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Sustainable Development Prediction of Start-ups in Ukraine

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Abstract:

The purpose of the article is to confirm the success of start-ups in Ukraine, which will be achieved through a trend analysis of the integral indicator of the success of start-ups in Ukraine using polynomial forecasting of the 4th degree. The research methodology is based on the analysis and collection of data on indicators of the effective existence of the macro and microenvironment in Ukraine, an index analysis of the most significant indicators characterizing the prospects and efficiency of start-ups, trend analysis. Empirical data allowed to formulate a hypothesis: that there is a theoretical and methodological ability of the integral indicator of the success of start-ups in Ukraine to ensure the relevant trends in their sustainable development. The specific features and stages of development of start-ups were analyzed in the article. The study notes recommendations for creating an effective start-up and its financing. The procedures for collecting, analyzing, and processing information made it possible to build a trend line and forecast an integrated indicator of sustainable development of start-up success in Ukraine.

Keywords: start-up management; innovation project; start-up success; forecasting.

JEL Classification: M00; O10; O30; Q56.

Introduction

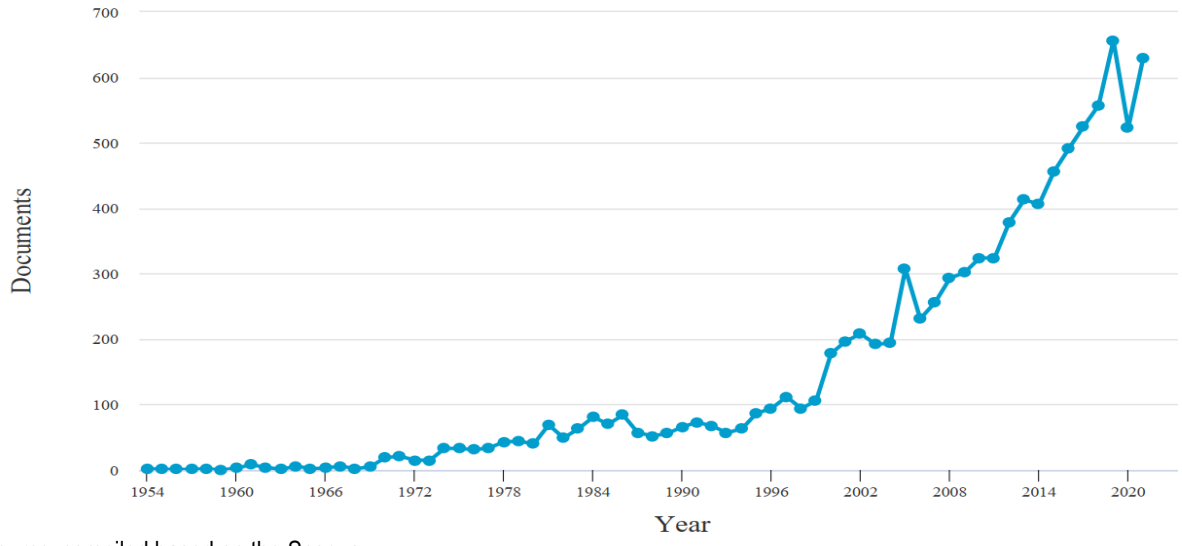
Global processes are a natural result of increased competition, which has affected the position of innovative companies in the economy. A completely new nature of relations with various market institutions has been formed, their functions and role in creating new jobs and achieving social stability in society have changed. The successful development of small innovative companies (their quantitative and qualitative growth) actively influences the sustainable development of the economy, is the driving force behind the innovation orientation of the entire economic complex. Achieving the necessary continuity, the scale of the innovation process and the

possibility of rapid implementation of projects is directly determined by the potential and state of enterprises focused on the production of new knowledge, the introduction of high-tech products into industrial production, and the commercialization of scientific research. Small innovative entrepreneurship significantly changes the priorities of applied research and development, actively stimulates the process of creating new industrial production. The scale of the subjects of innovation activity increases the competitiveness and efficiency of the production sector of the national economy, requires the creation of optimal institutional conditions for them for successful functioning and growth.

The development of start-ups and their speedy transformation into a business is a key task for the functioning of the national economy, the reproduction of the country's intellectual capital to accelerate socio-economic development in the context of post-industrial transformations. Awareness by the government, business and the community of the factor of innovation as a source and moving sustainable development of the country will contribute to the growth of investment in education and applied research, technological renewal. The main threats to the implementation of start-ups lie in the existing and potential risks of the perception of an innovative product, since it is impossible to predict the reaction of the target audience, even with the use of modern marketing technologies.

