Estimation of the Level of Interest and Modeling of the Topic of Innovation Through Search in Google

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Abstract. The study presents the use of the Google Trends Search Engine Toolkit in identifying interest in innovation trends through queries in different languages of users in Ukraine for terms of innovation: innovation, startup, innovative entrepreneurship, business incubator. The Decision Making Helper software to model the components of the impact on the development of startups in the region was built, taking into account the high asymmetry of the development of startups in the regions of Ukraine. Google Trends search engine have ample opportunities to determine users' level of interest in major trends in the economy and other areas of public life was shown, the study of moods and thoughts, which allows to form a statistical base for decision making for modeling the directions of territorial development. The example of the topic of innovation the moods and thoughts, which allowed to form a statistical base in dynamics for decision-making on modeling the tasks of innovative development of regions was explored.

Keywords: innovation, startup, business incubator, search engine, development, modeling, search, Google Trends, analytics.

1 Introduction

In the globalized world there is increasing interest in the problem of further development of innovative entrepreneurship. This is due to its direct impact on GDP growth. A progressive form of innovative entrepreneurship is start-ups [1]. Business incubators are being created to activate their start-up process. In order to confirm the actual actualization of such opinion in the society, a search for approaches to possible modeling of the topic of innovation, analysis of the formed interest in this topic, opin-

ions and interest of the society in defining the essence of the list of linguistic terms in this direction has been started.

2   Analysis of Publications

The development and dissemination of the Internet has greatly expanded the methodological base of scholars. The solution to the problem of determining the relevance of the chosen research direction, for example, from financial terms through defragmentation by the method of analysis of Internet resources based on search queries [2] with high accuracy and reliability was presented. This method by Google's largest known international search engine, which arbitrarily uses a ban-filter system, since the method is based on multiple queries was implemented [3]. The proposed method has been tested in various fields, which proves its adequacy [3, 4, 5]. The use of search queries to measure the activity of Internet users had a high level of confidence in the prediction of the current value of real estate of various types in a large city, which was performed using the group method of argument accounting [6]. Based on searches on the Internet, sociological methods for analyzing protest events have been improved [7]. It has been shown that defining a set of keywords in Google advertising using an economic-mathematical model allows to keep a profitable advertising campaign with minimal risks [8]. The Google Trends Intelligent Search and Analytical System has been used in research by the International Federation of Library Associations to analyze full-text databases [9]. Recently, the study of population's interest in certain events in the life of society and the state through the Internet has become especially relevant, as, for example, it is made possible by the use of statistical services of various search engines to study the dynamics of changes in the interests of the population regarding the country's accession to the WTO [10]. The use of Google Trends data to determine the frequency of country searches on the Internet has a significant relationship with macroeconomic variables (eg real GDP, inflation, capital flows), which contributes to a timely assessment of economic conditions in developing countries with low income [11]. Therefore, Google's search engine experience is progressive and relevant to the task of analyzing the level of user interest in the topic of innovation.

3   Using the Google Trends Search Engine Toolkit in Research

Google Trends, a Google service that delivers a wide variety of search metrics, is used to solve this problem: search term frequency by total search volume (by world, country, period), compare queries, display results over time, provide statistics, and measure it is the level of interest [12].

The Google Trends Search Engine determines the degree of popularity of keywords among Google search engine users by topic in different regions, countries, world, presents as a graph over a period, shows the proportion of keyword searches in the total number of searches performed on Google. All data is presented in relative form (Google algorithms for 100 points accept the highest level of popularity of the

query, 50 - the level of popularity of the query twice lower than in the first case, 0 - the level of popularity of the query not higher than 1% of the level in the first case) [10]. In doing so, the result of a search query will depend heavily on the choice of key terms [13], because the use of one search term often leads to very little data, which gives zero response.

The statistical method used by Google Trends proves that it is an effective tool for market research and statistical data collection.

In [14], analyzing the data of search queries that give an idea of people's behavior, economic life using the method of quantifying complex time series correlations revealed a trend between Google search and financial market fluctuations.

