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ANALYSIS OF COMMUNITIES AND GROUPS IN SOCIAL NETWORKS AS A SIGNIFICANT FACTOR OF INFLUENCE ON CRYPTOCURRENCY RATES

Currently, most existing cryptocurrency exchanges do not have tools in their arsenal that would allow them to verify and investigate information disseminated on social media regarding a particular cryptocurrency. This allows to conduct research with the subsequent development of an appropriate tool that, if used correctly, will provide users with recommendations on how to proceed with the cryptocurrency under investigation. Based on this advice, interested parties will be able to adjust their decisions regarding further financial steps. As part of this task, it is important to choose a social network that would best meet the requirements, as this is what determines the impact of celebrity publications on the formation of prices for a particular cryptocurrency at a certain point in time. The importance and existence of this influence has been previously proven by statistical methods. The **purpose of the study** is to identify and analyse the key aspects when choosing social networks for further monitoring of social groups in order to analyse the impact of posts on the course of the chosen cryptocurrency. The object of the **study** is social networks. A set of selection criteria, coefficients of their importance, and statistical data on the selected social networks were used as input data, on the basis of which the values of the alternatives (social networks) will be obtained. The objective of the **study** is to evaluate and rank social networks in order to choose the one that will best meet the specifics of analysing the impact of social media posts on the cryptocurrency rate. **Research methods.** The ranking of social networks was carried out by the value of the value function of alternatives, calculated using the linear convolution method. **Results.** As a result of the research, an algorithm has been developed that allows analysing the selected social networks for their compliance with the formulated criteria. The results of the experiment with the selected social networks were presented. As a result, a ranked list of them is obtained. Based on the results obtained, the authors will develop an information technology for determining the impact of posts of famous people in social networks on cryptocurrency rates.

Keywords: cryptocurrency rate; social media; decision maker; importance coefficients; scaling; evaluation of alternatives; criterion value function; social media ranking; information technology.

1. Introduction

The cryptocurrency exchange rate is the result of the interaction of various factors, which may include technical, economic, political and other aspects.

In particular, some of the main factors that can influence the cryptocurrency rate are:

Popularity and usage: The growing popularity and support of a cryptocurrency among users, investors, and businesses can lead to an increase in its price.

Regulation and legislation: Changes in the regulation of the cryptocurrency market, including bans or regulations from governments, can affect the credibility of a cryptocurrency and its price.

Technical updates and events: Technical updates, developments, and other events in the development of blockchain technologies and cryptocurrencies may affect their price.

Events in the traditional finance market: Economic crises, changes in exchange rates, gold prices, and other factors in the traditional finance market can affect the price of cryptocurrencies.

Media reports and public opinion: News, articles, and messages in the media and social media about cryptocurrencies can affect public perception and, consequently, the price.

Large transactions and volatility: Large transactions and significant price changes can cause a lot of volatility in the cryptocurrency price.

Technical analysis and trading: Technical analysis, as well as trading and speculation in the cryptocurrency market, can influence the course through traders' trading actions and strategies.

Due to these various factors, the cryptocurrency rate can experience significant fluctuations in the short and long term.

The process of choosing the "right" social media for the study of social groups is essential in the context of the topic of researching the impact of expert publications on cryptocurrency rates. Currently, social networks are one of the most powerful tools for analyzing social groups, as they provide access to a current, large amount of data, such as information about communication, interests, and behavior of users. Choosing the "right" social media platforms is a key step in conducting social

group research because of their significant impact on the research results. Choosing the "wrong" platform can lead to incomplete or even distorted data, which will negatively affect the objectivity and reliability of the results. It is also important to take into account the peculiarities of each social network selected for the study, such as the composition of the audience, types of communication, mechanisms of information dissemination, and others. Such an analysis allows you to choose the platforms that best meet the research objectives and ensure maximum efficiency of social group analysis.

The aim of this study is to identify and analyze the key aspects when choosing social networks for further monitoring of social groups as part of the analysis of such a significant factor of influence on the course of the chosen cryptocurrency as posts in them.

In particular, these aspects include:

- Availability and volume of data in social networks,
- Representativeness of the audience and its characteristics,
- Methods and tools for analyzing social media,
- Criteria for evaluating the effectiveness and practicality of platforms,
- Contextual factors that influence the choice of social media,
- Practical recommendations for choosing and using social media in the study of social groups.