Analysis of the dynamics of number of documents indexed in the Scopus, containing the term "start-up" in the title (Fig. 1), indicate a high level of publishing activity in the world, which is increasing over time. In total, 9816 documents were indexed in Scopus, 39.1 % of which were published over the last seven years, which indicates the significant attention of scientists to this problem in recent studies and publications.

Figure 1. Dynamics of the number of documents indexed in the Scopus, containing the term "start-up" in the title, 1954–2021



Source: compiled based on the Scopus.

In the Ukrainian scientific literature, there has not been a clear understanding of the essence of the "start-up" category, since several economic blocks (infrastructure, financial blocks) belong to the scope of start-ups, marketing is no exception. The traditional interpretation of marketing is not suitable for categorizing start-ups, the research and promotion processes of this organizational function are narrow-minded, taking into account a number of factors, including limited financial resources, a high probability of losses associated with a large level of uncertainty depending on demand, and a lack of business experience predominant part of start-up companies, the difficulty of translating the idea into the final product required for a particular market, and, accordingly, not all traditional marketing research is appropriate for launching a start-up.

Some researchers (Srijna 2022; Szarek and Piecuch 2018; Tech 2018) note that all definitions of start-ups can be conditionally divided into two main groups – taking into account the innovative idea that is at the heart of the start-up project, and without taking into account the innovative idea only on the basis of an assessment of the dynamics, age and turnover. Scientists also note that the conceptualization of the concept of each of the groups separately does not form an objective perception of a start-up (Szarek and Piecuch 2018; Tech 2018; Partyn *et al.* 2020).

So, the concept of a start-up can be used as a general name for a recently created radically new project, a newly created company or enterprise. A start-up presupposes the presence of a certain innovative business idea,

which has not yet found a way to implement it and requires organizational design, financing, development and market testing (Kucher, *et al.* 2021; Pan and Yang 2019).

The classic and most common definition of a start-up is formulated by Steven Blank, namely: "a temporary structure that searches for a large-scale, reproducible and profitable business idea" (Blank and Dorf 2013). Therefore, this category can be formulated as a business operating in conditions of uncertainty and the absence of a guaranteed positive result and specializing in the development, implementation, and promotion of products to solve current problems and cover a potential market.

The Oxford English Dictionary traces the origins of the term, as used today, to a 1976 Forbes article and a 1977 Business Week magazine. In the dictionary, the term "start-up" is defined as "an enterprise (business) in the process of founding", usually applied to "the process of starting a company" (Boni and Gunn 2021).

E. Ries (2011) defines a start-up as an organization dedicated to creating something new in conditions of extreme uncertainty. In the work by K. Charoontham and T. Amornpetchkul (2021) start-ups describe as a company designed for rapid growth. D. Zbanatsky identifies two concepts and notes that "a start-up or start-up company is a company or project that has a short history of activity and for the purpose of making a profit. Most often, start-ups are completely new projects and even those that are only under development" (Zbanatsky 2013). Start-up consultants and entrepreneurs (Zbanatsky 2013; Giraudo, Giudici and Grilli 2019) reveal a start-up as a product that solves a problem in an innovative technological way and can be easily scalable.

In our opinion, it is necessary to expand the categorical apparatus with the definition of O. E. Kofanov (2017), based on a synergistic approach that combines commercial, structural, entrepreneurial, process approaches, according to which the term "start-up project" is interpreted as a form of high-risk innovative entrepreneurship aimed at creating and scaling a business model in a VUCA environment and limited own resources, the implementation of which is ensured through the use of market infrastructure (Kofanov 2017). So, one of the core components of this definition is the VUCA environment (Kofanov 2017), characterized by variability and instability (volatility), uncertainty (uncertainty), complexity (complexity) and a certain incomprehensibility (ambiguity).

