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Information system for selection the optimal goods supplier

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Abstract

Today there is a wide variety of similar products in the market that are usually offered by several suppliers. This leads to the need to analyze the market and to solve the problem of finding the best goods supplier that would satisfy all necessary consumer requirements. The study is devoted to the web-based information system development for selecting the optimal supplier among those who are located on the AliExpress trading platform under multicriteria conditions. The optimal supplier selection is carried out with the Analytic hierarchy process method considering the priority of the evaluation criteria for the consumer. The suppliers are evaluated by the complex indicator of supplier's competitiveness which is calculated by developed mathematical model.
The main functions of the proposed information system are the follows: goods selection, the forming a set of alternatives which consist from all suppliers, the evaluation of alternatives by eight independent criteria, the calculation the complex indicator of supplier's competitiveness, the forming of a good's supplier's rating. It allows to find the best goods' supplier providing data on calculated suppliers rating and current prices.

Keywords: Information system; Optimal supplier selection; Multicriteria decision making

1. Introduction

The necessity to obtain high quality goods at minimal cost is essential for any customer whether it is a company or an individual client. It determines the relevance of improving the purchasing process connected with the problem of searching for the optimal supplier.

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The optimal supplier selection is the most important activity of a purchasing department among the tasks of supply chain management. It is complicated process which consist of stages: supplier identification, supplier evaluation, gaining supplier feedback, developing business partnerships. The supplier's evaluation is performed by several criteria such as product price, supplier reliability, delivery timeliness, customer service quality during the supply process, supplier position on the market etc. These criteria may be quantitative and qualitive and vary for particular decision-making task [1]. Hence, the right supplier selection is a multi-criteria problem process encompasses different factors impact on potential supplier assessment by purchaser. Solution of this task requires appropriate information base with supplier's characteristics. In the case of past cooperation with the supplier, there is an opportunity to evaluate the supplier from their own experience. If there is a search for a new supplier, the selection process becomes quite complicated due to lack of information for making decision.

Nowadays the popularity of e-trading is rapidly growing. People prefer to purchase goods via Internet while spending a lot of time looking at dozens of websites to find necessary goods. There are large e-trading platforms on which thousands of suppliers propose their goods. One of the most popular online markets is AliExpress, a global online retail marketplace of Chinese e-commerce giant Alibaba. Online trading is associated with risks for purchasers. Usually online purchaser is required to pay first before the goods are delivered. Moreover, the goods selection is carried out solely based on the description provided by the supplier. Therefore, the issue of selection goods supplier when trading on the Internet is current interest. AliExpress trading platform provide information that can assist to make right decision on supplier selection. On the page Seller Feedback it demonstrates seller ratings and detailed feedback history including positive and negative feedbacks. This information is usually enough to estimate how long the seller has been on the market and what progress the seller has achieved, whether this particular person is reliable or not. Considering a large number of sellers on AliExpress, it is complicated task to analyze a huge data amount concerning their rating manually. Thus, it is necessary to provide special tool for automatization the process of supplier selection.

The aim of the study is to develop an information system for making decision support on selection the optimal goods supplier on AliExpress trading platform.

2. Related work

Selection of suppliers is multi-criteria decision-making task which can be solved by the application of decision support systems (DSS). To help purchasers to make right decisions with respect to supplier selection, the different decision methods have been developed [2]. The methods on the optimal supplier selection and DSS types where these methods can be applied are given in a Table 1.

Table 1. The supplier selection methods.

DSS Type	Methods
Data-driven	Categorical methods
	Data envelopment analysis
	Cluster analysis
Model-based	Operation research
	Analytic hierarchy process
	Analytic network process
	Simulation optimization
	Multi-attribute utility theory
	Fuzzy logic

Data-driven DSS are intended for suppliers' prequalification where the set of all suppliers is divided into several subsets depending on their compliance to purchaser preferences [3]. Categorical methods are based on historical data and may be used for qualitative criteria. Data envelopment analysis system classifies suppliers between two

groups – efficient and inefficient based on two sets of criteria namely outputs and inputs. Cluster analysis divides a set of suppliers which are characterized by a set of quantitative criteria into several clusters [2].