According to the goal, the objectives of the study are to evaluate and rank social networks in order to choose the one that best suits the specifics of analyzing the impact of social media posts on the cryptocurrency rate.

2. Literature review

Nowadays, the analysis of publications on the Internet is very important, as it allows to obtain a large amount of information about the moods and intentions of users.

Paper [1] discusses the process of computer detection and categorization of opinions expressed in a piece of text to determine whether the author's attitude toward a particular topic, product, etc. is positive, negative, or neutral. A detailed study of the analysis of temporal sentiment and the cause-and-effect relationship of sentiment. Using this analysis, we can find out the generalized event based on the mood and time. On the other hand, the use of causality will be useful not only for determining the causes and effects,

respectively, but also for their further forecasting. The main part of the publication is a review of the combination of these two approaches, which degenerates into a model that allows you to determine the mood for future events, as well as create a time forecast for the time that will pass between certain events. The following parameters were used to assess accuracy: mean absolute error and root mean square error.

To view publications, you need to choose a place where there are the most of them and they are in a single text format, for this purpose Twitter is a good messenger, work [2] describes in detail the special linguistic analysis and statistics of Twitter. This study aimed to identify criminal elements in the United States by modeling topics of discussion and then incorporating them into a crime prediction model. Thus, a study was conducted on the impact of social media posts on future crimes.

In [3], methods for predicting user ratings of individual items using probabilistic algorithms were considered. In fact, the article perfectly illustrates the existence of computational patterns regarding what network users will like under certain circumstances. In other words, this study emphasizes the impact of probabilistic algorithms in the field of recommender systems, and provides an overview of key methods that have been successfully applied. The considered algorithms for object classification allow solving the problem of predicting user evaluation of content and its categorization, as well as improving existing methodologies for building information systems.

Work [4] considered a comprehensive reference for researchers and practitioners, as well as covering all areas that contribute to the construction and analysis of social networks.

Paper [5] is quite relevant today due to the difficult epidemiological situation in the world. It analyzed microblogs on Twitter and proposed several methods for reliable classification of tweets based on their sentiment and data visualization using an interactive map in real time.

The paper [6] identified individuals who influence knowledge sharing processes through an internal social network and predicted future knowledge flows that may cross it. The authors use exploratory research and develop a four-phase methodology that combines social network analysis with structural modeling.

The article [7] discusses the expanded use of social media in society and its significant impact on organizations' financial performance and market share. It describes how social media communities influence broader financial trends.

Paper [8] presents a study of user adoption of a hypothetical social network-backed cryptocurrency in Central Europe, which provides insight into how social media communities can influence cryptocurrency markets.

Paper [9] describes the role of brand connectivity in engaging consumers in social media brand communities. It presents the results of a study on how strong community ties can influence consumer behavior, which can potentially be applied to cryptocurrency communities.

Paper [10] presents the results of a study of the role of social community members in the formation and increase of digital assets existing in the blockchain.

All of these works demonstrate the important role of posts on social networks as a means of shaping the opinions of social community members regarding a particular problem, in particular the situation in the cryptocurrency market.

In works [11–13], the authors of this paper analyzed the level of influence of posts by famous personalities in social networks on the course of the chosen cryptocurrency using statistical and probabilistic methods. As the results of the study show, the ATAPSN algorithm and its modifications proposed in these articles allow for a more accurate forecast of the cryptocurrency rate than classical time-series algorithms, which do not allow for the assessment of the influence of this factor. According to the above studies, it can be stated that the posts of famous personalities for a short period of time to some extent affect the rate of the chosen cryptocurrency due to the fact that they can shape the opinion of their numerous subscribers on issues that directly or indirectly relate to this cryptocurrency. The level of their influence depends on the criteria for selecting these individuals, which are presented in the paper [14].

The analyzed articles do not provide a methodology for analyzing social networks in order to choose one that would best suit the specifics of studying the impact of posts on it on the rate of the chosen cryptocurrency. This task, according to the authors, has not been sufficiently studied. That is why this paper is devoted to it.

3. Social media selection criteria

To solve the problem of choosing the most suitable social network, the following criteria were formulated:

Criterion 1: Data availability and volume

1) The volume of users and platform activity: One of the key criteria is the number of active users and their activity on the social network. The more users and

the more actively they interact on the platform, the more data is available for analysis.

