“Modelling of strategic managerial decisions in the system of marketing logistics of enterprise”

AUTHORS	Oleksandr Velychko http://orcid.org/0000-0003-2700-0329 https://publons.com/researcher/1771375/oleksandr-p-velychko/ Liudmyla Velychko https://orcid.org/0000-0002-8255-8774 https://publons.com/researcher/2015009/velichko-lyudmila/ Mykola Butko https://orcid.org/0000-0002-4349-1298 http://www.researcherid.com/rid/I-3593-2016 Svitlana Khalatur https://orcid.org/0000-0001-8331-3341 https://publons.com/researcher/T-7645-2019

ARTICLE INFO	Oleksandr Velychko, Liudmyla Velychko, Mykola Butko and Svitlana Khalatur (2019). Modelling of strategic managerial decisions in the system of marketing logistics of enterprise. *Innovative Marketing* , *15*(2), 58-70. doi:10.21511/im.15(2).2019.05
DOI	http://dx.doi.org/10.21511/im.15(2).2019.05
RELEASED ON	Wednesday, 19 June 2019
RECEIVED ON	Saturday, 27 April 2019
ACCEPTED ON	Monday, 10 June 2019

JOURNAL	"Innovative Marketing "
ISSN PRINT	1814-2427
ISSN ONLINE	1816-6326
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
39	2	4

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Oleksandr Velychko (Ukraine), **Liudmyla Velychko** (Ukraine),
Mykola Butko (Ukraine), **Svitlana Khalatur** (Ukraine)

MODELLING OF STRATEGIC MANAGERIAL DECISIONS IN THE SYSTEM OF MARKETING LOGISTICS OF ENTERPRISE

Abstract

Integrated decisions in the system of the marketing logistics are the main resource for providing the efficient management of the value chain. Moreover, there is not a sufficient number of methodological approaches, which could use in complex the principles of the integrated modelling of decisions in the operational systems "procurement marketing – supply logistics" and "sales marketing – distribution logistics". Considering that fact, the methodology of selecting strategic alternatives based on the integrated modeling in separate marketing logistics chains and in stage-by-stage formation of the supply chain participants has been developed in the article. The research is based on the application of the AHP method and the method of planning "dual sourcing" (70/30) for grounding the selection of the supply strategy at the market of material resources; methods of optimal planning according to Bayes criterion, linear programming and logistics modelling – for grounding the selection of the managerial decisions on the strategy of distributing the ready produce. The research covers, firstly, grounding the essence of the marketing logistics through the systemic approach to identification of its main and servicing business processes; secondly, improvement in the process of planning decisions in the procurement marketing system by adding the procedure of the logistical selection of the hierarchical estimation with a different degree of advantages in alternative supply strategies; thirdly, formation of the cascade integrated approach toward selection of the alternative distribution channels for the finished produce by estimating the complex marketing effect and application of the logistical model of optimal distribution.

Keywords market, resources, produce, procurement, sale, supply chain, alternative, optimization

JEL Classification C61, M11, M31

Received on: 27th of April, 2019
Accepted on: 10th of June, 2019

Oleksandr Velychko, Doctor of Economics, Professor, Head of Management and Law Department, Dnipro State Agrarian and Economic University, Ukraine.

Liudmyla Velychko, Ph.D. in Public Administration, Senior Lecturer at the Department of Economics, Entrepreneurship and Management of Enterprises, Oles Honchar Dnipro National University, Ukraine.

Mykola Butko, Doctor of Economics, Professor, Head of Management and Public Service Department, Chernihiv National University of Technology, Ukraine.

Svitlana Khalatur, Doctor of Economics, Assistant Professor, Assistant Professor at the Finance and Banking Department, Dnipro State Agrarian and Economic University, Ukraine.

INTRODUCTION

In the system of the logistical management of the material flows, the marketing works both in the direction of sales and purchasing. At that, the marketing of sales is more typical for business processes in the distribution area. Moreover, recently the procurement marketing has been mainly connected with the supply business activity of an enterprise. In the first case, the enterprise focuses on the market of own produce, while in the second one – on the market of material resources. The integration of the marketing and logistical processes at the stages of purchasing and distribution forms the system of the marketing logistics.

Christopher (1972) was among the first authors who focused the attention on the issue of studying logistics within the marketing context. The conceptual approaches toward harmonizing the marketing and logistical strategies in the supply chain management have been grounded (Christopher & Peck, 2011). Furthermore, the scientists

http://dx.doi.org/10.21511/im.15(2).2019.05

have developed the idea that there are two spheres of demand in the business environment: creation of requests (marketing) and fulfillment of conditions (logistics). Nowadays, in most cases, the marketing logistics is studied in the system of marketing of sales and distribution. In particular, Jeanpert and Paché (2016) consider the integration of the marketing and logistical functions in the business for improving the quality of services for buyers through many distribution channels. In the same way, the development of the efficient logistical strategies for retailing is the integral part in the studies of the marketing logistics carried out by Rouquet et al. (2018). Besides, Majercakova and Majercak (2015) determine not only the distribution, but also the process of purchasing material resources at the market as the most important types of the logistical activity focused on the marketing environment. The systemic analysis of such approaches makes it possible to ground the existence of the marketing logistics at certain stages of the supply chain. Thus, the marketing logistics first of all unites the spheres of the supply logistics and distribution logistics. Therefore, the integrated solutions in the system of the marketing logistics are some of the most important ways of efficient management of the value chain. Simultaneously, it concerns both a separate link of the supply chain and a set of the interconnected business processes.

1. LITERATURE REVIEW

The approach toward modelling managerial decisions on certain business processes in the system of the marketing logistics has become the center of attention for a large number of scientists. However, mainly this issue is considered within the context of managing the supply chain. In particular, the general integrated base for improving the efficiency of the supply chain was systematically grounded in the doctoral dissertation written by Elberegli (2018). Although, the research of this issue exactly at the strategic level remains scarce. Among those publications are Siddh et al. (2018) who offered the integrated structural model, which is focused on the strategy of providing the quality of supply, production, internal logistics, staff and information. Scientists such as Spillan et al. (2018) in the logistical strategy of the enterprise integrated three components: processes, marketing, information.