In model-based DSS the operation research branches as mathematical programming includes linear programming, mixed-integer linear programming, nonlinear programming and stochastic programming methods are widely used [4-5]. These methods can be applied for multicriteria decision making tasks, but their main disadvantage is that they are applicable only for quantitative criteria. Given that the criteria for the supplier evaluation can be both quantitative and qualitative, the methods of multi-attribute decision-making are most suitable for solving the problem of choosing the optimal supplier. Multi-attribute decision-making technique includes simple additive weighting method, methods of analytic hierarchy process [6-8], analytic network process [9],combination of analytic hierarchy process with multi-attribute utility theory [10], simulation optimization [11], technique for order preference by similarity to ideal solution, fuzzy decision-making method [12, 13]. This technique is implemented to solve multi-attribute decision making problem uncertain multi-attribute decision making problem when criterions are inconsistent with the other.

To deal with multiple criteria decision-making problems, the first step is to figure out how many criteria exist. The second step is to collect the appropriate data correctly reflected preferences of decision maker. Further work consists in forming a set of possible alternatives. The next step is to evaluate the possible alternatives by appropriate method. As a result, the best alternative or several better alternatives should be presented to decision maker [14].

3. Selection the optimal goods supplier on AliExpress trading platform

The optimal goods supplier selection on the AliExpress trading platform under multicriteria conditions is based on the Analytic hierarchy process method. In a role of experts are users of AliExpress who rated the sellers after the purchase of goods. Alternatives are all sellers of certain good or group of goods of some trade mark who are registered on the AliExpress. Every alternative is estimated by following criteria are listed as the follows:

- Compliance with characteristics and communication
- Sending speed
- Neutral and negative feedback, positive feedback for the month and positive feedback for 6 months
- Number of sales per month and number of sales in 6 months

The pair-wise comparison of the alternatives is performed with respect to the complex indicator of supplier's competitiveness. The model of calculation the complex indicator of supplier's competitiveness is represented by following equation:

$$c_k = \sum_{i=1}^{N} w_i \cdot P_i \tag{1}$$

where w_i – normalized weight of criterion P_i and P_i – normalized value of i-th criterion.

Weight of criterion determines the degree of importance of this criterion for purchaser. It can be set by the following scale: 1 - indifferently, 2- does not matter, 3 - important, 4 - very important, 5 - absolutely important. It needs to be normalized by using the following equation:

$$w_i = \frac{\overline{w}_i}{\sum_{i=1}^{n} \overline{w}_i} \tag{2}$$

where $\overline{w}_i$ – weight of criterion P_i and w_i – normalized weight of criterion P_i.

Values of criteria for evaluating suppliers are calculated by equations (3)-(6).

The calculation of normalized value of criteria P_1 «Compliance with characteristics», P_2 « Communication», P_3 «Sending speed» values is performed by equation:

$$P_i = \frac{Z_i}{5} \tag{3}$$

where P_i – normalized value of criteria P_1/ P_2/ P_3 and Z_i – scores in detailed seller rating from Aliexpress website:

- Position «Item as Described» for criterion P_1
- Position «Communication» for criterion P_2
- Position «Shipping Speed» for criterion P_3

The normalized value of criterion P_4 «Neutral and negative feedback» is calculated by using the following equation:

$$P_4 = \frac{N_{SMT} + N_{SMO}}{N_{SMF} + N_{SMT} + N_{SMO}} \tag{4}$$

where:

- N_{SMT} – number of neutral feedbacks for 6 months
- N_{SMO} – number of positive feedbacks for 6 months
- N_{SMF} – number of negative feedbacks for 6 months

The calculation of normalized value of criteria P_5 «Positive feedback for the month » and P_6 « Positive feedback for 6 months » is performed by using the following equation:

$$P_j = \frac{N_{jMF}}{N_{jMF} + N_{jMT} + N_{jMO}} \tag{5}$$

where:

- P_j – normalized value of criteria P_5/P_6
- N_{jMT} – number of neutral feedbacks for 1 month/6 months
- N_{jMO} – number of positive feedbacks for 1 month/6 months
- N_{jMF} – number of negative feedbacks for 1 month/6 months

Since AliExpress platform does not offer data on the number of sales, it can be determined indirectly through the number of feedbacks. The calculation of normalized value of criteria P_6 «Number of sales per month» and P_6 «Number of sales in 6 months » is performed by using the following equation:

$$P_k = 0.001 \cdot (N_{kMF} + N_{kMT} + N_{kMO}) \tag{6}$$

where:

- P_k – normalized value of criteria P_7/P_8
- N_{kMT} – number of neutral feedbacks for 1 month/6 months
- N_{kMO} – number of positive feedbacks for 1 month/6 months
- N_{kMF} – number of negative feedbacks for 1 month/6 months

The proposed model is implemented in information system for selection the optimal goods supplier from AliExpress. The architecture and main functions of the developed system are described below.