2) Variety of content and formats: It's important to keep in mind that different social networks have different types of content (texts, photos, videos, audio, etc.). Evaluating the variety of content will help determine how much and what types of data can be extracted from a particular platform.

3) Data retrieval capabilities: Before selecting a social network for analysis, it is important to determine whether there are opportunities to extract data from it. Some platforms provide APIs for data retrieval, while others may prohibit the collection of information directly from the platform.

4) Access to historical data: For a deeper analysis of social groups, it may be important to have access to historical data to study the dynamics of changes over time.

5) Availability of additional analysis tools: In addition to the platform itself, it is also important to assess the availability and level of development of data analysis tools on a particular platform. The availability of tools for collecting, processing, and visualizing data will greatly simplify the research process.

Criterion 2: Audience and its representativeness

1) Demographic characteristics of users: It is important to consider the demographic characteristics of the social media audience, such as age, gender, geographic location, social status, etc. This data will help to draw conclusions about the representativeness of the audience and its relevance to the chosen research topic.

2) User interests and behavior: Analyzing user interests and behavior will help you understand whether the platform's audience meets the research objectives. For example, if the research is aimed at analyzing political opinions, it is important to choose a platform where users actively discuss political issues.

3) Audience activity and interaction: To ensure the representativeness of the study, it is important that the platform's audience is active and interacts with each other. A high level of activity indicates user engagement and the possibility of obtaining more data for analysis.

4) Behavior towards publications and interaction with content: Analyzing audience reactions to posts and their interaction with content (likes, comments, reposts, etc.) will help you understand how actively the audience perceives and interacts with information. This is important for assessing the impact of the platform on social groups and their activity.

Criterion 3: Data analysis and processing capabilities

1) Availability of APIs and tools for data retrieval: It's important to check whether the platform provides access to its API for data retrieval. An API allows you to automate the data collection process and gain access to a variety of information about users and their interactions.

2) Data filtering and sorting capabilities: Some social media platforms provide advanced features for filtering and sorting data by various parameters such as date, location, content type, etc. This allows for more precise and specific analysis.

3) Data visualization capabilities: It is important that the platform provides the ability to visualize the data in a convenient and understandable way. Graphs, charts, and other visual elements will help make the analysis more informative and understandable.

4) Support for programming languages and analytical tools: Some social networks provide support for different programming languages and analytical tools, which simplifies the process of data processing and analysis.

5) Opportunities for machine learning and text analysis: It is important to consider the availability of tools for applying machine learning and text analysis methods to the data. This will allow you to draw deeper and more comprehensive conclusions from the collected data.

Criterion 4: Specification of the platform and its tools

1) Availability of data analysis functions: You need to check what specific data analysis features the platform provides. This may include audience statistics, tools

• each of the l factors that describe a particular criterion is assigned a numerical indicator $x_{ij}^k, k = \overline{1, l}$ – the value of the alternative a_i assessment according to the k -th factor of the j -th criterion.

$$x_{ij} = \begin{cases} 0, & \text{low level of compliance with the criterion } j, \\ 0,5, & \text{sufficient level of compliance with the criterion } j, \\ 1, & \text{high level of compliance with the criterion } j; \end{cases} \quad (1)$$

$$x_{ij}^k = \begin{cases} 0, & \text{low level of compliance with the factor } k, \\ 0,5, & \text{sufficient level of compliance with the factor } k, \\ 1, & \text{high level of compliance with the factor } k; \end{cases} \quad (2)$$

• a set of l numbers $(\omega_j^1, \dots, \omega_j^l)$, that meet the criteria for evaluating the k -th factor of the j -th criterion and determine the preferences of the decision maker for each criterion (hereinafter referred

for analyzing audience interaction, filtering and sorting data, etc.

2) Monitoring and trend analysis capabilities: It is important that the platform provides the ability to monitor and analyze trends in communication and posts on the platform. This allows you to identify and respond to trending topics.

3) Level of data security and privacy: Equally important is the specification of the level of data security and privacy on the platform. You need to make sure that the platform complies with the relevant security and personal data protection standards.