There are certain studies, which are focused on modeling local business processes in the system of the marketing logistics. The sphere of the procurement marketing and supply logistics is the most spread. In particular, Namdar et al. (2018), Shen and Willems (2014) grounded the strategic models of diversifying the supply to enhance the stability of the work in the marketing logistics system. At that, Subramanian et al. (2010) used the integrated approach to estimating the interrelations in the system "supplier-customer" (BSR) using the method of interpretive structural modelling (ISM). Though in certain cases management of the supply logistics for modelling similar decisions is made using the method of integer linear programming and criteria of minimizing costs and maximizing the level of service (Sawik, 2016). Such scientists as Hoseini Shekarabi et. al., (2018) used mixed integer nonlinear programming (MINLP) for modelling the supply chain under the conditions of deficit and restrictions in warehouse logistics.

An essential feature of the research methodology in the system of the integrated modeling of the marketing supply logistics is the widespread application of the AHP (Analytic Hierarchy Process) method (Saaty, 1987). This method has been frequently used for: estimating the productivity of suppliers (Wang et. al., 2017), choosing the models SCOR and GSCF (Ponis et al., 2015), ranging the information from partners through the supply chain (Ramanathan, 2013), making critical decisions on projecting a set of purchase channels (Barker & Zabinsky, 2011), planning personal decisions (Castillo et al., 2017) and so on. The AHP method is suitable for the situations when the combination of qualitative and quantitative criteria for making decisions is used. The process of applying the Analytic Hierarchy Process method implies: formation of the set of key criteria and priority relationships between them; determination of the priority relationships between available alternatives on certain criteria; calculations of absolute advantageous indicators for each option. Under the contemporary conditions, the AHP method can be applied practically in all spheres of the economic activity. Afshar and Haghani (2012) developed the complex mathematical model, which controls the flow of goods from certain

supply sources to end-users. At that, the network corresponds to the complex logistical structure. And the model itself considers limitations in capacities of the transportation system. Moreover, several heuristic methods have been recommended for application.

The methodology of the strategic managerial decisions on marketing of sales or logistical distribution is also partly focused on the integration of different method and approaches in certain processes. An example of that is the application of the integrated modelling for evaluating the unsatisfied demand for the stability of the supply chain (Ni et al., 2018). Besides the integrated approach toward developing decisions in the distributive logistics is often connected with the previous business processes in the supply chain (purchasing, transportation, production). In particular, such an approach has been suggested by Safaei et al. (2018). The scientists have developed the optimization model for the network "supply-distribution" under the conditions of undetermined parameters of demand and supply. At that, they used the integrated method of optimization, in which the value of risk for cooperating with the supplier is determined using the model TOPSIS (Ye & Li, 2014). Before that, Khalili et al. (2016) had developed the model of the integrated planning of production and distribution. The common feature of the models, which are focused more widely on the business processes of the marketing logistics, is the consideration of different risks in one or another. Particularly it concerns two previous cases. Besides, Behzadi et al. (2018) paid attention to it too. The scientists have suggested the quantitative models of managing risks for the food supply chains using the reliability criterion and persistence criteria.

However, there is not a sufficient number of methodological approaches, which could apply in complex the principle of the modelling toward the general system of the marketing logistics, as well as to certain interconnected elements of such a system. Besides, in the existing procedures of the strategic planning, achievements of the appropriate level of diversification in supply sources, selection of transporters and channels of distribution are insufficiently considered. Greater attention should be paid to the diversification of the logistics strategies by the influence on the profit and levels of risks in the quality of the supply, as well as by the essence of the goods and the level of complexity in the supply management.

The methodology of the decision planning should more completely consider the differences between the logistics modelling in social and marketing business systems and the possibilities of the heuristic methods in optimal selection of logistics strategies under the condition of uncertainty. Special complex indicators of the efficiency in the marketing logistics (marketing and logistical mix) are not used in the process of optimizing the selection of the strategy. The probabilistic limitations to the high quality of transportation and the reliability of the supply and complete sale of the produce by the distribution channel in the corresponding period are not used in the existing models based on the method of linear programing. Along with the production and distribution limitations in each period of time, the expected demand for the ready produce is insufficiently considered.

The application of the AHP method in the sphere of the marketing logistics requires the increase in the level of adaptability to a certain managerial situation, as well as to a certain improvement in the procedure of evaluating alternatives. Nevertheless, it is necessary to improve the AHP method so that the project decisions are precise and flexible. Thus, the existing methodological approach implies the categorical selection of one of the two criteria, which are compared. In particular, it happens while making up the matrix for determining the importance of the criteria for estimation. But in case of the categorical selection between the two criteria, the total sum of the competitive points of different suppliers according to the weighted evaluation can vary significantly. Therefore, these flaws of the existing methodology testify to the need for widening the alternative selection during the pairwise evaluation of the criteria. It will significantly promote the increase in the level of flexibility of the AHP method during comparison of a set of suppliers. To improve the procedure of accuracy in choosing the alternatives, the system of indices and their estimation should be widened, and the essence of separate levels of advantages of the supply strategies should be considered.

http://dx.doi.org/10.21511/im.15(2).2019.05

Therefore, the aim of the article is to develop the methodology of selecting strategic alternatives based on the integrated modelling both in the separate marketing logistics chain and in general planning of its business processes.

2. METHODOLOGY

The methodology of the research was focused on the systematic approach toward projecting the strategic decisions in the sphere of the marketing logistics. In the process of the scientific research, the integrated complex of special methods has been used. At that, the biggest part of the known methods had further improvement, development and adaptation within the context of the tasks for the strategic management of the supply chain. Besides, the process of the research was based on the concept of the dualistic nature of the entrepreneurial logistics in the direction of providing (Velychko, 2014a) and rationalization (Velychko, 2014b). Moreover, the dualistic concept of the marketing logistics as a system with the initial and completing business processes in the supply chain has been suggested and used. The transportation in the system has been determined as the social servicing business process (Figure 1).

The research was carried out in two stages. At the first stage (procurement marketing/supply logistics), the methodology of projecting strategic decisions of purchasing material resources from outside sources was developed. The conclusive providing were: the concept of combining strategies (single sourcing, multiple sourcing, cross sourcing, dual sourcing – 70/30) (Formentini et al., 2018) and the AHP method (Saaty, 1987).