4. Information system for best supplier selection

The system for selection the optimal goods supplier from AliExpress trading platform is built as web-based information system with three tier client-server architecture. Its main components such as users' interface, application server and database server are shown in Fig. 1.

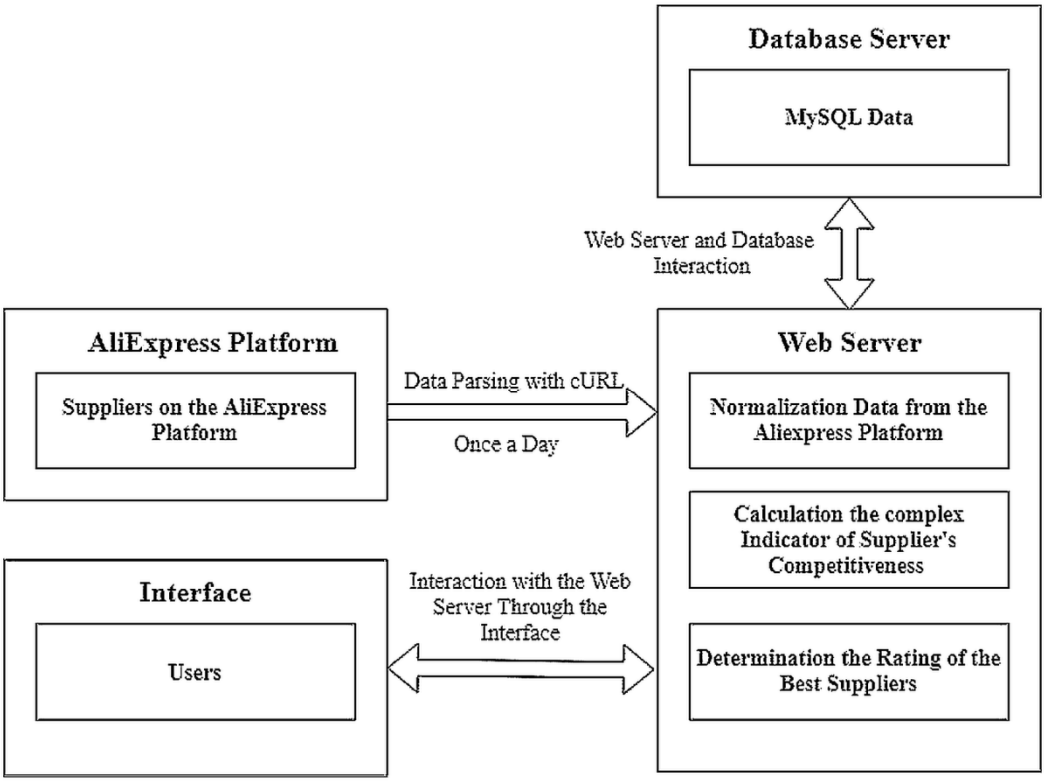

Fig. 1. System architecture.

The application web server realizes the data acquisition from the AliExpress platform, their normalization, calculation the complex indicator of supplier's competitiveness and determines suppliers rating. The results of calculations are displayed via the user-friendly web interface. The database server contains data to calculate the supplier rating used by the web server. The data from the AliExpress platform are gathered by web server through parsing using URL once a day. The system users are clients, system administrator and system manager. Their roles are presented on use case diagram in Fig. 2.

The client has free access to the system, where he can find the required supplier according to the criteria. User capabilities working with the system: submit a request to add new supplier, evaluate criteria for supplier selection by filling the form, view the Top 10 Suppliers, find and view suppliers, view information about the system.

The system administrator has access to all users' functions, as well as the ability to manage data through the admin panel (after authorization) namely add, edit, delete data about categories of goods and suppliers in database and manage all data on website. The system manager using software scripts generates special keys for parser, which once a day gather new data and add them to the database, which allows to have the actual data in the system.

