Mastering Computer Linguistics for the Designation of Risks in Cooperation Communications

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Abstract

Google Trends is a popular computational linguistics tool designed to determine and analyze the range of public interests, taking into account the linguistic features of the formation of Internet queries. In this paper, it is proposed to use the Google Trends service to determine the risks of cooperative ties between industrial enterprises of the Kharkiv and Zaporizhia regions, which are already leaders in industry clustering in Ukraine. The information base of the study was the groups of enterprises, which were determined by the analysis of the hierarchy of cooperation relations. An analysis of the names of enterprises in the group using Google Trends made it possible to determine the demand for their products by region, which made it possible to assess the state of their promising cooperation. In this aspect, a list of clustering risks is defined, a relative assessment of indicators according to the linguistic features of the formation of scales including. The work carried out an experiment with Kharkiv enterprises, which made it possible to make a decision on cooperation with certain institutions, taking into account the processing of qualitative indicators by using linguistic information. Thus, the scientific novelty of the paper is the technology of processing quality information with widespread use of methods of using linguistic information, which is important for the formation of prerequisites for decision-making in economics was developed by the authors.

Keywords

Computational Linguistics, Google Trends, Risk of Cooperation, Matrix, Interaction, Partnership.

1. Introduction

Computational linguistics is a relatively new field of knowledge in linguistics, designed to create automated systems for processing textual information for the purpose of its recognition, translation, etc. One of the tasks is to build knowledge management systems, which involves the implications of expert systems to achieve the result of solving an individual problem of natural language processing through mathematical models and artificial intelligence tools. The primary mission of computational linguistics is due to the need to create and improve the linguistic support of information processing systems. The results of the analysis of requests and messages underlying the communication of users with intelligent automated information systems (AIS) can be used not only to achieve the goals of linguistics, but also to process economic databases. AIS solves issues in the economy that require the translation or analysis of language terms, processing the level of interest in these definitions according

to certain criteria for belonging to a region, for example, key words and annotations formed using Google, Lingvo and other automatic translators are essential structural elements of an economic article. Computational linguistics is a means of expanding the tools for analyzing economic processes that are dynamically changing in the modern unstable environment of economic development in the country. In the context of the economic crisis caused by epidemiological and political world phenomena, the issue of combating economic risks that have led to a deterioration in the activities of enterprises is becoming increasingly important. Linguistics has the ability to solve the problem of analyzing the real economic situation by determining the current social directions of the country's development. To confirm the priority of this issue in society, a search has begun for ways to overcome risks for enterprises and to analyze the prevailing opinion on this topic in the aspect of the country's regions using Google Trends.
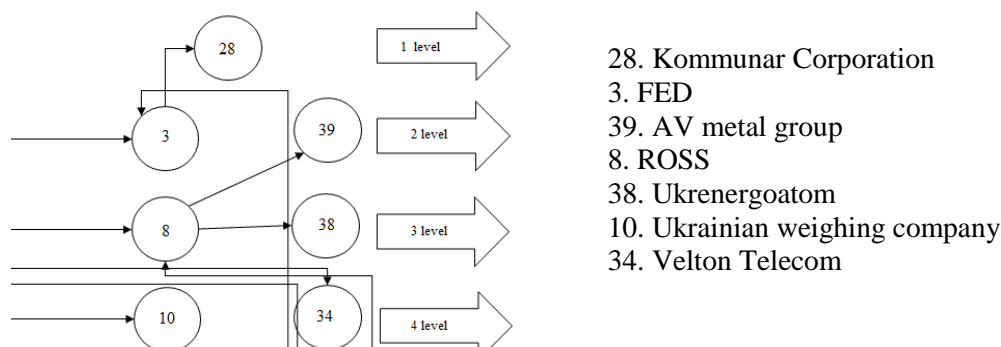
2. Analysis of publications