Studies [9] of modern scientific periodicals, available through the international full-text databases Oxford University Press, SAGE and Springer Link, have analyzed and found that the use of Google Trends is maximally involved in medical research and information technology. The largest number of Google services surveys use them as a web statistics tool (SEO) to analyze marketing information, but in recent years this analytic tool was used to study social and political processes.

When planning the areas of research in the field of innovative entrepreneurship, key terms was defined: business incubator, start-up, innovation, innovative entrepreneurship, SME, and each request tracks the dynamics of popularity of these requests in Ukraine over the past 5 years. For more detailed analysis, the resulting data is exported in CSV format, which contains data tables.
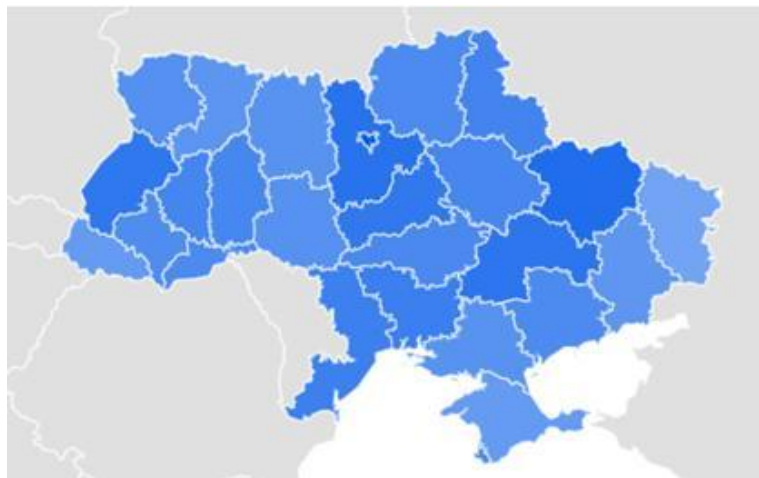

Fig. 1. Results for "startup" search in the regions of Ukraine (source: Authors' own developments based on Google Trends)

In addition to statistics, search results were obtained across regions and cities, which allows us to identify strategic centers that are actively promoting and developing the innovation sector.

Figure 1 shows the results of a search query for a "startup" among the regions of Ukraine, which clearly shows the concentration of the two centers of western and eastern, while almost bare center.

4 Analysis of the Level of Interest in the Term Innovation and Innovative Entrepreneurship

In order to explain and analyze such asymmetry in launching an innovative interest business in Ukraine, we investigated the frequency of the term "innovation" through the Google Trends search and analysis system, which was considered in various language submissions: Ukrainian, Russian, English. The results of the comparison revealed that the most popular query is English - innovation, while in comparison with Ukrainian – innovation (інновація), the query frequency generally exceeds several times (Fig. 2).
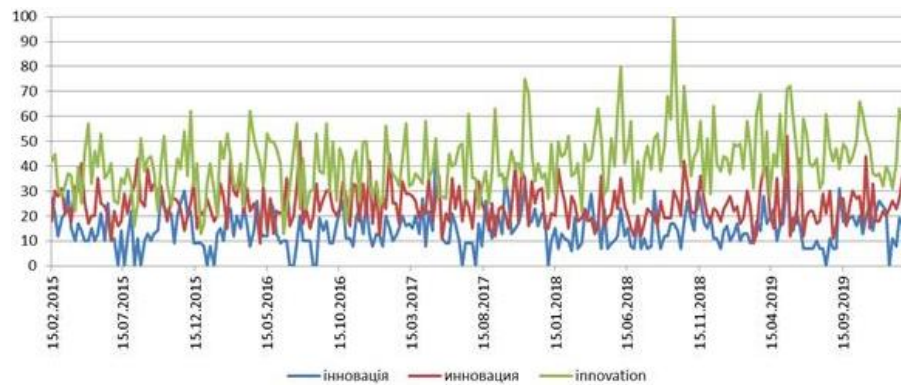

Fig. 2. Frequency request for the term "innovation" (source: author's own developments based on Google Trends)

Examining the results by region, 11 leading regional innovation centers of Ukraine were identified: Kyiv, Lviv, Kharkiv, Kiev, Odesa, Kirovograd, Dnipropetrovsk, Zaporizhia, Crimea, Kherson, Donetsk. "Innovation", with the exception of the Kiev region, remains the prevailing term in Ukraine as a whole (Fig. 3, Table 1).