Hence, the multi-criterion model for planning strategic decisions by the customer on seeking for resources at the market and their supply has been suggested. The model is focused on the strategy of "dual sourcing", when one of the suppliers meets approximately 70% of the customer's demand and the other supplier – around 30%. It makes possible to encourage the competition in the supply chain: if the productivity of the first supplier decreases, then the other supplier will receive more orders. The elimination of a set of the early mentioned disadvantages in application of the "Analytic Hierarchy Process" in the sphere of the marketing logistics of an enterprise can be carried out using several changes and additions to the existing approaches. In particular, additions were made to: 1) the system of pairwise comparison of criteria of such a point estimate: (0.5 and 0.5 points – if the priority is absent); (1.0 and 0.0 points – in case of a clear priority) and (0.75 and 0.25 points – in case of an unclear priority); 2) matrixes of estimating the importance of the criteria – additional indicator "level of the hierarchical position". This indicator was calculated as a part of the certain criterion by the index number of the sequence in its location by the degree of importance in the total sum of all index numbers; 3) matrixes of evaluating suppliers – indicator "weighted estimate by the level of the hierarchical position" (multiplication of the expert estimate of the criteria by the inversely ranged in the row level of the hierarchical position).

Besides the procedure of estimating the criteria for selecting the contractor should include five levels of the logistical advantages of the alternative supply strategies. The highest among them are the compelling choice (advantages: high, middle and low). This advantage is by the weighted estimate by the importance of the criteria, weighted estimate by the level of the hierarchical position and expert estimate. Besides, the high, middle and low levels are determined by the sign of accuracy of estimating

Source: Developed by the first author.

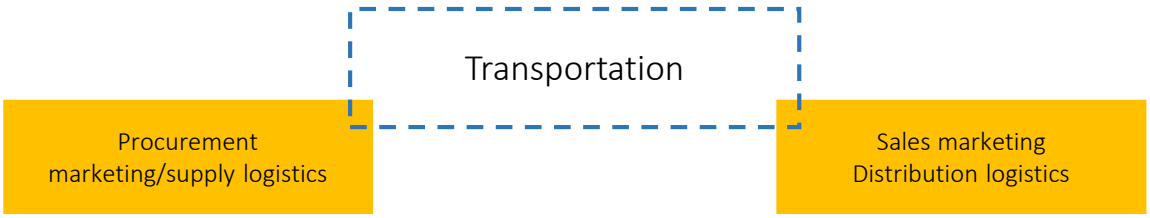

Figure 1. Business processes in the system of the marketing logistics of an enterprise

such an advantage. Then it is the weighty choice (advantage: high and middle). It implies the advantage by the weighted estimate of the importance of the criteria and the weighted estimate by the level of the hierarchical positon. The middle level is represented by the acceptable choice (advantages: high and low). It is focused on the advantage by the weighted estimate by the importance of the criteria, expert estimate. By the decrease of the value the middle level is flowed by the uncertain level (advantages: low and middle). This is the advantage only by the expert's estimate and the weighted estimate by the level of the hierarchical position. And the lowest level is the impossible choice. This situation happens in case of the advantage of the alternative supply strategy only by one indicator.

The implementation of those changes and additions to the AHP method for estimating the strategic alternatives in the system of procurement marketing made possible to create the linear algorithm. Unlike the existing procedure, it includes nine stages of the sequent logistical estimation (Figure 2).

The possibilities of using the corresponding model in the system of the marketing logistics is not limited by grounding the selection of the suppliers. It can be applied while choosing the alternative technologies, types of transportation, marketing channels and so on. At that, Vasylieva (2018), Yatsiv and Kolodiichuk (2017) pay attention to the fact that the process of purchasing material resources of such enterprises is usually diversified by numerous both large and small companies in the sphere of the business. It is the diversification that most often provides the financial strength and competitive advantages on different types of markets.

Source: Developed by the first author.