The presented topic is not new for modern scientists, moreover, the number of interested people is constantly growing. So, in 2020, O. Kliuiev [2] with a team of authors developed a successful startup investment model, using in his research the results of interest in the terms "innovation", "business incubator" in various speech variations. In turn, in 2021, N. Vnukova and S. Achkasova [3] came to the conclusion about the seasonality of interest in financial risk by studying the level of interest in the definition of "forensic" and "risk control" in Google Trends, taking into account discrepancies in time and in dynamics. Also, the results of a study by V. Shmatkov and S. Hlibko [4] are interesting regarding the difference between the concepts of "copyright" and "intellectual property" in the framework of the formation of digital user competence regarding the mechanism for indemnification and the use of results for risk assessment. V. Vysotska [5] dealt with web analytics, including those generated by means of Google Trends, considered e-commerce issues based on the search for relevant information through keywords on the topic based on the feedback activity of the audience. That is, the practice of using Google Trends tools to solve the problems of economic science exists and is widely represented in the studies of modern scientists.

Publication activity on enterprise risk issues is substantiated by the real state of economic development, which is reflected in the publications of young authors. So, M. Klimchuk [6] developed an adaptive model for countering the risks of business processes of alternative energy enterprises and formed a matrix for the distribution of risk zones for it. Y. Shvets [7] analyzed the methods for assessing the risk of industrial enterprises in order to determine the feasibility of their use in the activities of institutions. The topic of enterprise risk assessment is also relevant in foreign studies. For example, A. Hayes [8] considers all the features of risk assessment of modern American enterprises and ways to overcome it. In addition, P. Avila [9] draws attention to the need to assess the risk of collaborative enterprises in order to improve existing models in Portugal. Thus, modern domestic and foreign studies of determining the risk of enterprises are focused on the process of its assessment and methods of prevention. Meanwhile, there are almost no proposals on how to overcome the risks of enterprises, taking into account the means of computational linguistics, so it is proposed to study this issue in more detail using Google tools on the example of Ukrainian enterprises.

## 3. Database of enterprises for the study of cooperation ties

In times of unstable development of the financial sector in Ukraine, filled with risks for specific enterprises, a collaborative approach to industrial management that meets the principles of the state policy of the country and the European directions for the development of innovations in its economy is becoming increasingly important. Many industry experts note cooperation as a possible means of overcoming crisis phenomena in the activities of organizations [10]. Cooperation is the association of enterprises to achieve a common goal based on beneficial interaction and consensus. In Ukraine, this idea is actively promoted, which is reflected in the concept of creating clusters by the industrial

community of Kharkiv and Zaporizhzha in 2020 [11, 12]. The main mission of these clusters was to establish a partnership between the members of the association in order to strengthen internal interaction with each other and their entry into the international market. In 2021, by order of the German society GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH), which supports cluster cooperation in Ukraine, industry experts conducted a study of enterprises in the two regions represented on the possibility of strengthening ties and expanding the circle of cluster members. The authors propose an expert method for analyzing hierarchies [13] as a key research method, based on the structuring of relationships between subjects and their priorities for cooperation. In the constructed hierarchies, the first level symbolizes the high state of potential interaction between enterprises. The opinion of experts was collected through an online Google Form survey of representatives of industry enterprises using the Kharkiv region as an example. The results of the study (fragmentary) are shown in Figure 1.

28. Kommunar Corporation
3. FED
39. AV metal group
8. ROSS
38. Ukrenergoatom
10. Ukrainian weighing company
34. Velton Telecom

Figure 1: Hierarchical structure of Kharkiv cluster enterprises (Fragment)

4 levels are occupied by those enterprises that have prospects for clustering. Enterprise No. 28 "Kommunar Corporation" has all chance to become an active member of the EAM cluster (Engineering, Automation, Mechanical Engineering) through a system of interaction with organizations that already have the opportunity to use the prospects of association through cooperation with other enterprises. The constructed structure makes it possible to determine the directions for expanding the cluster by attracting more promising organizations that are ready for internal cooperation. The depicted hierarchy is difficult to perceive due to the chaotic nature of the directions of interaction, but at the same time it is informative for the logistics system of further attracting enterprises to internal association. A similar structure is observed in Zaporizhzhia (Figure 2).