Fig. 3. Regions of Ukraine where search queries were most frequently performed (source: author's own developments based on Google Trends)

Table 1. Query frequency breakdown by region

Region	Innovation in Ukrainian	Innovation in Russian	Innova-tion	Startup	Startup in Ukrainian
Kyiv	13 %	35 %	52%	48%	52%
Lviv	23 %	0 %	77%	62%	38%
Kharkiv	7 %	26 %	67%	50%	50%
Kyiv region	17 %	50 %	33%	38%	62%
Odessa	0 %	26 %	74%	47%	53%
Kirovograd	0 %	0 %	100%	0 %	100%
Dnipro	15 %	27 %	58%	42%	58%
Zaporizhzhya	0 %	0 %	100%	46%	54%
Crimea	0 %	46 %	54%	39%	61%
Kherson	0 %	18 %	82%	42%	58%
Donetsk	0 %	41 %	59%	42%	58%

Source: Google Authors' own custom development.

As can be seen from Table 1, the tendency to search for the Latin term of innovation term does not persist in the regions for the search for the Latin stratagogue; The phenomenon of Kirovohrad region is interesting, where all queries to search for innovations are in Latin, and all queries to search for startups in Cyrillic. Authorities and local governments in the region need to pay attention to this and determine the reasons that may lead to the choice of territorial development strategy.

However, the number of results on the queries "innovative entrepreneurship" in ukrainian, "innovative entrepreneurship" in russian, "innovative entrepreneurship" in

english is too small, that even after reducing the analysis period - there is not enough analytics for data submission, so there was a transition to finding interest in the concepts start-up and business incubator.

5 Estimation of Frequency of Startup Search Term and Business Incubator

The study of the frequency of the request for the term "business incubator" was considered in the language submissions: business incubator in ukrainian, business incubator in russian, business incubator in english. The most popular queries are business-incubator in Russian (бизнес-инкубатор), business incubator (бизнес инкубатор), and the activity of the query was localized exclusively in Kyiv. The number of search results in the Ukrainian Business Incubator and Business Incubator queries is too small.
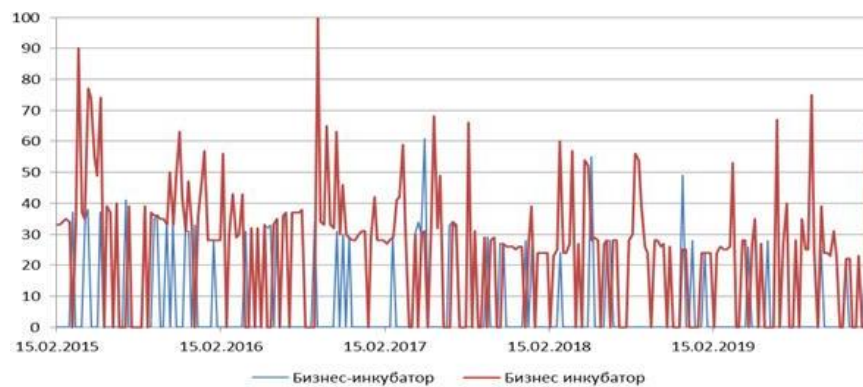

Fig. 4. Frequency of request for the term "business incubator" (source: author's own developments based on Google Trends)