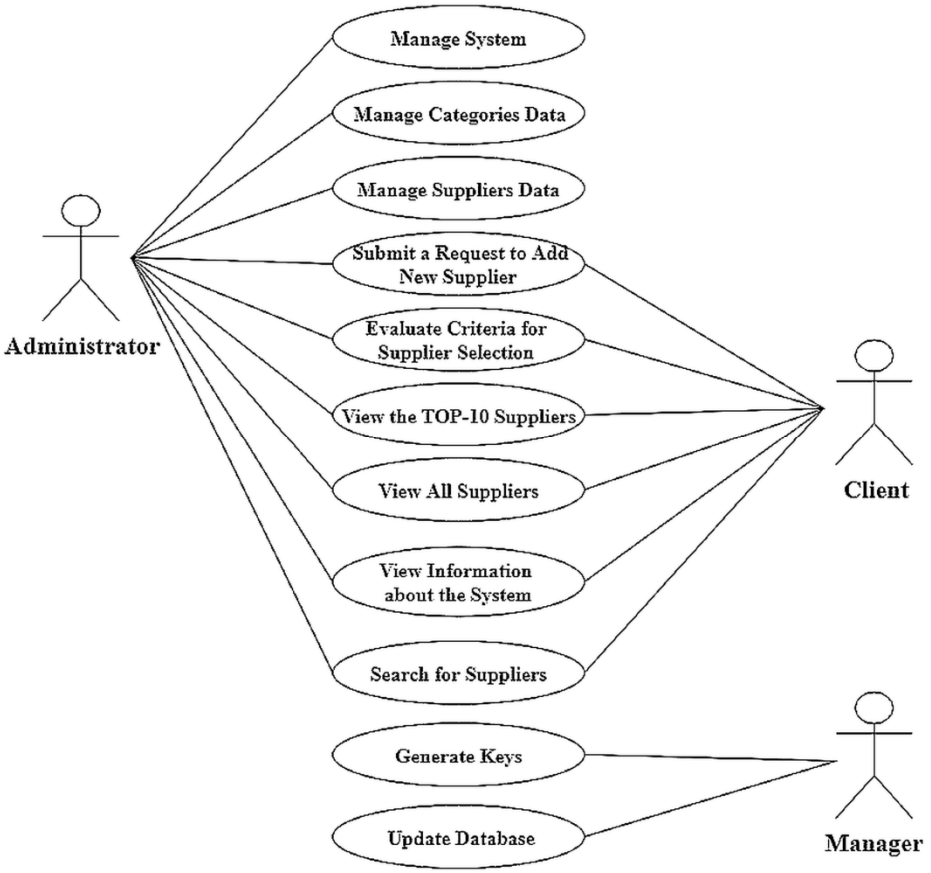

Fig. 2. Use case diagram for the optimal goods suppliers selection information system.

To start working with the information system, the client goes to its homepage in browser. The navigation through system web pages is s carried out using the top and side menu. The top menu of the information system consists of several items. The menu item "Suppliers" is responsible for displaying all the suppliers existing in system with active links to their pages in AliExpress. A menu item "Apply" provides the ability to send an application to the administrator from the supplier to add to system. A menu item "About system" provides brief help on working with the system. A menu item "Home" allows navigation to homepage. In the side menu there is a search block and a block with existing goods. The search allows to find a supplier and short characteristics. In the block with goods the user can choose the necessary good, for instance, product lines of phones, then - phone model.

As a result, the form of evaluating the criteria of suppliers' selection as it is shown in Fig. 3 will be offered. User should fill this form chooses his own attitude towards each evaluation criteria with check boxes. After completing the form, the user must click the "Calculate" button. As a result, the rating of TOP-10 suppliers with their overall weights and current prices is shown in Fig. 4.