25. Motor Sich
12. Thermo-Engineering Ltd
35. PrivatBank
43. Metinvest
48. Raiffeisen Bank
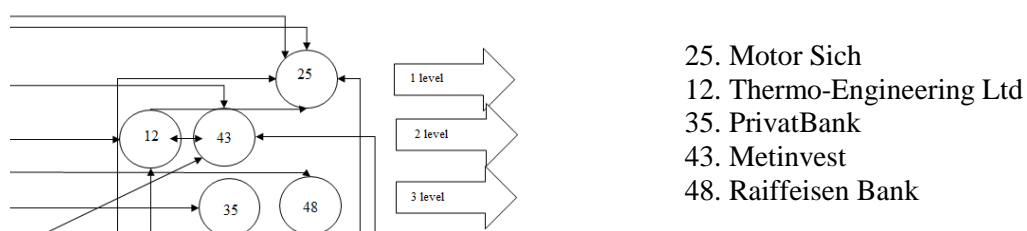
**Figure 2:** Hierarchical structure of Zaporizhzhia cluster enterprises (Fragment)

As can be seen from Fig. 2, the first 6 levels are occupied by those enterprises that have prospects for clustering. Enterprise No. 25 "Motor Sich" has the necessary elements of interaction in the cluster, which can enable productive cooperation between customers and suppliers. By involving active enterprises of the first levels of the hierarchy in cooperation, it is possible to realize the prospects for interaction between cluster members on the terms of benefits for everyone, which will not only expand the list of participants, but also allow constructively increasing the level of dialogue between them. It is necessary to assess the level of public interest in these enterprises in the regions. Google Trends was used as one of the computational linguistics tools to complete the task.

4. Analysis of the level of interest in the names of promising cluster enterprises as a tool of computational linguistics Google Trends (method 1)

Google Trends [14] is an Internet application that allows you to determine the frequency of search queries (terms) in different parts of the world and in different languages. In addition, the application allows the user to compare, analyze data over a period of time, search for non-obvious topics related to the query. The application is a tool of computational linguistics, because it can be used to determine the filtering of search results using punctuation. Google Trends search results are displayed in interactive graphs that show the current situation of the top queries. This application helps users to delve into scientific issues for free, collect large amounts of data and track any changes in the dynamics of interest in the concepts. Unlike other software products, such as AWStats, Matomo, which have similar functions, Google Trends has a simple interface and remains the most popular for users in Ukraine.

Google Trends algorithms are based on determining the ratio of the number of term requests to the total number of queries on this concept. The obtained data are automatically translated into a 100-point scale, which assigns the highest value of 100 and equates with it all other data, giving them points from 0 to 99 [15, 16, 17]. It should be noted that Google does not display rare, single, unpopular requests of one user in a short period of time. On the contrary, query statistics can provide results for phrases that include words in any order or in combination with other words [18, 19]. Thus, the capabilities of Google Trends and its functions make it possible to analyze the level of interest in the regions previously obtained as priority enterprises for cooperation (see Fig. 1, 2).

To determine the correspondence of the cooperative perspective to the modern public interests of business, a study was conducted to compare certain subjects of Kharkiv with each other. The analysis was carried out for three enterprises in the region in the last year (12 months). Search results in Google Trends are shown in Figure 3.
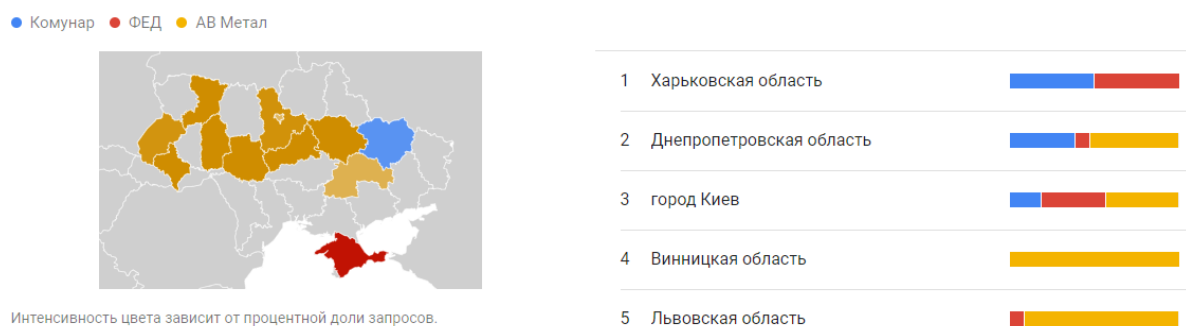
Figure 3: Results of comparative queries by names of selected enterprises of Kharkiv