The study of the frequency of the query term "start-up" was considered in linguistic representations: startup, startup in ukrainian (старап), start-up in ukrainian (старт-ап), start-up. Analyzing Fig. 5, it can be noted that Latin leads are startups and startups in ukrainian (стартап).
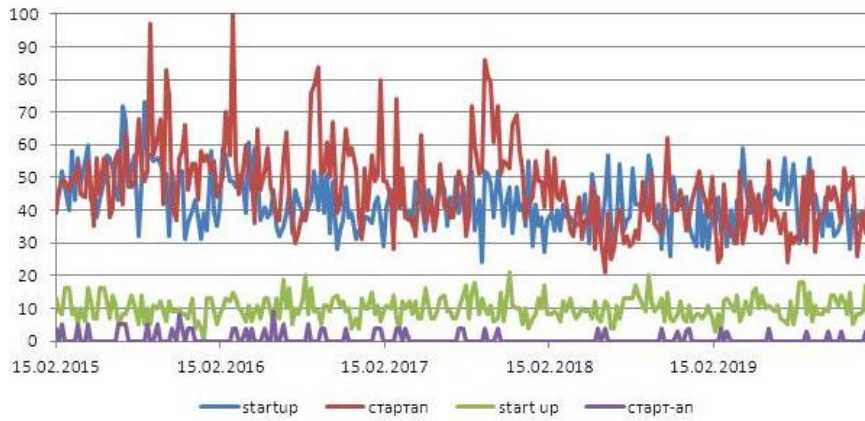
Fig. 5. Start-up Request Frequency (Source: Google Trends Authors' Own Developments)

In spite of different linguistic requests, 6 regions of Ukraine are clearly traced in terms of interest in "start-up" concepts: Kyiv, Lviv, Kharkiv, Dnipropetrovsk, Kyiv and Odesa (Fig. 6), which correlates with interest in the term "innovation" by region, reflecting their focus on development in these areas.
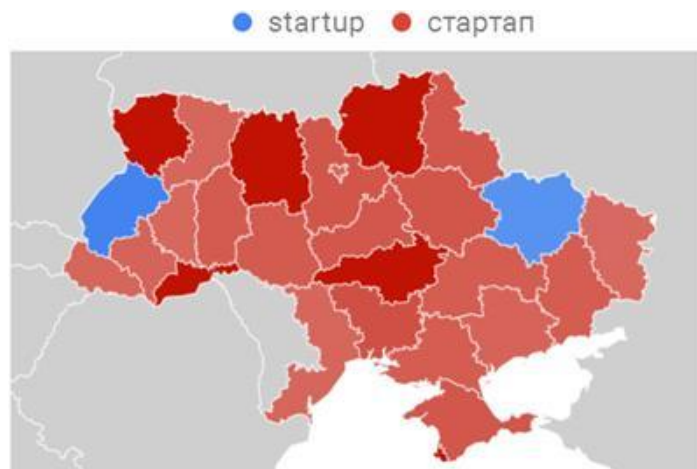

Fig. 6. Comparison of frequency of startup requests in different languages (source: author's own developments based on Google Trends)

As can be seen from Fig. 6, there is an asymmetry regarding the interest in the term startup Latin in Kharkiv and Lviv Oblasts, which are centers of development of the IT industry, where foreign language is predominant.

6 Building a Model for Innovation Development in the Region

The results of the analysis of queries on the Internet shows regional interest in such forms of innovation as business incubator and startup. The leaders of the study are the cities of Kyiv, Lviv and Dnipro (Table 1).

If we compare the information received from Google Trends on the rankings of innovative cities in the world and in Ukraine, they coincide, which indicates that there is a dependence of the indicator of interest and development of the region in innovation. In 2019, the well-known StartupBlink platform ranked the world's Innovative Cities [15], in which Kyiv ranked 34th (322 startups). At present, there is also a rating among cities of Ukraine, in which Kiev occupies the first place, and Lviv and Dnipro are also leaders (11 start-ups). It is logical to note that other cities do not have such large-scale startups and business incubators, but undoubtedly, promising areas of innovation was needed for each of them.

Therefore, there is a challenge to foster start-ups, which will help innovate in non-leading cities. According to scientists Gavrish OA, Boyarinova KA, Kopishinskaya KA [16] the process of creating startups has five stages: sowing, startup, growth, expansion, exit. To complete these stages, you need to have an idea, human resources, financing (or self-financing). That is, the reason for the underdevelopment of innovative entrepreneurship in the regions is the absence of one of these three components or all together.

To determine the impact of these components on the process of innovation development in the region and to formulate a model for a successful startup project, was proposed to use the Decision Making Helper (DMH) software as a decision support system that allows you to make a selection of any object by the specified criteria. The decision making Helper software was based on an expert method of estimating possible alternatives, which in turn is based on the use of the T. Satie scale [17]. Decision Making Helper is widely used primarily because of its availability on the Internet. Anyone can access the product in real time via a link on the Internet, which will allow him to get a free demo of a software product limited to three selection criteria. To explore more criteria, you need to use paid access to the program.