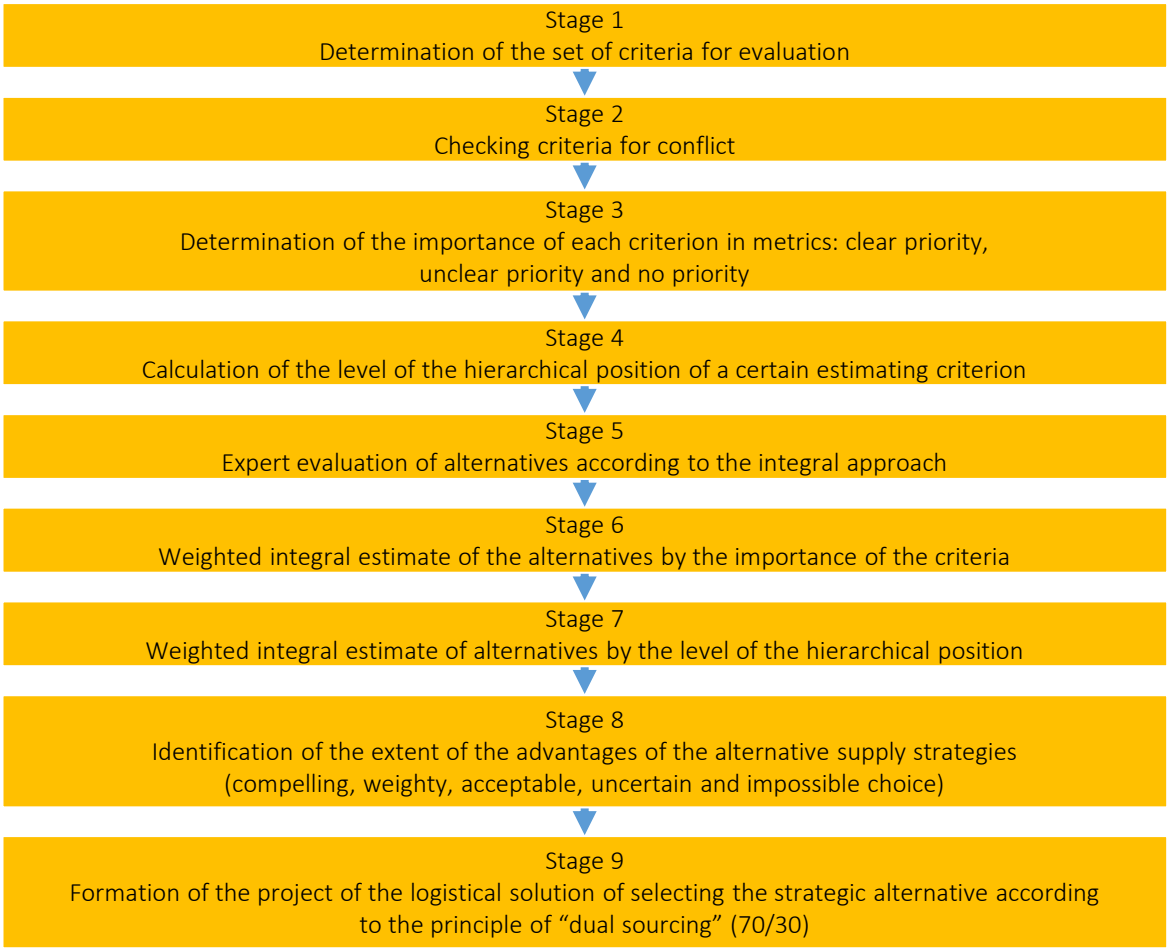

Figure 2. Algorithm of the multi-criteria model of the strategic solution on selecting the suppliers at the market of the material resources

http://dx.doi.org/10.21511/im.15(2).2019.05

At the second stage (marketing of sales/logistics of distribution), the methodology of projecting strategic decisions was developed for choosing the time and amounts for selling through the distribution channels based on the procedure of controlling. This approach is actual for the organization of transportation for the sphere of supply and the sphere of distribution. The conclusive providing were: methods of the logistical modelling in social (Bogodistov et al., 2017) and marketing (Khmarskyi & Pavlov, 2017) business systems, as well as the methods of making a decision in the face of uncertainty according to Hurwitz's criterion (Arsovski et al., 2017; Feduzi et al., 2017; Menukhova & Vyushkova, 2017).

At first, from a certain multitude, a set of the most efficient channels of distributing the produce was chosen. The selection criterion was the expected effect from the marketing mix ("4P" – Product, Price, Place, Promotion). Furthermore, this effect was determined by the conditional 10-point scale. Such a selection took place with the help of the method of selecting the strategic decision under the uncertainty conditions according to Bayes (Gilboa, 2015; Lecouteux, 2018; Li et al., 2016). All that made possible to choose three most prospective channels of distributing the finished produce. After that, the logistical model was created for the optimal sale of the ready produce by time and amounts of implementing the orders between these distribution channels. The model was built on the basis of the linear programming method (Ficken, 2015).

A certain multitude of unknown values was determined in the logistical model. In particular x_{ij} $\left(i=\overline{1,m},\ j=\overline{1,n}\right)$ displays a certain amount of the ready produce with the sales in the *i*-period by *j*-channel of distribution (by the distributing facilities). At that, n is the number of the distribution channels (distributing facilities), where m is the number of the time periods for selling the produce. The multiplication of the two latter values provided the general number of the unknown variables for the task.

The first group of limitations is represented by the inequalities, which consider in each time period by a certain distribution channel the expected demand for the finished produce:

$$\sum_{j=1}^{n} x_{ij} \le P_i \left(i=\overline{1,m}\right), \tag{1}$$

where P_i is the boundary amount of the expected demand for the produce.

The other group shows the existing limitations for the capacities of production and sales of the finished produce in each time period:

$$\sum_{j=1}^{n} x_{ij} \le P_i \left(i=\overline{1,m}\right), \tag{2}$$

where P_i is the boundary volume of the existing producing capacities of an enterprise for that type of produce.

The third group of limitations is represented by the inequality for the maximum amount of the budget finances for supporting the produce sales in the distributing facilities (advertising, merchandising, promotional discounts and so on):

$$\sum_{i\in I} s_i x_i \le S, \tag{3}$$

where s – costs on supporting the sales of the produce in each period of time by a separate distribution channel, while S – maximum possible amount of total cash costs of an enterprise spent on such measures.

The fourth group of limitations considers the probability of the complete sales of the produce in the distributing facilities during the determined time periods and is described by the following inequality:

$$\frac{\sum_{i\in I} l_i x_i}{\sum_{i\in I} x_i} \ge L, \tag{4}$$

where l is predicted probability of the total sale of produce in each time period by a separate distribution channel. At that, L – minimal possible mean probability of feasibility of such an action.

The fifth group of limitations is represented by the inequalities, which describe the need for performing the existing fixed orders for the produce in certain periods of time by a certain distribution channel:

$$x_{ij} \geq m_{ij} \cdot \left(i \in I, j \in J\right), \quad (5)$$

where $m_{ij}\left(i \in I, j \in J\right)$ – boundary volume of the produce, which has to be sold in the *i*-period through *j*-channel of distribution. Accordingly, I is the multitude with indexes of the time periods with the fixed orders. Moreover, J is the multitude with the indices of the distribution channels with the fixed orders.

The purpose of the logistical model is to determine the amount of the produce for selling at a certain time by a separate distribution channel in such a way that the expected total profit of the enterprise should be maximum. The corresponding objective function is as follows:

$$Z = \left(C, X\right) = \sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}x_{ij} \rightarrow \max, \quad (6)$$

where $c_{ij}\left(i = \overline{1,m}, j = \overline{1,n}\right)$ shows the predicted profit from selling the unit of the produce in the *i*-period through the *j*-channel of distribution (distributing facilities).

3. RESULTS AND DISCUSSIONS

At the first stage, the modelling of the strategic decision on selecting the main suppliers at the market of the material resources for LLC "NKZ" (Ukraine) was made. The enterprise deals with the deep processing of agrarian raw materials, as well as production and distribution of the canned fruit and vegetable produce. The task is to select two main suppliers among large agrarian holdings. They should provide the biggest amounts of supplied resources for further processing. The analysis was carried out for five agrarian corporations. A set of criteria was essential while making a decision. Among them are: distance to the supplier (K1), capability to cooperate within the logistical system "Just-In-Time" (K2), level of the technological quality of resources (K3), price of the resources (K4) and flexibility of the supply amounts (K5). To determine the level of importance and comparison of these criteria, the evaluating matrix (Table 1) was created based on rationalistic logistics (Velychko, 2014b) and the algorithm (Figure 2).

The determined numbers of advantages made it possible to determine the importance, range of priority and hierarchical position. At that, the numbers of advantages of each criterion over the rest considered three possible situations: clear priority (1.0; 0.0), unclear priority (0.75; 0.25) and no priority (0.5; 0.5). Next, all the suppliers were placed in the hierarchical order according to the place of importance (Table 2).

