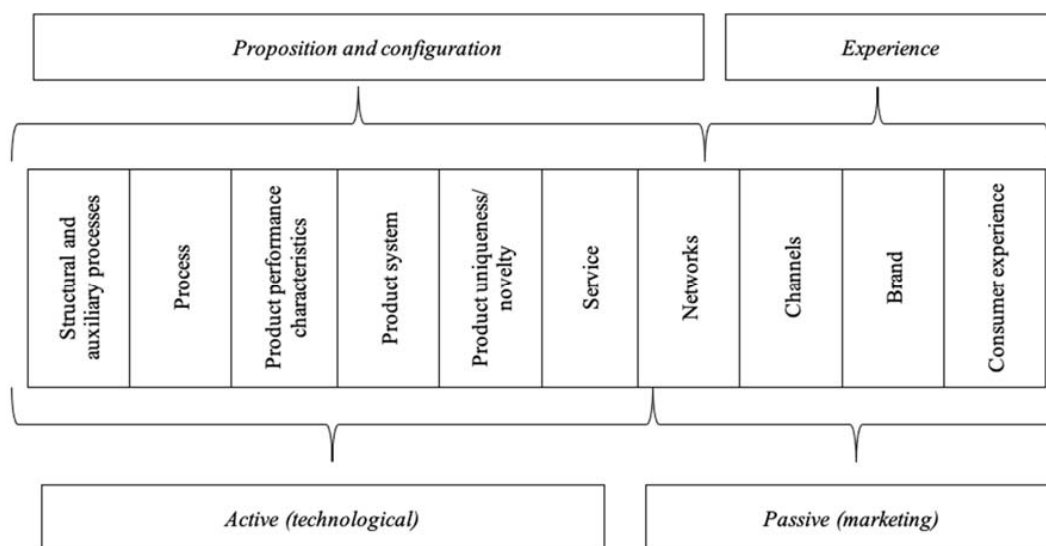


Figure 3. Innovation activity depending on the type of innovation strategy

Source: adapted and supplemented by the authors from [18]

sustainable economic development of a business entity. On the contrary, supporters of secondary modernization may find themselves in a circle of constant catching up with innovation leaders, adapting the enterprise to innovations and ready-made successful development models, as opposed to adapting and generating innovations to the needs of economic agents.

Conclusions. The lack of a "universal recipe" for development concerns the entire spectrum of economic agents, and enterprises are no exception to that. The issue of timeliness and conformity of innovations to the development needs of business entities prompts a rethinking of the transformational process on the way to innovativeness. The study shows that the market position, size, brand, and even the position of the innovation leader do not automatically ensure sustainable development for

the enterprise. Moreover, we have concluded that it is indeed the innovation transformation and not the innovation activity that is responsible for the company’s business success in the long run. Hence, this paper proposes a model of innovation company transformation along with updated innovation modes, which are based on the determination of the economic actor’s specific need or needs to innovate. And hence, choosing the right innovation type that fits the development criteria.

The pursuit of innovativeness and/or its imitation can cause a significant blow to a company’s economic security. Therefore, the need to introduce a competent innovation and appropriate financial policy is crucial, as that will ensure the innovation strategy implementation, providing at the same time an appropriate level of financial and economic stability.

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