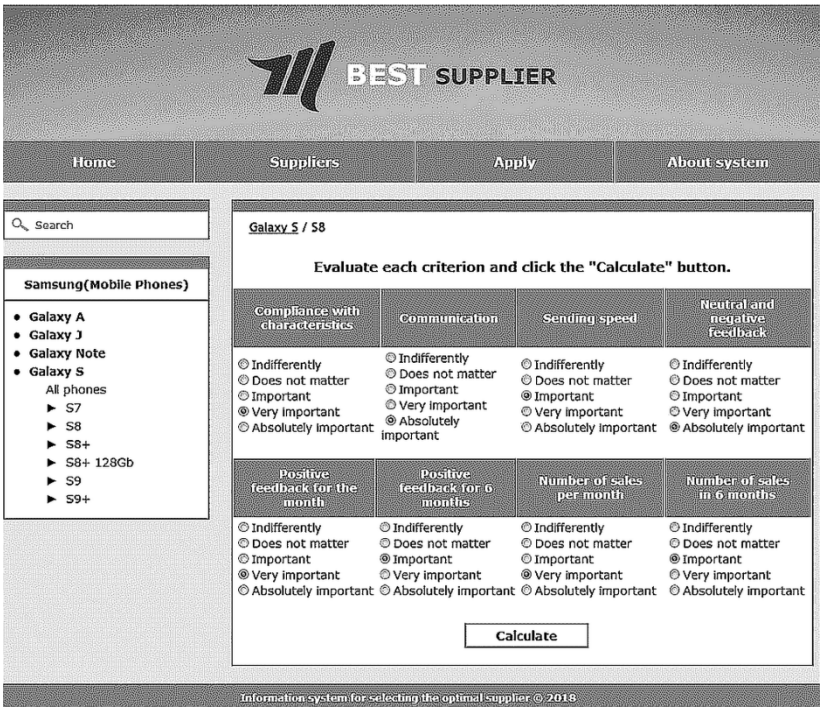

Fig. 3. User interface with form to evaluate criteria of suppliers selection.

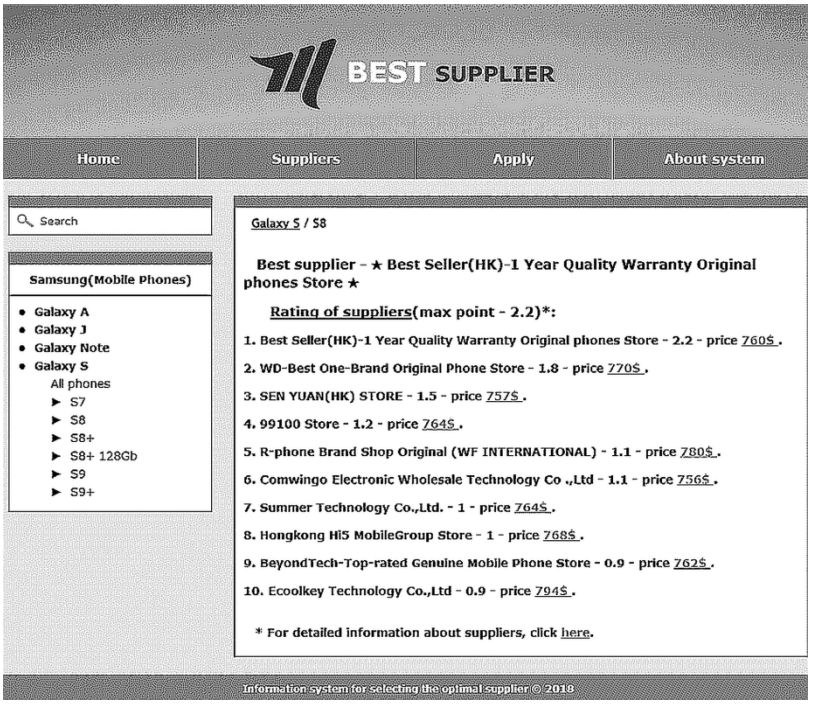

Fig. 4. User interface with suppliers rating.

When click on the price, the client goes to the seller's page on the AliExpress platform with goods description.

Sellers' feedback and goods prices are updated once a day. Thus, the calculation of suppliers rating in proposed information system is performed using actual data.

5. Conclusion

The decision making on goods supplier selection in e-markets is carried out under multicriteria conditions. To solve this task multi-attribute decision-making techniques are widely used. These methods should be implemented in DSS which collects, analyzes all data based on which the supplier selection process is implemented and outputs the result of selection to the end user.

This study presents the DSS for selection the optimal goods supplier from AliExpress trading platform. It has been developed as web-based information system and based on the Analytic hierarchy process method. The proposed DSS is intended to form a set of alternatives which are all suppliers of certain good, the comparison matrix of alternatives and to calculate a consistency rate of suppliers. The pair-wise comparison of suppliers is carried out using the complex indicator of supplier's competitiveness. The mathematical model to calculate this indicator have been developed. This model allows to consider the degree of importance of each criterion when choosing a supplier for a particular client. The developed information system provides users web-interface to evaluate weight of each criteria, to view calculated suppliers rating and the current price for selected goods. If necessary, the user can find detail information about every supplier from suppliers' rating.

The developed DSS is expected to simplify make purchases on AliExpress, because it performs data analysis from seller feedback of all possible sellers. It will save time of AliExpress purchasers to make right decision to select optimal supplier.

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