The research allowed the authors to summarize the main specific features of a start-up (Hrytsak and Klym 2019; Putra, Syah, Pusaka and Indradewa 2019):

1) the business model of a start-up must be able to become scalable – to be repeated and expanded as much as possible without making significant changes to the idea;

2) novelty and uniqueness of the idea, focus on the development of a completely new, innovative product that meets certain market needs. At the same time, projects with "copied" ideas can sometimes become successful start-ups, provided they are properly adapted to the market of a particular country;

3) high speed of development of the project and the most effective promotion of the company on the market, the ability to bring the planned profit in a short time. The average time for creating start-ups is 3–4 months, and in the case of a high-tech business, up to a year;

4) a start-up is a new enterprise, as well as a project that may not be registered at all with the relevant authorities;

5) minimal expenditure of resources by the authors of the start-up;

6) temporary existence: after a few years, a successful start-up turns into a full-fledged company, is sold or becomes a division of another company;

7) a brief history of operating activities;

8) confidence in the project and their adaptability, taking into account the needs of the market;

9) an unstable position in the market and the uncertainty of existence associated with a high level of business riskiness.

An important feature of start-ups that has so far been overlooked by researchers is the high intellectual potential of the founding team. The life of a start-up begins with the formation and development of an idea – new, unique knowledge – on the basis of which innovative products are developed (often in the field of IT or the latest technologies) (Banka *et al.* 2022; Tripathi *et al.* 2019).

The key resource for the development of ideas is the intellectual resource, therefore, in the early stages of their existence, start-ups can grow rapidly with limited financial investments and material resources. The need for finance arises later, at the stage of implementing the idea through an innovative product, when an active search for investors begins (Rohmani, Gamayanto and Sukamto 2021; Sullivan, Marvel, and Wolfe 2021).

For the successful launch and operation of a start-up, it is necessary to understand the stages of its development, since each stage is characterized by specifics, goals, and funding features. The author

systematized the stages of start-up development as a result of the study of scientific works (Zbanatsky 2013; Kornuk and Mahanko 2014) in Table 1.

Start-ups play an important role in ensuring sustainability and can be one of the tools for implementing sustainable development strategies of enterprises (Sumets *et al.* 2022). Obviously, this is possible when start-ups are successful.

1. Materials and Methods

The purpose of the article is to confirm the success of start-ups in Ukraine, which will be achieved through a trend analysis of the integral indicator of the success of start-ups in Ukraine using polynomial forecasting of the 4th degree.

The research methodology is presented in Fig. 2 and will be implemented using separate techniques.

Step-by-step description of the research methodology:

1. Analysis and collection of data indicators of the effective existence of the macro and micro-environment in Ukraine. At the first stage, the most significant indicators were selected that characterize the prospects and effectiveness of start-ups: Freedom in the World Score (FWS), KOF Index of Globalization (GI), The Open Data Barometer Score (ODB), Market Potential Index (MPI), Global Innovation Index (GInI), Ease of Doing Business Index (EDBI), Index of Economic Freedom (IEF), Networked Readiness Index (NRI). The analysis period covers data for Ukraine for the period from 2012 to 2021. The data were obtained from the proven and official sources of the international statistical database Knoema (2022).

Table 1. Stages of start-up development

Start-up stage	Characteristic
Pre-START-UP stage	
Pre-seed stage	There is an idea, and it has been determined that they need a direct customer, but there is still no clear understanding of how this idea should be technically implemented and pushed in order to be profitable.
Seed stage	The market is being studied, a start-up plan, TS is being drawn up, a prototype is being tested. There is a search for investors and preparations for the launch of the project.
Prototype	Creation of terms of reference and interface design.
Working prototype	Creation of a product or project with basic functions.
Alpha version of the project (product)	The product is ready, but not yet tested. During the testing process, some minor adjustments are made to the interface, which were not taken into account when developing and creating the terms of reference.
Closed Beta	The innovative project already looks close to how it was conceived by start-ups, the project has a small number of users in order to test the service and report on shortcomings and possible improvements.
Project (product)	There is a moderately active involvement of users who need the services offered by the project. Often a public beta happens by distributing a limited number of invites. Contracts are also concluded with the first clients.
Launching the project into operation (product into production)	
Start-up stage	The decisive stage for any project is the early and late start-up stages - the launch stage and the initial period of its work.
Post START-UP stage	
Growth stage	The start-up occupies a stable position in the market and is confidently moving towards conquering the niche outlined at the stage of writing a business plan.
Expansion stage	The start-up has moved closer to fulfilling its business plan in its primary target market and is starting to scale up by conquering other markets. The enterprise can expand its business either alone or through the purchase of other enterprises.
Exit stage	Exit (wholly or partially) from the business of venture investors and business angels and who previously participated in the financing of a start-up. The exit might take place through a private placement (selling of company shares), the placement of the firm's shares on the stock exchange (IPO), or the sale of the company to strategic investors. Venture capital funds invest in potential start-ups, which often expand quickly during the early phases of development. By the exit stage, however, the growth of a start-up has slowed down relative to the earlier stages, even though the company itself has grown more stable. Furthermore, one alternative for "exit" for start-ups and investors may be the end of operations and the bankruptcy of the organization.