4. Method for selecting and evaluating social networks**4.1. Statement of the task**

Let there be given:

• a set of acceptable alternatives $A = \{a_1, a_2, \dots, a_n\}$ (of the considered social networks), which are evaluated according to m criteria (see Section 3);

• each alternative $a_i, i = \overline{1, n}$ m numerical indicators are set in line with each other x_{i1}, \dots, x_{im} , where $x_{ij}, j = \overline{1, m}$ – value of the alternative evaluation a_i according to j -th criterion.

It should be noted that in order to determine the indicator x_{ij} , it is necessary to choose an appropriate rating scale. It is usually chosen at the discretion of the decision maker. In particular, the following rating scale was used in this paper:

It should be noted that to determine the indicator x_{ij}^k it is also necessary to choose an appropriate evaluation scale:

to as the weighting factor of importance of the factor ω_j^k);

• a set of m numbers $(\omega_1, \dots, \omega_m)$, that meet the criteria for evaluating alternatives and determine the

preferences of the decision maker for each criterion (hereinafter referred to as the weighting factor of the importance of the criteria ω_j).

Then the decision maker's task is to choose an alternative $a_i A$ so as to maximize the value function v_i represented by the following expression:

$$v_i = \sum_{j=1}^m \left(\sum_{k=1}^l x_{ik}^k \omega_{ij}^k \right) \omega_j, \quad (3)$$

or

$$v_i = \sum_{j=1}^m x_{ij} \omega_j, \quad (4)$$

where

$$x_{ij} = \sum_{k=1}^l x_{ik}^k \omega_{ij}^k, \quad (5)$$

$$\sum_{k=1}^l \omega_{ij}^k = 1, \quad (6)$$

$$\sum_{j=1}^m \omega_j = 1. \quad (7)$$

where $\omega_{ij}^k \in [0;1]$, $\omega_j \in [0;1]$.

Based on the obtained values of the value functions v_i , it is necessary to rank the alternatives in order to determine the social network that best meets the needs of the study – assessing the impact of posts by famous people in a social network on the rate of the chosen cryptocurrency.

4.2. Justification

To calculate the indicators x_{ij}^k or x_{ij} . It is important to choose a scale on which to evaluate the factors or criteria. For example, you can choose a 5, 10, 12, or 100-point scale. Fractions from the range $[0;1]$ or their percentage equivalents can also be used as scores. The chosen scaling should meet the needs of the decision maker and be consistent across all indicators.

It should also be noted that the weighting of the importance of factors and criteria ω_{ij}^k , ω_j (see formulas (3)–(5)) can be chosen at the discretion of the decision maker. They can also be determined by:

1) statistical methods, in particular by calculating paired Pearson correlation coefficients,

2) in the process of calculating the coefficients of a multivariate regression model.

In addition, they can be identified by means of data mining. In particular:

PageRank: One of the most famous algorithms for determining influential users on social media. PageRank

determines a user's influence based on the number and quality of connections they have with other users. For example, on Twitter, PageRank can identify users with a large number of followers and their activity on the network.

HITS (Hyperlink-Induced Topic Search): This algorithm determines the influence of users based on two parameters: hubs and influencers. Hubs are users who have a lot of outbound connections, i.e. many links to their pages. Influencers are users who have a lot of inbound links, i.e. many links to their pages. This algorithm can be useful for identifying experts in a particular topic.

Centrality Measures: These metrics measure the degree of centrality of users in the network. For example, Betweenness Centrality measures the number of shortest paths between all pairs of users that pass through a given user. The more such paths, the greater the centrality of the user.

Sentiment Analysis: This tool is used to determine the mood or emotional state of users in relation to a particular content or topic. For example, it can identify users who have a negative or positive attitude toward a particular product or service.

In this study, the linear convolution method was used as a method for evaluating social networks [15–16]. The value functions for each alternative were calculated according to formula (3) or (4), where the scaling given in formulae (1) and (2), respectively, was used to calculate the indicators x_{ij} or x_{ij}^k . This scaling was chosen for reasons of simplification of calculations and it allows to achieve the desired results, which was established by the authors of the paper experimentally. The weighting coefficients of the importance of the factors and criteria ω_{ij}^k were established by the authors of the paper in accordance with the needs of the study.