As shown in Figure 3, the pre-defined cooperation links fully reflect the public Internet user requests. "Kommunar Corporation", "FED" are Kharkiv enterprises representing the level of interest in the region in the proportion of 50/50, which demonstrates the demand for their activities by location. In addition, the neighboring Dnipropetrovsk region and the capital city of Kyiv are interested. "AV metal group", identified as a promising cooperation partner for the cluster in the region, really corresponds to such a mission, because the demand for its products covers 10 regions of the country, which can be said about the existing partnerships between companies in these regions. So, the group of enterprises represented reflects the real state of development of future prospects for interaction between certain enterprises in Kharkiv.

A similar study was conducted according to three enterprises in Zaporizhzhia (Figure 4).
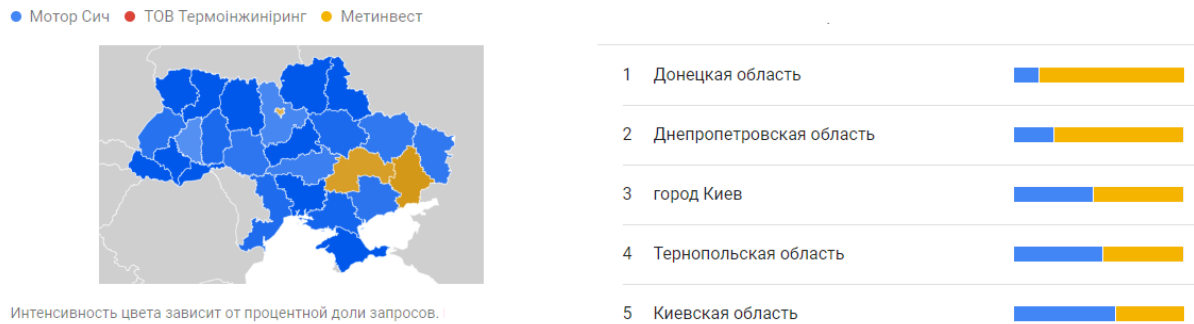
Figure 4: The results of comparative queries on the names of selected enterprises in Zaporizhzhia

As can be seen from Figure 4, "Motor Sich" is a model of public interest in all regions of the country, which reflects the prospects of partnership for such a company in the sectoral cluster. "Metinvest" is most interested in Donetsk and Dnipropetrivsk regions. Instead, in the search space for any variations of "Thermo-Engineering Ltd" is absent, which indicates inconsistency with the requests of the companies themselves in the survey. Thus, it is doubtful to take into account "Thermo-Engineering Ltd" when forming cooperation prospects, because the lack of mentions in Google Trends emphasizes the low level of interest in the company's products. Moreover, there are several companies in Ukraine with a commercial name that includes the words "thermo" and "engineering", and a significant number in the world. Cooperation in the event of such a discrepancy may create additional risks in the formation of associations.

The analysis of Google Trends made it possible to assess, using computational linguistics, the real state of possible interaction for future cooperation based on the demand for the company's products in the network, but this statistics does not guarantee the quality of the association, since it does not take into account the risks of this process. To determine the qualitative indicators of cooperation and their compliance with the results obtained, Google Trends suggests using a scoring matrix approach for assessing the corresponding risk, which includes elements of linguistic scaling.