Source: compiled based on the sources Zbanatsky (2013), Kornuk and Mahanko (2014)

2. Index analysis – the technique for calculating indices was carried out using the formula after the use of analytical processes for generalization and primary data processing to unify all indicators for one absolute format:

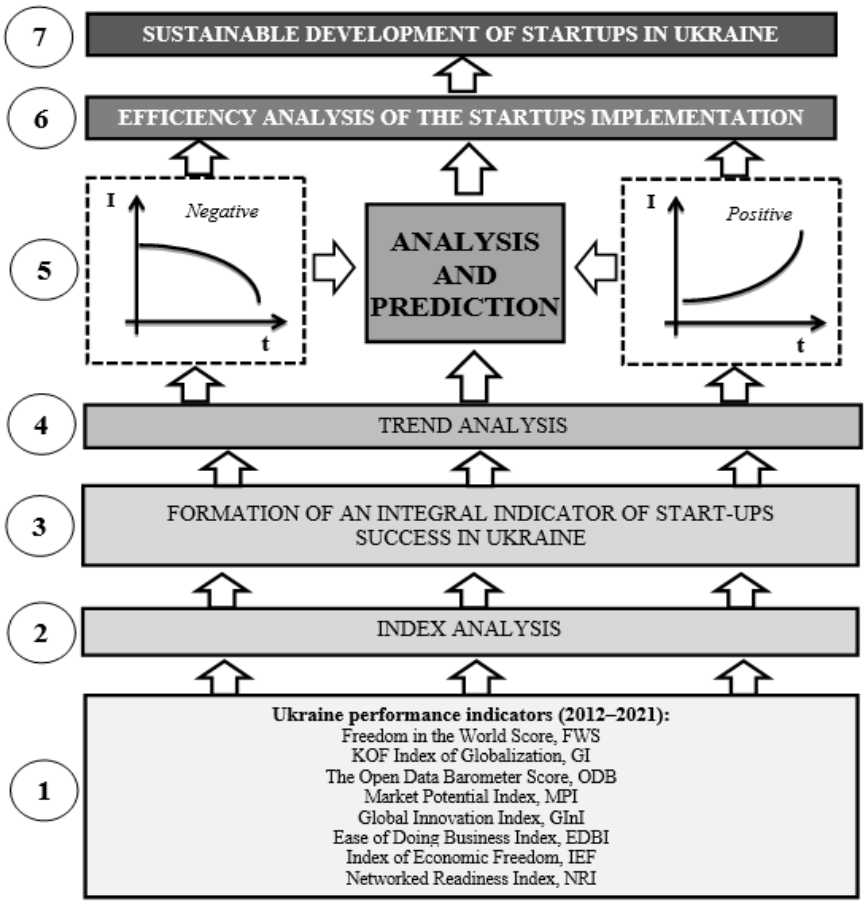
$$I_n = \frac{P_n}{P_{n-1}}, \quad 1.1$$

where *n* – period (years) of the study;
I_n – indicator index for the analysis period;
P_n – indicator for the time period under consideration;
P_{n-1} – indicator for the previous period.
To calculate the indices of indicators for 2013–2021, the period from 2012 to 2021 was analyzed (Table 2).
3. Formation of an integral indicator of start-up progress in Ukraine. At this stage, it was decided to evenly distribute the specific weight and significance level of each indicator of the country's development. The integral performance indicator of start-ups in Ukraine for each period is calculated by the formula:

$$I_{CP_n} = \frac{I_1+I_2+I_3+\cdots+I_n}{n} = \frac{\sum_{i=1}^{n} I_n}{n}, \quad 1.2$$

where I_{CPn} – integral indicator of start-up success in Ukraine;
n – period (years) of research;
I_n – indicator index for the analysis period.
4. Trend analysis. Conducting analytical operations utilizing Microsoft Excel standard 2016 technical information assistance, specifically, trend analysis, followed by the development of a polynomial trend line of the fourth degree (Sokil *et al.* 2022). The calculation result is shown in Figure 3.

Figure 2. Research methodology



Source: developed by the authors.

