

Supplier Selection in Manufacturing Industry using ANN and GA

Aniket A. Kadu¹, Deepak K. Kadam², Amit B. Sanap³ and Madan Jagtap⁴

¹Student, Saraswati College of engineering, nktkadu9@gmail.com

²Student, Saraswati College of engineering, kadamdeepak96@gmail.com

³Student, Saraswati College of engineering, amit10596@gmail.com

⁴Associate Professor, Saraswati College of engineering, jagtap.aero@gmail.com

Abstract

In this paper we tend to present a review of decision methods within the literature for supporting the supplier selection process. The review relies on an intensive search within the educational literature. We tend to position the contributions throughout a framework that takes the variety of acquisition things in terms of quality and importance into consideration and covers all phases among the supplier selection technique from initial downside definition, over the formulation of criteria, the qualification of potential suppliers, to the ultimate selection among the qualified suppliers. We tend to suggest the methodology of integration of GA with ANN to decide on best vendor among the other market suppliers.

Keywords

Supplier selection, decision making model, artificial neural network (ANN), genetical algorithm (GA), multi-criteria decision making (MCDM).

INTRODUCTION

Supplier selection and supplier analysis is one the foremost necessary activity within the management of supplier chain. Choice and analysis of suppliers is one in every of the foremost crucial activities of an organization and impacts the full performance of the firm. The worldwide competition among industries to reply quickly to customers has diode to the choice of the best provider from the lot. In several industries, value of raw materials and parts represent a significant portion of the merchandise cost so the supplier selection decision determine how many and which suppliers should be selected. Selection is claimed to be efficient when we get not only desirable solution but also optimal solution.

Demirtas and Ustun (2008) have advised 2 forms of supplier selection problems,

- 1 One provider will satisfy all the buyer's wants
- 2 Single provider will satisfy all the buyers or customers demand

In such circumstances, management desires to separate order quantities among suppliers for variety of reasons that has creating a relentless atmosphere of rivalry. The success of the supply chain is extremely enthusiastic about the choice of best suppliers, merely longing for suppliers that's giving lowest value isn't economical sourcing any longer multiple criteria are required to be taken under consideration once choosing providers. Shaping the criteria's for choice of the supplier is additionally a crucial task. The most criteria for supplier and key partner choice are: quality, delivery, performance history, production capability, service, engineering and technical capability, business structure, price, integrity, warranties, honesty, responsibility, reputation, commitment and monetary position a number of these factors are connected with one another, whereas some contradict others. Supplier selection method usually involves the choice of bound criteria whereas eliminating the other criteria. Take into account the state during which one provider is providing merchandise at cheaper rates however isn't ready to deliver on time additionally the standard of products/parts isn't good. On the opposite hand, another provider provides merchandise of higher quality however its value is another provider provides merchandise of higher quality however its value is high additionally delivery time is additional. Therefore, supplier choice belongs to the category of multi-criteria decision making (MCDM) downside during which

the companies have to be compelled to determine the highest priorities of choosing the simplest provider supported its operating vogue and also the trade sort. There exists several MCDM techniques for supplier selection a number of them are analytic hierarchy method (AHP), analytic network method (ANP), case-based reasoning (CBR), data envelopment analysis (DEA), fuzzy set theory, genetic algorithm (GA), artificial neural network (ANN), mathematical programming, simple multi attribute rating technique (SMART), and their hybrids. These approaches are used on an individual basis or are integrated along to resolve supplier selection issues.

LITERATURE REVIEW

Nitesh Asthana et al [1] presents the combination of GA with ANN to develop a decision making model for the choice of the best provider. This work integrates multi-attribute deciding models that offer grade to providers on a group of criteria with the mathematical programming techniques that model the constraints associated an objective perform to pick the simplest supplier.

C.Lakshmanpriya and Dr.N. Sangeetha et al [2] discovered that suppliers measure one in every of the foremost essential parts of the worth chain, the supplier selection and analysis measure critically necessary management task. The supplier selection method deploys an incredible quantity of a firm's monetary resources. They gift a hybrid model exploitation Analytic hierarchy method (AHP) and Neural Networks (NNs) theory to review seller performance.

Jitendra Kumar and Nirijhar Roy [3] discovered that to pick the vendors, there's requirement to rank all the potential vendors in keeping with a performance live as a result of during this trade the majority things measure outsourced from vendors and input material price represent nearly eighty percentage price of the merchandise. They gift a hybrid model exploitation analytic hierarchy method (AHP) and neural networks (NNs) theory to assess seller performance. The model permits to manage the complexness and criteria embedded within the seller choice downside.

Rajesh A. cubed et al [4] used Analytical hierarchy method for provider choice downside. The projected methodology may be used for choosing different choices associated with, production designing choices, development method, order production, supply administration and site selection.

Rachmad Hidayat et al [5] used fuzzy methodology to search out the weights of criteria, whereas information enclosing analysis is employed to gauge the potency. From the results of information process and analysis they notice best supplier.