According to the description of the criteria presented in Section 3 and the task statement (see Section 4.1), the following tables were formed for each alternative (social network) a_i :

Table 1. Criterion 1: Data availability and volume

k	Criterion 1 Factor	x_{i1}^k	ω_{i1}^k
1	Volume of users and platform activity	x_{i1}^1	ω_{i1}^1
2	Variety of content and formats	x_{i1}^2	ω_{i1}^2
3	Opportunities to obtain data	x_{i1}^3	ω_{i1}^3
4	Access to historical data	x_{i1}^4	ω_{i1}^4
5	Availability of additional tools for analysis	x_{i1}^5	ω_{i1}^5

Table 2. Criterion 2: Audience and its representativeness

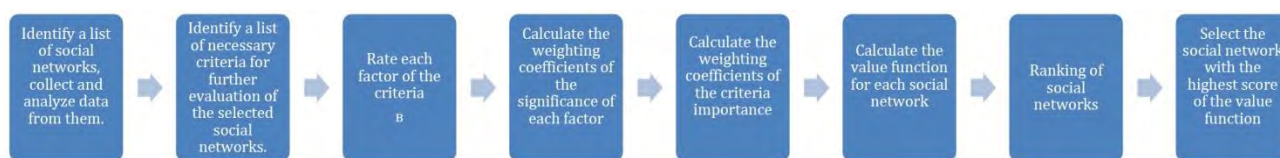
k	Criterion 2 Factor	x_{i2}^k	ω_{i2}^k
1	Demographic characteristics of users	x_{i2}^1	ω_{i2}^1
2	Interests and behavior of users	x_{i2}^2	ω_{i2}^2
3	Audience activity and interaction	x_{i2}^3	ω_{i2}^3
4	Behavior towards publications and interaction with content	x_{i2}^4	ω_{i2}^4

Table 3. Criterion 3: Data analysis and processing capabilities

k	Criterion 3 Factor	x_{i3}^k	ω_{i3}^k
1	Availability of APIs and tools for data retrieval	x_{i3}^1	ω_{i3}^1
2	Possibilities of data filtering and sorting	x_{i3}^2	ω_{i3}^2
3	Data visualization capabilities	x_{i3}^3	ω_{i3}^3
4	Support for programming languages and analytical tools	x_{i3}^4	ω_{i3}^4
5	Opportunities for machine learning and text analysis	x_{i3}^5	ω_{i3}^5

Table 4. Criterion 4: Specification of the platform and its tools

k	Criterion 4 Factor	x_{i4}^k	ω_{i4}^k
1	Availability of data analysis functions	x_{i4}^1	ω_{i4}^1
2	Opportunities for monitoring and trend analysis	x_{i4}^2	ω_{i4}^2
3	Level of data security and confidentiality	x_{i4}^3	ω_{i4}^3

**Fig. 1.** Diagram of the proposed algorithm

4.3. The results obtained

As a result of the experiment, 5 major social networks were considered: Facebook, Telegram, Instagram, X, Tik Tok. Each of them was analyzed according to the following algorithm. As a result, the following ranked list was generated:

Table 5. Evaluation of the value function for selected social networks

i	Name of the network	v_i
1	Telegram	0,975
2	X	0,61
3	Facebook	0,58
4	Instagram	0,545
5	Tik Tok	0,445

On the basis of Tables 1–4 and formulas (2), (3), (6), we determine the alternative with the highest value of the value function.

Thus, in the framework of the study, the following algorithm for evaluating social networks was proposed:

Step 1: Determine the list of social networks, collect and analyze data from them.

Step 2: Determine the list of necessary criteria for further evaluation of the selected social networks.

Step 3: Based on the collected statistical data, assign scores x_{ij}^k to each factor of the criteria under consideration according to the defined evaluation scale (see formula (2)).

Step 4: Calculate the importance weights of each factor ω_{ij}^k (see formula (6)) based on the preliminary analysis of the statistical data.

Step 5: Calculate the importance weights of the criteria ω_j (see formula (7)).

Step 6: Calculate the value function v_i for each social network (see formula (3)).

Step 7: Rank the social networks according to the obtained values of the corresponding value function.

Step 8: Select the social network with the highest value of the value function as the most suitable for research.

Fig. 1 shows a diagram of the proposed algorithm.

Therefore, in the future, the authors will use the Telegram network to study the impact of celebrity posts on social networks, as it has the highest value function within the framework of the criteria under consideration.