Choosing the most influential part of starting a startup involves using an expert method of evaluating possible alternatives [18]. The first step in such an assessment is to determine the optimal number of interviewing experts. That is, in order to recommend the use of the results obtained in practice, one must justify their statistical significance. Proof of the representativeness of the sample, that is, the sufficiency of the number of experts interviewed was conducted according to the variance indicators (the rule of "three sigmas").

To investigate the impact of components on the development of innovation in the region formed a general set of participants in the investment process in Ukraine. It is noted that the general population is determined by the number of successful Ukrainian startups that are recognized in the world, which were mentioned above - 322 startups. In total, they raised over $ 11 million. USA [15]. The differences of the established estimates are estimated on the 9-point scale by T. Saati method [17]. The tolerable error is set at 0.5 points and the confidence level of F (t) is 0.9802. That is, the data

obtained from the analysis of the adjusted sample volume, by 98%, will characterize the general population.

According to the results of the calculations, at least 9 specialists should be interviewed for reliable results. As specialists there are startups directly in the innovation environment.

The second step in calculating the optimal choice is direct peer review, which is done in the Decision Making Helper software. Valuation involves choosing the most influential component of a successful startup from an idea, human resource, and financing startups according to the criteria that was selected. There are many methods of evaluating these components, but there are those that are the same for all, namely efficiency, potential, value for the project. The initial data used for ranking was presented in Table. 2. All data are averages of 9 experts surveyed. Experts' assessments was added to the program in an indirect form, which allows the result to be obtained at the average industry level. Decision Making Helper automatically calculates the decision value for each alternative, in percentages from -100% to + 100% and verbally "unsatisfactory / fairly unsatisfactory / neutral / fairly positive / positive".

Table 2. Evaluating alternatives to the most important component of starting a startup

Criterion	Startup idea	Human resources	Financing
Efficiency	high	average	average
Potential opportunities	high	low	average
Value	low	high	average

Source: authors' own development

When interviewing experts, it is necessary to determine the weight of each of the criteria, based on their importance. In this software product, the importance is evaluated on a differential scale from 1 to 5 (from low (low) to high (high)). It is also necessary to evaluate the importance of the criteria of each option from -5 "low" to +5 "high", 0 - neutral. Indirect expert survey data together with weight was presented in Table. 3.

Table 3. Results of a survey of experts on the importance of startup components

Criterion	Financing	Human resources	Startup idea
Efficiency (important)	+4	+2	+2
Potential opportunities (increased importance)	+4	-2	+2
Value (increased importance)	+2	+2	+2

Source: authors' own development

The data entered in the program was presented in Fig. 7. The decision to determine the most influential component of start-ups resulting from the program was presented in Fig. 8-9.

Fig. 7. Background to determine the most influential component of a startup in Decision Making Helper (source: authors' own development)
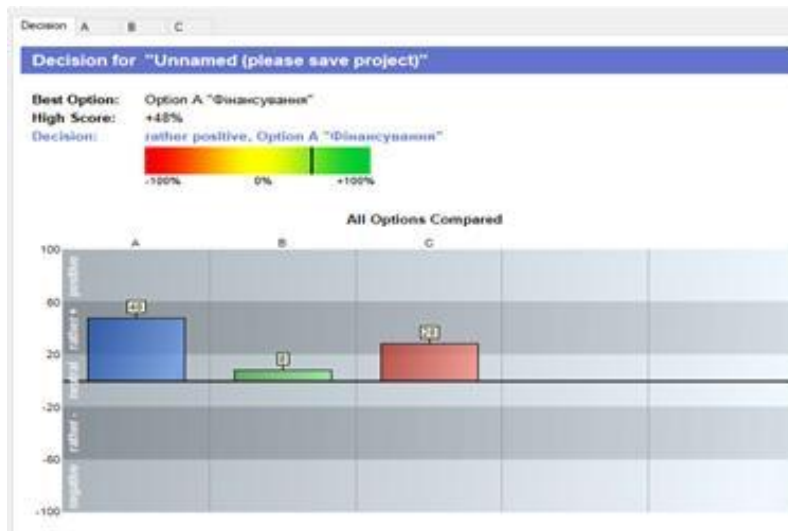