5. Risk components of joint relations of enterprises (method 2)

To determine the criteria for assessing the risk of cooperative ties between enterprises, it is necessary to consider the stages of the formation of a cluster structure that precede the merger. In the scientific literature, said the risks of cooperation arise at the stages: choosing partners, planning and implementing a cluster project, assessing the cluster synergy, making a decision to form a cluster. Each stage is accompanied by risks inherent only in certain processes of interaction between the two partners. In the study of O. Palyvoda [20] The system of certain risks within the presented clusters (Table 1), requiring linguistic generalization in order to be further used in the processes of direct evaluation of compounds. The list of risks is not exhaustive and can be constantly updated depending on the current aspects of economic development, but any changes will not significantly affect the logic of generalization.

Table 1
Generalization of components of cooperative risk

Stages of cluster structure formation			
Choice of partners	Planning and implementation of a cluster project	Estimation of cluster synergy	Making a decision to form a cluster
Specific risks			
– the risk of choosing partners with incompatible	– the risk of unilateral use of cooperation; - the risk of dependence on	- the risk of collecting inaccurate information about the results of	- risk of cluster identification; - risk of

business models; partners; cluster interaction; assessing the
– the risk of – the risk of losing technological - the risk of using specialization
misunderstanding innovations; inappropriate methods and prospects
the partners place – risk of loss of commercial for assessing the of the cluster;
and role in the information and organizational effectiveness of cluster - the risk of
cluster network; innovations; interaction; assessing the
– the risk of – risk of long-term decision- - lack of qualified existing
mismatch of moral making; analysts on cluster economic
values. – the inability to alternatively cooperation. conditions of
use the resources involved in the cluster;
the cluster project; - the risk of
– the risk of additional costs for finding
the organization of common
communications. interests.

<div align="center">Maximum negative risk</div>

Risk of partnership incompatibility	The risk of dependence on communication	Risk of dishonesty	Risk of lack of prospects for cluster development

Source: summarized on the basis of [20]

Thus, as can be seen from Table 1, all specific risks can be summarized according to the key direction of probable losses at the stages of cluster formation, which allows to characterize the criteria for further assessment, which underlies the scoring matrix approach to cooperative risk.

6. Unified matrix approach to determining the probability of losses in the event of cooperative risk of the enterprise

The unified matrix approach is a risk scoring method that takes into account not only the impact of cooperative risks, but also the likelihood of such risks occurring if agreements between partners are not fulfilled. In 2020, the Ministry of Finance of Ukraine approved the methodological manual "Risk-oriented planning of internal audit activities" [21], which actually provides recommendations for assessing any risks of enterprises in probability and impact, taking into account linguistic means of visualization. To achieve the objectives of the study, it is proposed to adapt the process of assessing the cooperative risk to the conditions of this methodology. So, taking into account the criteria of cooperation risk defined above, the level of its influence on the prospect of clustering (**low, medium, high and very high**) is determined. This unified way, the level of risk is determined by assigning an appropriate score to it (Table 2).

Table 2
Determining the levels of risk of enterprises on the formation of cooperative relations

Determination of levels (points) for criteria for determining cooperation risk				
Level (point)	Risk of partnership incompatibility	The risk of dependence on communication	Risk of dishonesty	Risk of the prospects for the development of the cluster
low (1)	Business models of partners coincide, they have the same	Partners do not depend on each other, cooperation is	The information about the cooperation really	The cluster has a wide range of prospects, partners