5. Analysis and forecasting of the received results. After visualizing the trend line of the essential indicator of start-up success in Ukraine, the direction and rhythm of sustainable processes within the country for start-up development become clear. Two options (scenarios) are available when forecasting this trend for the next 1–2

years:

1.Positive if $y = ax^4 + bx^3 – cx^2 + dx – e \rightarrow \infty$, then the processes within the country contribute to the sustainable development of start-ups.

2.Negative if $y = ax^4 + bx^3 – cx^2 + dx – e \rightarrow 0$, then the processes of development of start-ups have a negative trend and in the country as a whole there is a policy of localization and, accordingly, a slowdown in their development.

Authenticity assessment of approximate economic and mathematical models was carried out by the coefficient of determination R^2: the closer its value is to 1, the better the approximation function chosen by us describes the relationship between the studied quantities or phenomena. So, if R^2:

- more than 0.8 – the developed forecast based on the trend line has a higher reliability;
- 0.5–0.8 – the developed forecast based on the trend line has an average reliability;
- up to 0.5 – the developed forecast based on the trend line has low reliability.

6. Analysis of the start-ups' implementation effectiveness in Ukraine. Evaluation of the trend line of the integral indicator of the start-ups' progress in Ukraine and its forecast. Formation of the final conclusion of the level of the success rate of start-ups in Ukraine and its dynamics. Confirmation of the theory of the direct and inverse dependence of the trend of successful start-up implementation on the integral index of start-up success.

7. Formation of the research hypothesis: is there a theoretical and methodological ability of the integral indicator of the start-ups' success in Ukraine to ensure the relevant trends in the start-ups' sustainable development?

2. Results and Discussion

The calculation of the integral performance indicator of start-ups in Ukraine is presented in Table 2.

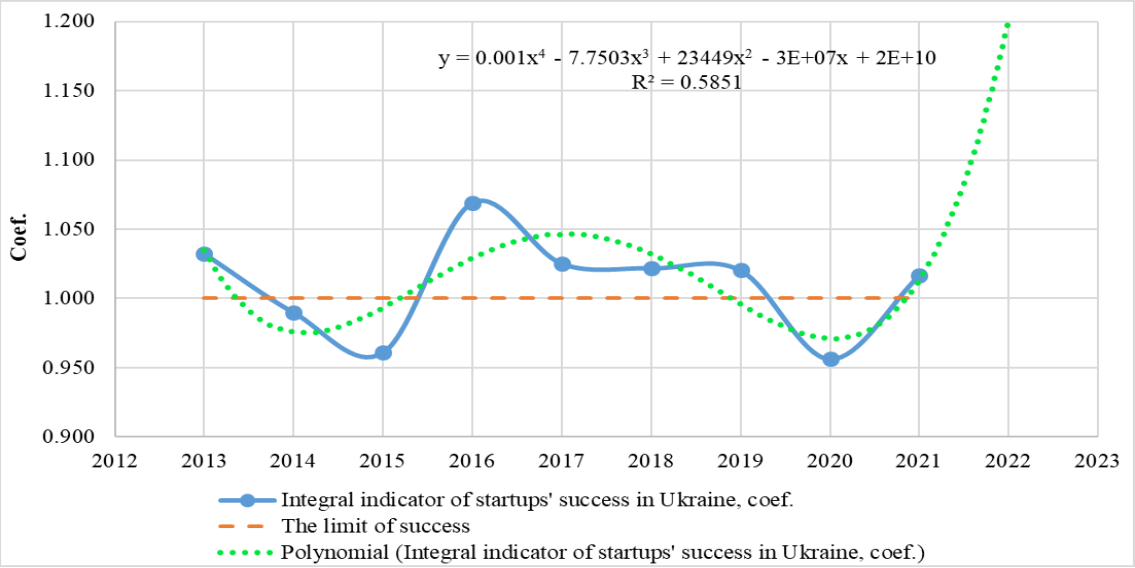
Table 2. Index analysis and formation of an integral indicator of the start-ups' success in Ukraine