Fig. 8. The result of determining the most important component of a startup in Decision Making Helper (source: authors' own development)
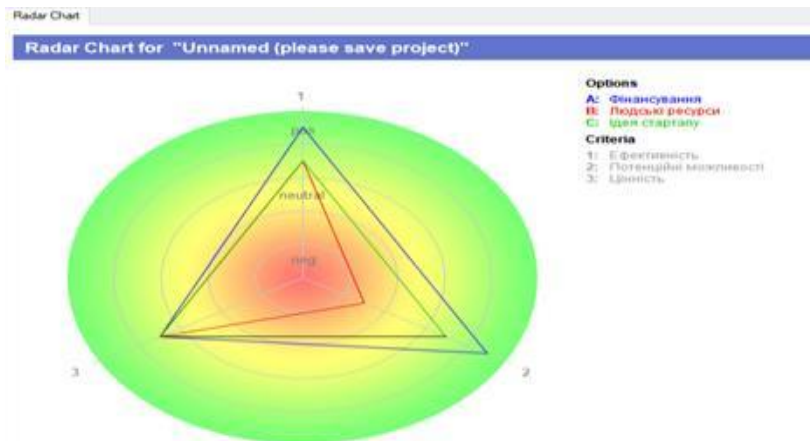
Fig. 9. The result of determining the most important component of a startup in the Decision Making Helper software (radar method) (source: authors' own development)

Therefore, as can be seen from Fig. 8-9, the most influential part of starting a startup is financing. That is, its presence or absence determines the development of innovations in the region, and thus further correlation of the obtained results can help to solve the problem of startup development. Building a successful startup project model requires financial support, having one idea or human resources is not a fundamental aspect. If you define a successful model of operation as a set of components for building a startup adjusted for importance factors, it will look like:

$$Startup = 0.5 * Financing + 0.3 * Idea + 0.1 * Human Resources + 0.1 * Other \qquad (1)$$

In view of the presented result, it is possible to conclude on many issues, not only the need for funding and ideas, but the least priority of human resources, which are defined by specialists as a minimum component

7   Conclusions

The research has shown that Google Trends search engine has ample opportunity to determine the level of user interest in the main trends of the economy and other areas of public life. It is noted that the English language component in terms of innovation-oriented change is predominant in innovation requests, however, with regard to start-ups Ukrainian. In general, it should be noted that the society is not very interested in the term innovativeness, which is not well understood and is not in demand, which indicates negative trends. The concept of startups and innovation is not identified by search engines, because startups are more viewed as a fast-paced project rather than an innovative one. There is also some slowdown in interest in startups after 2018, which is consistently low during 2018-2019. Therefore, it is an indicator of crisis phenomena in innovative entrepreneurship, which was confirmed by the limited

search for the term "innovative entrepreneurship", despite the greater demand for the terms startup and business incubator. It is possible to note a certain lag of maximum interest in the topic of innovation in 2016 and after about six months increased index of search for business incubators, the interest to which remains relatively high and unchanged, whereas the startups were slowed down, indicating the interest in finding tools for reducing entrepreneurial activities, which are entrepreneurial, seen in the used of business incubators. To this end, the components of influencing start-ups where financial resources was identified as priorities have been modeled, which confirms the interest of job seekers in business incubators where the financial risks of projects can be reduced. An advantage of Google search services is the ability to measure interest in changes in the innovation market across the regions of Ukraine, which tracks some west-east asymmetry of interest in startups, which requires seeking measures to balance the development of innovative entrepreneurship throughout Ukraine, including the center. The significant predominance of searching for the term innovation in English in most of the considered regions of Ukraine requires additional study, in particular, for example, in Kirovohrad and Zaporizhzhya regions. Such a search tool may be an additional marker for local governments to evaluate public opinion in these regions. The use of Google's search engines has confirmed, in search experiments with language terms, the ability to study moods and thoughts, which allows us to form a statistical base for decision-making to model development topics, in particular territories.

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