It made possible to carry out three dimensional estimations. In particular, by the expert's method by 10-point scale, as well as the weighted method on both importance and the hierarchical position. The last indicator was calculated as the inverse to the ordinal number by the range of importance. Due to that, the modelling of choosing the strategic decision according to the principle of "dual sourcing" was carried out (Table 2). The analysis has revealed that Supplier 4 obtained the undisputed logistical advantage over other suppliers according to all three measuring indicators: expert's estimate (34), weighted estimate by importance (712.5) and the weighted estimate according to the hierarchical position (6.467). In such a way,

Table 1. Matrix of the logistic evaluation of criteria for choosing the suppliers at the market of the material resources

Source: Developed by the authors.

Criterion	K_1	K_2	K_3	K_4	K_5	Numbers of advantages	Importance, %	Place	Hierarchical position
K_1		$^{0.25}K_1$ $_{0.75}K_2$	K_3	$^{0.5}K_1$ $_{0.5}K_4$	K_1	1.75	17.5	3	0.200
K_2			$^{0.5}K_2$ $_{0.5}K_3$	K_4	K_5	1.25	12.5	4	0.267
K_3				$^{0.75}K_3$ $_{0.25}K_4$	K_5	3.25	32.5	1	0.067
K_4					K_4	2.75	27.5	2	0.133
K_5						1.0	10.0	5	0.333
Total						10	100	15	1.000

http://dx.doi.org/10.21511/im.15(2).2019.05

Table 2. Modelling of the strategic decision on choosing the main suppliers at the market of material resources ("dual sourcing")

Source: Developed by the authors.

Criterion	Importance, %	Hierarchical position	Logistical estimate of supplier's criteria		
			Expert	Weighted by	
				Importance	Hierarchical position
Supplier 1					
K3	32.5	0.067	6	195	0.402
K4	27.5	0.133	4	110	0.532
K1	17.5	0.200	5	87.5	1.000
K2	12.5	0.267	6	75	1.602
K5	10.0	0.333	7	70	2.331
Total	100	1.000	28	537.5	5.867
Supplier 2					
K3	32.5	0.067	4	130	0.268
K4	27.5	0.133	8	220	1.064
K1	17.5	0.200	8	140	1.600
K2	12.5	0.267	3	37.5	0.801
K5	10.0	0.333	6	60	1.998
Total	100	1.000	29	587.5	5.731
Supplier 3					
K3	32.5	0.067	2	65	0.134
K4	27.5	0.133	5	137.5	0.665
K1	17.5	0.200	4	70	0.800
K2	12.5	0.267	4	50	1.068
K5	10.0	0.333	2	20	0.666
Total	100	1.000	17	342.5	3.333
Supplier 4					
K3	32.5	0.067	9	292.5	0.603
K4	27.5	0.133	6	165	0.798
K1	17.5	0.200	7	122.5	1.400
K2	12.5	0.267	5	62,.5	1.335
K5	10.0	0.333	7	70	2.331
Total	100	1.000	34	712.5	6.467
Supplier 5					
K3	32.5	0.067	7	227.5	0.469
K4	27.5	0.133	5	137.5	0.665
K1	17.5	0.200	2	35	0.400
K2	12.5	0.267	3	37.5	0.801
K5	10.0	0.333	1	10	0.333
Total	100	1.000	18	447.5	2.668

the main supplier has been clearly determined, amounts of orders from it will be about 50-70%. Besides, the strategy of "dual sourcing" implies the mandatory diversification of the system of purchasing material resources. Therefore, from the rest of four potential offers, the other supplier was chosen. Nevertheless, the choice here was not so definitely clear as in the previous situation. It was caused by the presence of the advantage of the Supplier 1 only by the hierarchical position (5.867). At the same time, the Supplier 2 outperformed according to the expert's estimate (29) and the weighted estimate by the importance (587.5). By the five-point scale of choosing the alternative in the first case, we have situation with the Supplier 5 (impossible choice). Besides, the other case – situation with the Supplier 3 (acceptable choice). Furthermore, such essential logistical advantage is definitely not as convincing as the absolute logistical advantage by the Supplier 4.

However, as the second partner for cooperation by the principle of relativity Supplier 2 was chosen. For the needed choice, situation with the Supplier 3 can be considered better than situation with the Supplier 5. But the level of orders for the second

Table 3. Decision on selecting the main channels of distributing canned vegetable produce by the complex effect of the marketing mix ("4P")

Source: Developed by the authors.

Chain of supermarkets	Product group 1	Product group 2	Product group 3	Product group 4	Product group 5	Product group 6	Product group 7	Product group 8	Product group 9	Product group 10	Criterion of Bayes
	Expected probability										
	0.2	0.07	0.1	0.08	0.07	0.08	0.1	0.05	0.15	0.1	
The matrix of winnings, points											
Pakko	3	5	4	4	7	6	4	3	5	6	4.54
SPAR	3	5	9	4	5	6	5	5	6	5	5.15
Le Silpo	8	7	9	6	6	8	6	9	7	10	7.63
EKO-Market	4	5	7	6	4	5	2	5	2	4	4.16
Furshet	8	6	8	5	6	4	5	6	7	9	6.71
Brusnychka	3	2	4	3	5	7	4	3	5	4	3.99
Billa	3	4	3	7	2	4	3	3	2	5	3.45
ATB	7	9	6	5	7	6	6	5	7	6	6.5
The matrix of risks, points											
Pakko	5	4	5	3	0	2	2	6	2	4	3.38
SPAR	5	4	0	3	2	2	1	4	1	5	2.77
Le Silpo	0	2	0	1	1	0	0	0	0	0	0.29
EKO-Market	4	4	2	1	3	3	4	4	5	6	3.76
Furshet	0	3	1	2	1	4	1	3	0	1	1.21
Brusnychka	5	7	5	4	2	1	2	6	2	6	3.93
Billa	5	5	6	0	5	4	3	6	5	5	4.47
ATB	1	0	3	2	0	2	0	4	0	4	1.01

supplier will be much lower than that of the first Supplier (approximately 10-30%). Thus, for future cooperation by the system of "dual sourcing", two main suppliers have been suggested. However, the final decision should include a set of other factors, which are hard to consider using the rationalistic logistics (reputation, experience of cooperation, personal contact and so on). In complex, it will provide the efficient selection of alternatives at the market of supplying material resources and in the system "procurement marketing/supply of the material resources" and in the system "procurement marketing/supply logistics".