Characteristic	Absolute indicator / Index	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Freedom in the World Score (FWS)	Absolute indicator	49	51	55	58	60	61	62	60	62	60
	Index		1.041	1.078	1.055	1.034	1.017	1.016	0.968	1.033	0.968
KOF Index of Globalization (GI)	Absolute indicator	73	74	73	74	75	75	75	74.94	73.2	75.1
	Index		1.014	0.986	1.014	1.014	1.000	1.000	0.999	0.977	1.026
The Open Data Barometer Score (ODB)	Absolute indicator	23	25	22	20	34	47	49	51	53	55
	Index		1.087	0.880	0.909	1.700	1.382	1.043	1.041	1.039	1.038
Market Potential Index (MPI)	Absolute indicator	13	14	18	16	15	12	13	19	12	14
	Index		1.077	1.286	0.889	0.938	0.800	1.083	1.462	0.632	1.167
Global Innovation Index (GInI)	Absolute indicator	24.7	24.6	24	25.5	25	26	26.1	26.6	26.68	26.1
	Index		0.996	0.976	1.063	0.980	1.040	1.004	1.019	1.003	0.978
Ease of Doing Business Index (EDBI)	Absolute indicator	140	112	87	81	80	76	71	64	58	52
	Index		0.800	0.777	0.931	0.988	0.950	0.934	0.901	0.906	0.897
Index of Economic Freedom (IEF)	Absolute indicator	46.1	46.3	49.3	46.9	46.8	48.1	51.9	52.3	54.9	56.2
	Index		1.004	1.065	0.951	0.998	1.028	1.079	1.008	1.050	1.024
Networked Readiness Index (NRI)	Absolute indicator	75	93	81	71	64	63	64	48.92	49.4	51.2
	Index		1.240	0.871	0.877	0.901	0.984	1.016	0.764	1.010	1.036
Integral indicator of start-ups' success of in Ukraine			**1.032**	**0.990**	**0.961**	**1.069**	**1.025**	**1.022**	**1.020**	**0.956**	**1.017**

Source: calculated by the author using the statistical base Knoema (2022).

The procedures for collecting, analyzing, processing information according to the above research methodology (Figure 2) made it possible to build a trend and forecast for an integrated indicator of sustainable development of start-up success in Ukraine, which is shown in Figure 3.

Figure 3. The trend line of the integral indicator of the start-ups' success in Ukraine



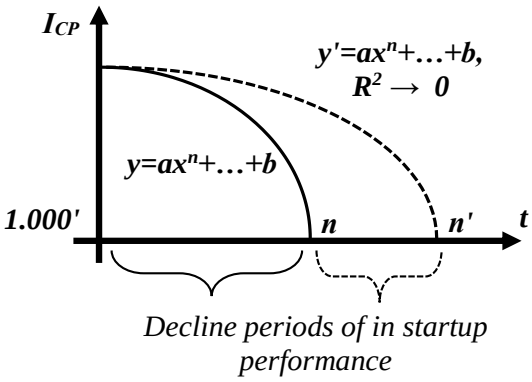
Source: calculated by the authors.

In general, with the help of empirical data of Figure 3 we can visualize two options for the flow of events, in which further development of scenarios is possible.

The first scenario is a gradual decrease in the predicted integral indicator of the performance of start-ups in Ukraine, which after a certain time reaches a value of less than 1.000 – the point at which the integral indicator of start-ups in Ukraine crosses the line of the limit of achievement (Figure 2). This point in time is the end of the dominant academic performance and the beginning of the decline of start-ups in Ukraine. These scenarios were typical in 2014, 2015, 2017 and 2020 of Figure 3. These assumptions can be visualized and represented as a model of the decrease in the performance of start-ups in Ukraine (Figure 4).

The elasticity of the curve line depends on the approximation coefficient: the larger the coefficient, the longer the period of decline of the curve before it intersects with the limit indicator of the academic limit of 1.000.

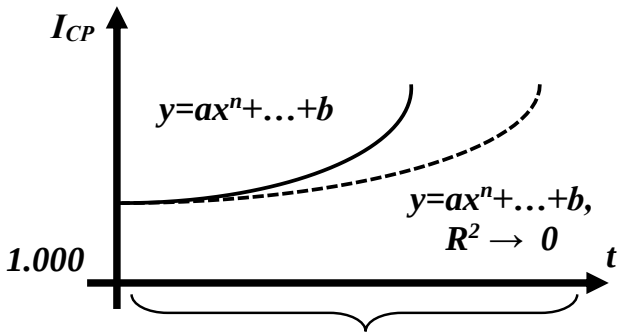
Figure 4. Model of the decrease in the progress of start-ups in Ukraine



Source: formed by the authors.