5. Conclusions

In this paper, we propose one of the possible methods of analyzing social networks for compliance with all the requirements for studying the impact of posts on them on the rates of the chosen cryptocurrency. The algorithms for assessing this influence and the criteria for selecting famous personalities are presented in the authors' previous works [11–14].

In this paper, the linear convolution method was used as a method for evaluating social networks, as it is the simplest and most intuitive of all possible approaches. In addition to the proposed method, it is also possible to use such methods as the hierarchy analysis method (HAM) and the TOPSIS method.

One of the most important tasks within the proposed method is the selection of evaluation criteria. Depending on their choice, the results of the analysis of the same social networks can be completely different. When forming the list of criteria, the role of the decision maker is crucial.

The role of the decision maker is important for obtaining the weighting coefficients of the importance of factors and criteria ω_{ij}^k , ω_j . They can also be determined by statistical methods, in particular, using Pearson correlation coefficients, or in the process of calculating the coefficients of a multivariate regression model. In addition, they can be determined by means of data mining. It should be noted that, depending

on the priorities of the decision maker or the quality of the input statistical data, different values for these coefficients are possible.

To calculate the indicators x_{ij}^k or x_{ij} , it is important to choose a scale on which to evaluate the factors or criteria. In particular, a 5, 10, 12, or 100-point scale can be selected. Fractions from the interval $[0:1]$ or their equivalents in percentage terms can also be selected as scores. The chosen scaling should meet the needs of the decision maker and be consistent across all indicators.

The correctness of the obtained results was verified experimentally.

The proposed algorithm is universal and can be used to analyze social networks for compliance with the criteria of any study based on statistical data obtained from them.

In the future, the results of this study will be used to create an information technology for determining the impact of social media posts on cryptocurrency rates.

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АНАЛІЗ СПІЛЬНОТ І ГРУП У СОЦІАЛЬНИХ МЕРЕЖАХ ЯК ЗНАЧУЩОГО ФАКТОРА ВПЛИВУ НА КУРСИ КРИПТОВАЛЮТ

Нині більшість криптовалютних бірж не мають у своєму арсеналі інструментів, що дали б змогу перевірити та дослідити інформацію, яка поширюється в соціальних мережах про ту чи іншу криптовалюту. Це дозволяє проводити дослідження з подальшим розробленням відповідного інструменту, який за умови коректного використання надаватиме користувачам рекомендації щодо подальших дій у системі криптовалюти. Грунтуючись на цих порадах, зацікавлені особи зможуть коригувати свої рішення щодо фінансових кроків. У межах цього завдання важливим є вибір соціальної мережі, яка б максимально відповідала поставленим вимогам, оскільки саме від цього залежить вплив публікацій відомих осіб на формування цін за певну криптовалюту в конкретний момент часу. Важливість і наявність цього впливу було доведено раніше статистичними методами. **Метою дослідження** є ідентифікація та аналіз ключових аспектів у виборі соціальних мереж для подальшого моніторингу соціальних груп у межах аналізу впливу дописів у них на курс обраної криптовалюти. **Об'єктом вивчення** є соціальні мережі. Як вхідна інформація застосовувалися набір критеріїв відбору, коефіцієнти їх важливості, статистичні показники про обрані соціальні мережі, на основі яких будуть отримані значення оцінок альтернатив (соціальних мереж). **Завдання дослідження:** оцінювання та ранжування соціальних мереж з метою вибору такої, що максимально відповідатиме особливостям аналізу впливу дописів у соціальних мережах на курс криптовалюти. **Методи дослідження.** Ранжування соціальних мереж здійснювалося за значенням функції цінності альтернатив, що обчислювалися за допомогою методу лінійної згортки. **Досягнуті результати.** У процесі проведених досліджень розроблено алгоритм, який дає змогу проаналізувати обрані соціальні мережі щодо їх відповідності сформульованим критеріям. У статті подано результати експерименту з обраними соціальними мережами. Унаслідок отримано їх ранжований список. На основі досягнутих результатів автори роботи сформували інформаційну технологію визначення впливу дописів відомих людей у соціальних мережах на курси криптовалют.

Ключові слова: курс криптовалюти; соціальні мережі; особа, що приймає рішення; коефіцієнти важливості; шкалювання; оцінки альтернатив; функція цінності критерію; ранжування соціальних мереж; інформаційна технологія.

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