At the second stage of the research, we developed the project of a managerial decision toward selecting prospective channels of selling canned vegetable produce. As an alternative, eight chains of supermarkets and ten groups of the assortment of goods were considered. In this case, the criterion for evaluating was the complex effect of the marketing mix (4P) from application of one or another channel of selling canned vegetable produce. The estimation took place according to the criterion of Bayes. At that, all chains of supermarkets were viewed from the winning position (receiving the maximum effect), and from the position of the risk (loss of the effect). By each product group by the expert method there existed the expected probability of receiving (losing) the corresponding marketing effect from the use of a certain distribution channel. A different value of the probability was mainly connected with the positioning of product groups into different categories according to the model of Kraljic. It was also caused by the features of the production technologies, storing and transportation, as well as by the dependence on the market conjuncture. As a result, according to the win matrix, two distributing chains were selected, which had the highest weighted index of Bayes. These chains of supermarkets were "Le Silpo" (7.63 points) and "Furshet" (6.71 points) (Table 3).

The matrix of losses showed a bit different result. Thus, the lowest risks of receiving a high complex effect from the marketing mix are achieved in case of cooperation between the chain of supermarkets "Le Silpo" (0.29 points) and "ATB" (1.01 points). Hence, "Le Silpo" possesses unambiguous advantages in the depth of cooperation, and "Furshet" and "ATB" have only partial. Nevertheless, all these chains of supermarkets were used for further modeling of the managerial decision on selecting the place, time and amounts of selling the canned produce.

http://dx.doi.org/10.21511/im.15(2).2019.05

Table 4. The project of the logistical decision on distributing the vegetable produce by sales channels in different months of 2019 (expected annual average loading of the production capacities)

Source: Developed by the authors.

Month	Chain of supermarkets								
	ATB			Furshet			Le Silpo		
	Probability of the total sales of goods	Expected profit from one unit of produce, UAH	Optimal solution on the amounts of sales, tons	Probability of the total sales of goods	Expected profit from one unit of produce, UAH	Optimal solution on the amounts of sales, tons	Probability of the total sales of goods	Expected profit from one unit of produce, UAH	Optimal solution on the amounts of sales, tons
1	0.45	1.00	0	0.65	3.25	100	0.75	3.25	54
2	0.35	1.00	0	0.65	4.25	80	0.90	2.58	87
3	0.75	2.75	75	0.95	2.50	51	0.95	3.65	74
4	0.80	1.85	65	0.65	2.80	55	0.65	3.85	65
5	0.65	1.45	50	0.35	1.10	0	0.45	1.50	48
6	0.55	2.55	80	0.65	2.55	90	0.40	1.35	45
7	0.65	1.60	60	0.97	3.50	90	0.65	3.20	50
8	0.75	3.70	50	0.65	3.60	120	0.50	3.85	70
9	0.65	1.95	75	0.65	4.20	80	0.40	1.00	0
10	0.85	2.50	80	0.50	1.10	58	0.20	1.50	45
11	0.55	2.80	56	0.65	1.50	120	0.65	3.85	50
12	0.65	1.65	40	0.60	2.80	130	0.45	3.35	40
Optimal profit by the criterion of maximum – 6,197,144.64 UAH									

For that purpose, the matrix of the logistical model was created. It included 36 variables. Each variable corresponded to the amounts of the selling the produce through the corresponding chain of supermarkets in a certain month of the calendar year. Besides, the matrix contained 51 limitations. From 1 to 36, those are the limitations to the expected demand for the canned produce, 37-48 – limitations to possibilities of production and distribution of the produce in each time period, 49 – to maximal amount of the finances spent on the promotion of sales of goods in chains of supermarkets (not more than 5,000 thousand UAH); 50 – to the mean probability of the total sale of the goods in the distributing facilities (0.65); 51 – to the amounts of carrying out fixed orders with supermarkets (not less than 1,800 tons). The objective function is the maximum profit according to the results of the calendar year. The calculation of the task was made in the software MS Excel. The results of solving the task made possible to get the project of the decision. According to it, the maximal profit by the maximum criterion is UAH 6,197 million (Table 4).

In this project of the decision, there are certain periods, when the intensity of selling the canned produce through the distributing facility must be significantly decreased. First of all, it is connected with the low probability of the total sales of goods in the corresponding month of the year or a low expected profit from one unit of produce. But anyway under the existing numerical limitations, such an approach made it possible to get the project of the optimal managerial decision for LLC "NKZ" in the system "sales marketing/sales logistics".

Thus, unlike the previous studies of AHP in the system of logistics (Barker & Zabinsky, 2011; Ponis, et al., 2015; Ramanathan, 2013; Wang et al., 2017), the author's methodical approach increases the level of flexibility and accuracy in the integrated evaluation of the criteria of selecting the suppliers. In particular, the low level of pairwise advantages of certain criteria is considered mathematically. Besides, five different layers of analysis are used to ground the reasonability of selecting a certain supplier: from the absolute logistical advantage to the full absence of advantages. Unlike similar studies of the distributive logistics made by Khalili et al. (2016), Safaei et al. (2018) and Gharaei et al. (2019), the developed methodical approach to selecting the alternative decisions is focused on the complex of indicators of the selection efficiency. Among them is the integral indicator of the marketing mix (4P). Step by step procedure of

selection is focused on the integration of different methods. And the logistical modeling considers limitations to the possibilities of the demand for the produce and the probability of the total sales of goods through the distribution channels in a certain period. Besides, the author's methodological tools can be applied for solving tasks of a certain component of the marketing logistics in the form of the complex stage by stage procedure in the management of the supply chain.

CONCLUSION

The AHP method can be considered as the basis for the methodology of modelling strategic decisions of selecting the supplier at the market of the material resources. However, this method requires adaptation within the context of increasing the level of accuracy in carrying out the evaluation of alternatives. The improvement of the AHP method within the sphere of marketing purchases and the supply logistics should include a complex of additional measures. They are the following: addition to the system of the pairwise comparison of criteria of the three-dimensional point scoring of priority; introduction into the evaluating matrix of the importance of criteria "hierarchical position"; introduction to the evaluating matrix of the indicator "weighted estimate by the hierarchical position". Moreover, the procedure of estimating criteria for selecting the contractor should consider five levels of advantages in the alternative supply strategies. The suggested linear algorithm of modelling the managerial decision by the AHP method in the system of the marketing logistics should consider not less than nine stages of the consequent estimation. And the latter stage is reasonable to be focused on the preparation of the project of the decision of selecting the strategic alternative in the supply logistics by the principle of "dual sourcing" (70/30).