The second scenario is an increase in the predicted integral indicator of the performance of start-ups in Ukraine, which after a certain time reaches a value of more than 1.000 – the point at which the integral indicator of start-ups in Ukraine crosses the line of the limit of achievement (Figure 3). These scenarios were typical in 2016, 2018, 2019 and 2021 of Figure 2. These assumptions can be visualized and represented as a model for increasing the performance of start-ups in Ukraine (Figure 5).

Figure 5. Model of the increase in the progress of start-ups in Ukraine



Source: formed by the authors.

In this theory, the elasticity of the integrated index and, accordingly, the success of start-ups are also significantly affected by the level of approximation R^2. If R^2 tends to zero, then the progress process has features of greater positive effect.

The calculated data made it possible to build a trend line and forecast for 2022–2023 (Figure 3), where the success of start-ups and their sustainable development are observed. The level of approximation R^2 of the function of the integral indicator of the success of start-ups in Ukraine is 0.5851, which indicates that the constructed trend line forecast has an average reliability. Accordingly, the trend and forecast line has a positive value and growth in 2022–2023, which indicates the prospect of start-ups in Ukraine in the coming periods.

It is obvious that the success of a start-up depends significantly on the efficiency of its creation and management. It should be noted the recommendations for creating an effective start-up, formulated by O. Kornukh and L. Makhanko (2014):

1. Availability of accessible information about investors, innovators and project managers in information networks. The information system should contain a general description of each of the main components of a start-up, their scope and direction of activity.

2. Ensuring the interaction of key elements for launching a start-up. As a result of combining a good idea and material support, there is a need for effective management of the implementation of an innovative project, which is satisfied by involving a project manager with relevant experience.

3. Integration of the interests of start-up participants – the owner, innovators and manager to achieve a synergistic effect of their collaboration.

4. Development of an effective business plan – a practical guide for the implementation of a business idea, designed not only to carry out a timely assessment of the effectiveness of the project, but also to adjust the plan if necessary.

5. Constant monitoring of the market and demand for the developed innovative product.

6. Maximizing the efforts of presenting an innovative business idea to increase the interest of all project stakeholders.

7. Marketing of a future innovative product, which involves systematic activity in the development and promotion of goods, services and technologies to the market to meet the needs and demands of consumers, scaling the project to attract a large number of loyal customers, using crowdfunding platforms.

8. Attracting the support of information social networks to promote innovative ideas, projects and products.

It is clear that the launch and implementation of a start-up project is impossible without attracting financial resources, the sources of which for entrepreneurs usually remain unattainable in the modern infrastructure of the innovation market. This is explained by the fact that the problem of finding investors is complicated by a high level of probability of non-repayment of funds in the event of a start-up fiasco. Here are the main models of sources of financing for innovative projects (Kornuk and Mahanko 2014; Cherniavska, Hnypa-Chernevetska and Zhijun 2017):

1. Franchising – “copying a business”, when a well-established business process with detailed instructions for selling is obtained; already promoted name (brand) of the company; savings on advertising.

2. Venture funds – funds that show interest in the project and participate in the implementation of the start-up.

3. Competitions (tenders), when financing is received not only by nominal winners, but also by any projects that some of the investors like.

4. Business angel – an investor who invests his own funds in projects at the stage of creating an enterprise in exchange for a return on investment and a share in the capital.

5. Crowdfunding is a process in which funding occurs on the basis of the collective cooperation of people who voluntarily pool their resources to support the efforts of other people or organizations.

6. Smart money – a model that assumes that the investor invests in the development of the project funds, knowledge, experience, connections and understanding of the market and has the necessary level of competence in the industry.

7. The "3D" model: home, friends, fools" assumes that at the stage of creating a start-up, an entrepreneur has to go to friends and relatives for financial help.

8. A strategic investor makes investments in a start-up that involve receiving a permanent income, control over property and participation in the management of the investment object.

9. State subsidies with financial support from state bodies, thanks to which the subject receives benefits (profits).

10. Initial public offering (IPO) – an offer that the company makes to all interested investors.

Conclusions

The COVID-19 epidemic has caused the entire globe to reexamine not just its development predictions and short-term economic and social strategies, but also how it approaches the formulation of its own long-term goals. The lessons learnt by humanity through this epidemic have the potential to transform not just management methods in the future, but also human social behavior, which in turn can be both a positive and a negative factor in the development of start-ups in Ukraine and beyond.

Of course, Russia's aggression against Ukraine has caused a lot of difficulties for the development and implementation of start-ups. But, under such conditions, new needs open up, to which young start-ups will respond and develop new directions and ideas. These will be start-ups related to humanitarian and psychological assistance, architecture and construction, military affairs and digital technologies.