	roles and ethical values, which has a positive impact on the development of the partnership	beneficial to both parties, outflow of resources does not occur, cooperation does not require significant costs	reflects its results, the interaction is effective, the analytical reports are conscientious and meet the goal	have common interests, economic conditions for joint development are favorable
medium (2)	Business models of partners are similar, roles are the same or close in importance, ethical values almost coincide	There is a slight dependence between the partners, the level of profitability of cooperation between them is maintained, a small outflow of resources and costs of cooperation	Expected results from cooperation are a bit high, the efficiency of interaction is too low, reports are bona fide	The cluster has narrow-minded prospects, the interests of the majority of partners coincide, the economic conditions for the development of interaction are acceptable
high (3)	Business models are different, the roles of partners do not match. Ethical values vary	The level of dependence of partners is constantly increasing, cooperation is beneficial only to one partner, there is an outflow of resources, cooperation requires costs	Information about cooperation calls into question the overestimated effectiveness of interaction, which is reflected in false analytical reports	The cluster has no clear prospects, the interests of partners are different, but have common ground, economic conditions are unstable
very high (4)	Business models are incompatible, the roles of partners differ significantly. The ethical beliefs of each participant contradict each other	There is a dependence of partners on each other, cooperation is not mutually beneficial, there is an outflow of resources, cooperation requires significant financial costs	Information on the results of cooperation is questionable, efficiency indicators are low, analytical reports do not reflect the real state of cooperation	The cluster has no prospects, partners do not have common interests, economic conditions of cluster development are unfavorable

Source: based on Tables 1 and [21]

As can be seen from Table 2, the discrepancy in the criteria makes it possible to assess the level of impact of cooperation risk on the future partnership, thus presenting it in matrix form by assigning it to a certain quadrant. For clarity of the matrix, it is proposed to supplement it with criteria for the probability of occurrence of the risk of cooperative relations of enterprises. Since the level of risk exposure is determined by 4 components, it is proposed to introduce 4 criteria (Table 3).

Table 3
Determining the levels of probability of cooperation risk of enterprises

Level	Criteria of probability of occurrence cooperation risk	point
Rare / almost impossible	The probability of occurrence is very low (0-24 %)	1
Unlikely	The probability of occurrence is remote (25-50 %)	2
Perhaps	Probability of risk within 1-2 years (51-74 %)	3

Source: [21]

As can be seen from Table 3, each level of probability meets certain criteria, which are assigned an appropriate score, which allows you to adjust the previous estimate, which is presented in Table 2. Overall risk assessment is determined by multiplying the impact assessment and probability estimate as shown in the matrix Ministry of Finance of Ukraine [21] (Figure 5).

Risk assessment matrix						
Level (score)			Probability			
			Rarely / Almost impossible	Unlikely	Probably	Often /expected
			1	**2**	**3**	**4**
INFLUENCE	Low	1	Low (1)	Low (2)	Low (3)	Low (4)
	Medium	2	Low (2)	Low (4)	Medium (6)	Medium (8)
	High	3	Low (3)	Medium (6)	Medium (9)	High (12)
	Very high	4	Low (4)	Medium (8)	High (12)	Very high (16)

Figure 5: Matrix for assessing the risks of cooperative relations of enterprises

As can be seen from Figure 5, risks from levels 1 to 4 are marked in blue and are considered "low" (or acceptable), from levels 6 to 9 - "medium" risks (yellow), with levels from 12 to 16 - " high risks "or" very high "(red and orange). This matrix approach allows for a two-level assessment of the cooperation risk of enterprises, taking into account its impact and probability of occurrence for the organization. Further, to test the effectiveness of the method, it is proposed to conduct a risk assessment for pre-selected enterprises that are promising for cooperation and membership in existing regional clusters.

7. Risk assessment of cooperation relations of regional perspectives (experiment)

Assessment of the impact and probability of assigning points can be done in different ways, but each of them is based on an individual survey as a tool for collecting information. Thus, in order to assess the risk of the priority Kommunar Corporation as enterprise of the potential cluster of Kharkiv, an oral survey of representatives of the enterprise was conducted, the results of which are shown in Table 4.