The complex effect by the marketing mix is essential to be considered in the process of the integrated modelling of decisions of the distributive logistics. By to this indicator it is reasonable to carry out the selection of the most efficient channels of distributing the produce by the method of the strategic alternative under the conditions of uncertainty by the criterion of Bayes. After that the logistical model of optimizing time and amounts of the distributing produce by the selected earlier channels of distribution can be applied. In this case, it is essential to consider limitations to the expected demand for the produce, production capacities and the sales of the produce in each time period, boundary budget for the promotion of goods, level of the probability of total sales by channels, amounts of fulfilling the fixed orders and so on. This model has to be clearly focused on maximization of the company's profit.

Such systemic integration of different methods and models promotes the multi-criteria analysis, and development of the efficient strategic solutions in the environment of the marketing logistics. Further research should be focused on the situational approach to modelling decisions in the supply chain management.

ACKNOWLEDGEMENT

The work has been funded by the Ministry of Education and Science of Ukraine. The research was carried out within the context of tasks for scientific projects: "Concept of transformation for organizational-economic mechanisms of management and logistics for enterprises in the system of economic safety of Ukraine" ((No. ID:62198 22.08.2016 (64-1)) and "Management in development of agricultural markets, agrarian, ecological logistics in the system of food safety" ((No. ID:64770 26.08.2016 (00009-1)). The projects were recommended by the National Council of The Ministry of Education and Science of Ukraine for financing at the expense of the state budget.

http://dx.doi.org/10.21511/im.15(2).2019.05

REFERENCES

1. Afshar, A., & Haghani, A. (2012). Modeling integrated supply chain logistics in real-time large-scale disaster relief operations. *Socio-Economic Planning Sciences, 46*(4), 327-338. https://doi.org/10.1016/j.seps.2011.12.003
2. Arsovski, S., Todorovic, G., Lazić, Z., Arsovski, Z., Ljepava, N., & Aleksic, A. (2017). Model for selection of the best location based on fuzzy AHP and Hurwitz methods. *Mathematical Problems in Engineering,* 1-13. https://doi.org/10.1155/2017/2803461
3. Barker, T. J., & Zabinsky, Z. B. (2011). A multicriteria decision making model for reverse logistics using analytical hierarchy process. *Omega, 39*(5), 558-573. https://doi.org/10.1016/j.omega.2010.12.002
4. Behzadi, G., O'Sullivan, M. J., Olsen, T. L., & Zhang, A. (2018). Agribusiness supply chain risk management: A review of quantitative decision models. *Omega, 79,* 21-42. https://doi.org/10.1016/j.omega.2017.07.005
5. Bogodistov, Y., Presse, A., Krupskyi, O. P., & Sardak, S. (2017). Gendering dynamic capabilities in micro firms. *RAE Revista de Administracao de Empresas, 57*(3), 273-282. http://dx.doi.org/10.1590/S0034-759020170308
6. Castillo, C. N., Degamo, F. K., Gitgano, F. T., Loo, L. A., Pacaanas, S. M., Toroy, N., Ocampo, L., Sia, L., & Ocampo, C. O. (2017). Appropriate criteria set for personnel promotion across organizational levels using analytic hierarchy process (AHP). *International Journal of Production Management and Engineering, 5*(1), 11-22. https://doi.org/10.4995/ijpme.2017.5857
7. Christopher, M. (1972). Logistics in its marketing context. *European Journal of Marketing, 6*(2), 117-123. https://doi.org/10.1108/EUM0000000005131
8. Christopher, M., & Peck, H. (2011). *Marketing logistics* (2nd ed.) (157 p.). New York: Routledge. Retrieved from https://books.google.com.ua/books?hl=uk&lr=&id=7oEABAAAQBAJ&oi=fnd&pg=PP1&ots=cMBpMJ6n47&sig=k_--IhYV6ImHaN5Tzm-Se2_lTyU&redir_esc=y#v=onepage&q&f=false
9. Elberegli, M. A. (2018). *An integrated framework for improving supply chain performance* (Doctoral dissertation). Sheffield Hallam University. https://doi.org/10.7190/shu-thesis-00110
10. Feduzi, A., Runde, J., & Zappia, C. (2017). De Finetti and Savage on the normative relevance of imprecise reasoning: A reply to Arthmar and Brady. *History of Economic Ideas, 25*(1), 211-223. Retrieved from https://opus.lib.uts.edu.au/handle/10453/127579
11. Ficken, F. A. (2015). *The simplex method of linear programming.* Republication of the edition published by Holt, Rinehart and Winston. New York: Courier Dover Publications. Retrieved from https://www.bookdepository.com/Simplex-Method-Linear-Programming-F-Ficken/9780486796857
12. Formentini, M., Ellram, L. M., Boem, M., & Da Re, G. (2018). Finding true north: Design and implementation of a strategic sourcing framework. *Industrial Marketing Management, 77,* 182-197. https://doi.org/10.1016/j.indmarman.2018.09.006
13. Gilboa, I. (2015). Rationality and the Bayesian paradigm. *Journal of Economic Methodology, 22*(3), 312-334. https://doi.org/10.1080/1350178X.2015.1071505
14. Hoseini Shekarabi, S. A., Gharaei, A., & Karimi, M. (2018). Modelling and optimal lot-sizing of integrated multi-level multi-wholesaler supply chains under the shortage and limited warehouse space: generalised outer approximation. *International Journal of Systems Science: Operations & Logistics.* https://doi.org/10.1080/23302674.2018.1435835
15. Jeanpert, S., & Paché, G. (2016). Integration process in multichannel management: from consumer decisions to supply chain strategy. *Supply Chain Forum: An International Journal, 17*(4), 231-245. https://doi.org/10.1080/16258312.2016.1238165
16. Majercakova, E., & Majercak, P. (2015). Application of Clarke-Wright method for solving routing problem in distribution logistics. *Logi-Scientific Journal on Transport and Logistics, 6*(1), 90-99. Retrieved from http://logi.upce.cz/issues/2015-01/09.pdf
17. Menukhova, T., & Vyushkova, A. (2017). Using of Regionalization Techniques to Select Optimal Routes Based on Criteria of Road Features. *Transportation Research Procedia, 20,* 436-442. https://doi.org/10.1016/j.trpro.2017.01.071
18. Khalili, S. M., Jolai, F., & Torabi, S. A. (2016). Integrated production-distribution planning in two-echelon systems: a resilience view. *International Journal of Production Research, 55*(4), 1040-1064. https://doi.org/10.1080/00207543.2016.1213446
19. Khmarskyi, V., & Pavlov, R. (2017). Relation between marketing expenses and bank's financial position: Ukrainian reality. *Benchmarking: An International Journal, 24*(4), 903-933. https://doi.org/10.1108/BIJ-02-2016-0026
20. Lecouteux, G. (2018). Bayesian game theorists and non-Bayesian players. *The European Journal of the History of Economic Thought, 25*(6), 1-44. https://doi.org/10.1080/09672567.2018.1523207
21. Li, Y., Jiang, X., Zhu, H., He, X., Peeta, S., Zheng, T., & Li, Y. (2016). Multiple measures-based chaotic time series for traffic flow prediction based on Bayesian theory. *Nonlinear Dynamics, 85*(1), 179-194. Retrieved from https://link.springer.com/article/10.1007/s11071-016-2677-5
22. Namdar, J., Li, X., Sawhney, R., & Pradhan, N. (2018). Supply