Summarizing the above, we can say that:

- analytical support tools are an excellent forecasting tool and, as a result, a way of developing an effective model for projecting start-up development possibilities;

- a comprehensive indicator of start-up success in Ukraine, combining eight factors, is a helpful source of information on the dynamic development and direction of start-up policies;

- forecasting based on the constructed trend line have been confirmations of the focus of start-ups on sustainable development.

The crisis of 2020 caused by the COVID-19 pandemic and the war of 2022 in Ukraine have become powerful catalysts for change and transition to a reassessment of start-ups, approaches to their promotion, principles and consumer needs.

Prospects for further research will be focused on the analysis of the sustainable development of start-ups in Ukraine during the war and post-war periods.

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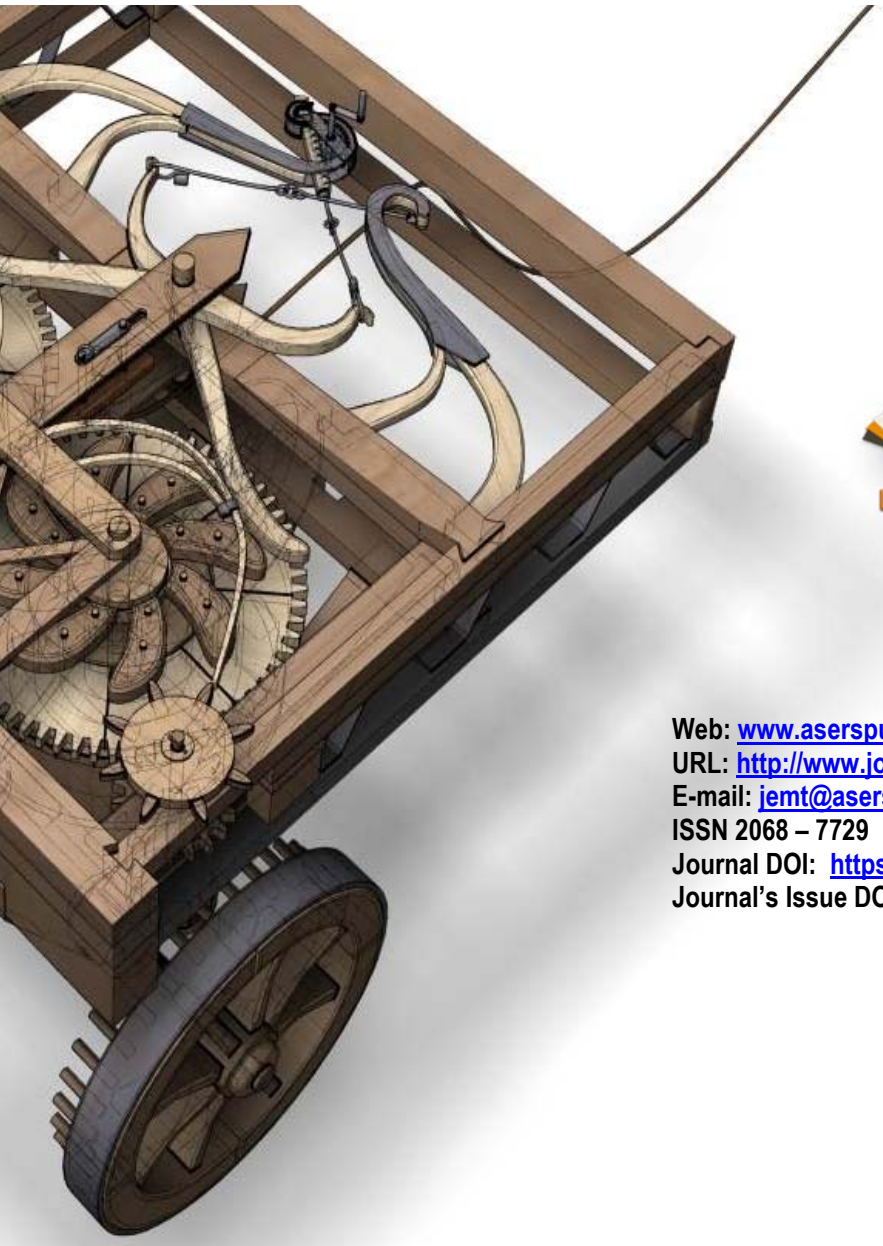

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