Table 4
Determining the levels of influence of cooperative risk Kommunar Corporation on the association with the regional cluster of Kharkiv

Risk of partnership incompatibility	Risk of dependence on communication	Risk of dishonesty	Risk of lack of prospects for cluster development

The company has similar business models with the members of the cluster (Zaliznychavtomatika, UKRDIPROVAZHMASH, etc.), they have the same role in terms of importance at the level of state strategies	The partnership does not provoke dependence, but only creates additional opportunities for earnings for Kommunar Corporation, resource outflow, including financial will not happen, because the cooperation will be carried out on the terms of mutual guarantees in the cluster	Preliminary assessment of the cooperation confirms the good faith intentions of the contractors	Perspective Kommunar Corporation partners have identical interests that can be expressed in joint projects, although the economic conditions for the development of cooperation are unstable
Low (1)	Low (1)	Low (1)	Average (2)

Source: compiled by the authors

The risk levels listed in Table 4 indicate the low impact of the criteria on the possible cooperation of Kommunar Corporation with the members of the regional cluster. According to only one criterion, the respondents had doubts about the smooth integration, which was reflected in the risk assessment - average. This score is associated with the unstable economic situation in the country, which provokes additional risks of partner companies. The next step in the matrix approach, as already mentioned, is to assess the probability of risk, which is presented in Table 5.

Table 5
Determining the levels of probability of cooperation risk Kommunar Corporation at the merger with the regional cluster of Kharkiv

Risk of partnership incompatibility	Risk of dependence on communication	Risk of dishonesty	Risk of lack of prospects for cluster development
Unlikely (2)	Rare (1)	Possible (3)	Possible (3)

Source: compiled by the authors

As can be seen from Table 5, the probability of occurrence of different evaluation criteria has a discrepancy, covering the range from 1 point to 3. Opinions of experts in the survey coincide. According to them, the most probable aspects that negatively affect cooperation may be the fleeting economic conditions in the country and the dishonesty of partners in providing reliable information on the results of cooperation.

Thus, by multiplying the two tables 4 and 5 in pairs, you can determine the total number of points by criteria and the quadrant of the matrix of risk assessment of cooperation (Table 6).

Table 6
Risk assessment matrix of Kommunar Corporation cooperation

Risk of partnership incompatibility	Risk of dependence on communication	Risk of dishonesty	Risk of lack of prospects for cluster development

| Low (2) | Low (1) | Low (3) | Average (6) |

Source: compiled by the authors

As can be seen from Table 6, the overall assessment of the level of risk indicates the possible cooperation of Kommunar with members of the Kharkiv regional cluster. Moreover, the low level of 3 of the 4 criteria suggests that cooperation is mutually beneficial for both Kommunar and their promising partners. The only obstacle remains the unstable economic situation, which could significantly change the course of the partnership. However, Kommunar's readiness to cluster under such conditions is obvious, which allows further promotion of this idea to the media space of potential participants in the cooperation.

8. Conclusions

The results of the assessment of the level of risk of cooperation of «Kommunar Corporation» with promising partners of the Kharkiv regional cluster completely coincide with the conclusions on public interest requests in Google Trends, which is a tool of computational linguistics that helps integrate statistics to potential users. That is, we can conclude that Google Trends is a relevant tool for assessing the interest in cooperation, which can reflect the main trends in the relevant industry selected for analysis. The demand for certain requests characterizes the real-time state of affairs for companies that aim to expand their own prospects for partnership.

The results obtained to determine the risks of cooperative relations of enterprises were based on the technology developed by the authors of processing quality information with widespread use of methods of using linguistic information, which is important for forming the preconditions for decision-making in the economy.

The practical significance of this research lies in the developed approach and the actual experiment based on multi-step transformations: using the online Google Forms for the survey, applying the hierarchy method, determining interest in Google Trends tools, building linguistic scales, combining the results of each step to confirm economic decision in the potential construction of cooperative ties of the cluster at the regional level in the priority development zone of Industry 4.0 of the industrial region of Ukraine.

The developed technology in further research can be used to achieve the goals of computational linguistics in terms of improving the processing of user requests on the Internet and to conduct a more in-depth analysis of the terms that precede any research in economics. To more deeply determine the state of enterprise cooperation, research can be scaled up by regions of Ukraine or in the global European space. Also, to understand the place of each studied object in the risk zone and to determine possible trends in the transition from one risk zone to another, it is possible to supplement the study with similar calculations in the dynamics.

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