chain resilience for single and multiple sourcing in the presence of disruption risks. *International Journal of Production Research, 56*(6), 2339-2360. https://doi.org/10.1080/00207543.2017.1370149

23. Ni, N., Howell, B. J., & Sharkey, T. C. (2018). Modeling the impact of unmet demand in supply chain resiliency planning. *Omega, 81,* 1-16. https://doi.org/10.1016/j.omega.2017.08.019

24. Ponis, S. T., Gayialis, S. P., Tatsiopoulos, I. P., Panayiotou, N. A., Stamatiou, D. R. I., & Ntalla, A. C. (2015). An application of AHP in the development process of a supply chain reference model focusing on demand variability. *Operational Research, 15*(3), 337-357. Retrieved from https://link.springer.com/article/10.1007/s12351-014-0163-8

25. Ramanathan, U. (2013). Aligning supply chain collaboration using Analytic Hierarchy Process. *Omega, 41*(2), 431-440. https://doi.org/10.1016/j.omega.2012.03.001

26. Rouquet, A., Henriquez, T., & Paché, G. (2018). Omni-Channel Strategies: An Exploratory Typology to Better Understand Logistical Dimensions. *IUP Journal of Supply Chain Management, 15*(4), 7-26. Retrieved from https://search.proquest.com/openview/fedbdfc1119b22deebdaf9370424112c/1?pq-origsite=gscholar&cbl=2030007

27. Saaty, R. W. (1987). The analytic hierarchy process-what it is and how it is used. *Mathematical modelling, 9*(3-5), 161-176. https://doi.org/10.1016/0270-0255(87)90473-8

28. Safaei, A. S., Farsad, S., & Paydar, M. M. (2018). Robust bi-level optimization of relief logistics operations. *Applied Mathematical Modelling, 56,* 359-380. https://doi.org/10.1016/j.apm.2017.12.003

29. Sawik, T. (2016). Integrated supply, production and distribution scheduling under disruption risks. *Omega, 62,* 131-144. https://doi.org/10.1016/j.omega.2015.09.005

30. Shen, Y., & Willems, S. P. (2014). Modeling sourcing strategies to mitigate part obsolescence. *European Journal of Operational Research, 236*(2), 522-533. https://doi.org/10.1016/j.ejor.2014.01.025

31. Siddh, M. M., Soni, G., Jain, R., & Sharma, M. K. (2018). Structural model of perishable food supply chain quality (PFSCQ) to improve sustainable organizational performance. *Benchmarking: An International Journal, 25*(7), 2272-2317. https://doi.org/10.1108/BIJ-01-2017-0003

32. Spillan, J. E., Mintu-Wimsatt, A., & Kara, A. (2018). Role of logistics strategy, coordination and customer service commitment on Chinese manufacturing firm competitiveness. *Asia Pacific Journal of Marketing and Logistics, 30*(5), 1365-1378. https://doi.org/10.1108/APJML-09-2017-0224

33. Subramanian, C., Chandrasekaran, M., & Govind, D. S. (2010). Analyzing the buyer supplier relationship factors: an integrated modeling approach. *International Journal of Management Science and Engineering Management, 5*(4), 293-302. https://doi.org/10.1080/17509653.2010.10671120

34. Vasylieva, N. (2018). Ukrainian Agricultural Contribution to the World Food Security: Economic Problems and Prospects. *Montenegrin Journal of Economics, 14*(4), 215-224. Retrieved from http://repec.mnje.com/mje/2018/v14-n04/mje_2018_v14-n04-a25.pdf

35. Velychko, O. (2014a). Development of infrastructural objects of providing logistics in the system of storing plant cultivation produce. *Economic Annals-XXI, 1-2*(1), 110-113. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-849025-84284&partnerID=MN8TOARS

36. Velychko, O. (2014b). Integrated modeling of solutions in the system of distributing logistics of a fruit and vegetable cooperative. *Business: Theory and Practice / Verslas: Teorija ir Praktika, 15*(4), 362-370. https://doi.org/10.3846/btp.2014.480

37. Wang, T. K., Zhang, Q., Chong, H. Y., & Wang, X. (2017). Integrated supplier selection framework in a resilient construction supply chain: An approach via analytic hierarchy process (AHP) and grey relational analysis (GRA). *Sustainability, 9*(2), 289. https://doi.org/10.3390/su9020289

38. Yatsiv, I., & Kolodiichuk, V. (2017). Formation of social responsibility of large agricultural land users in Ukraine. *Economic Annals-XXI, 168,* 11-12. https://doi.org/10.21003/ea.V168-10

39. Ye, F., & Li, Y. (2014). An extended TOPSIS model based on the possibility theory under fuzzy environment. *Knowledge-Based Systems, 67,* 263-269. https://doi.org/10.1016/j.knosys.2014.04.046

http://dx.doi.org/10.21511/im.15(2).2019.05