Dr. Bhatt Rajiv and Dr. Bhatt Darshana et al [6] uses 3 multi criteria deciding techniques such as: Analytic Hierarchy method (AHP), (TOPSIS) and (VIKOR) methodology for best provider choice for purchase of cement in construction project. TOPSIS suggests best provider in keeping with ranking index and VIKOR methodology suggests best provider closest to the perfect resolution. Such innovative approach will bring profit maximization and quality sweetening of construction comes.

Huan-Jyh Shyur et al [7] presents a good model exploitation each ANP and changed TOPSIS technique for strategic seller choice. To accommodate the factors with reciprocity, the ANP methodology is chosen to get the relative weight of criteria.

Masoud Rahiminezhad Galankashi Kashi et al [8] projected associate integrated Balanced Scorecard-Fuzzy Analytic Hierarchical method (BSC-FAHP) model to pick suppliers within the automotive trade. In spite of the large quantity of studies on supplier choice, the analysis and choice of suppliers using the particular measures of the automotive industry are less investigated. So as to fill this gap, they projected a replacement BSC for supplier selection of industry.

Ahmed Dargi Ali et al [9] develops a framework to support the supplier selection method in associate Iranian industry. A fuzzy Analytical Network method (FANP) is employed to weight the extracted measures and confirm their importance level.

Ali Chegwin et al [10] uses NGT to extract the foremost necessary inexperienced provider choice key performance indicators aligned with addressing a FANP to rank them. This technique is versatile to be used for various managerial decisions to gauge suppliers.

Luitzen de Boer et al [11] presents a review of decision methods reported within the literature for supporting the supplier selection method. The review is predicted on an intensive search within the educational literature.

Gul Polat and Ekin Eary et al [12] projected an integrated approach that integrates analytic hierarchy method (AHP) and evidential reasoning (ER), to assist construction firms in choosing the

foremost applicable provider in their projects. Within the projected approach, the AHP methodology is employed to search out the weights of the selection criteria and also the ER methodology is employed to rank the alternative suppliers.

Chuda Basnet and Andres Weintraub et al [13] discuss the matter of choosing suppliers for an organisation, wherever variety of suppliers have created supply offers for supply of things, however have restricted capability. Choosing most affordable combination of suppliers could be a simple matter, however purchasers usually have a twin goal of lowering the quantity of suppliers they manage.

S.H. Tang et al [14] combines the AHP with Artificial Neural Network (ANN) and projected a hybrid AHP-ANN methodology. Group action of the AHP and ANN may compensate on every other's disadvantage in satisfying the wants of the supplier selection process. The effectiveness of their approach is demonstrated through the instance of shoes producing company that finds the connected criteria, evaluate and choose the simplest provider.

Vladimir Raskovic et al [15] given supplier selection using evolutionary algorithm (SPEA method) as criteria for selection improvement. They used variance of quality and total prices. Result shows that represented methodology may be applicable for the sensible functions.

Ashutosh Kumar Mishra et al [16] centred his study on the identification of the extremely appropriate land for organic farming within the study area. AHP matrix with integration of GIS issued for the analysis during which six completely different criteria were thought-about. The AHP with combination of GIS was found terribly helpful for the acceptable site identification. The ultimate result may be adopted for the decision making method of the organic farming within the study area, because it provides insight find the acceptable areas.

Mani. Va. Agarwal et al [17] complete that social sustainability practices within supply chain go an extended manner in achieving he company triple essential purpose approach. During this study, several social sustainability criteria were known through the Delphi process and these metrics were additionally applied in real environments in 3 completely different firms. The results were tabulated and shown to the several purchase managers for sustainable supplier selection. The

AHP model helped the supply chain executive in socially sustainable supplier selection. Relevant and essential social parameters were accustomed prioritise suppliers during this model. This analysis addresses the requirements for social sustainability in business, particularly within the supplier chain. Though social sustainability parameters within the supply chain aren't very prevalent, with this new model, company would be ready to incorporate them in analysis and partner choice.

Kerem Toker et al [18] have determined vital strategic factors to producing firm by combining SWOT with AHP techniques. The findings show the subsequent ranking of every SWOT cluster priority

Strengths(groupweight32.5%)Opportunities(40.3%), Weaknesses (9.6%) and Threats (17.3%). According to analysis the foremost necessary factors are "Rising living standards and increasing trendy buildings" from opportunities group. This matter is the most significant issue to be thought-about with associate overall priority value of 0.197. Alternative extended factors as follows in keeping with priority: Quality of the product (15.6%), Energy costs (5.7%), Labor costs (5.6%) and Competition (3.2%) factors. Using calculated priorities of SWOT factors might be developed a management approach or supported for animportant choices.

Josef Jablonsky et al [19] determined how the AHP models may be used for the efficient evaluation of production units, and to match the results given by the projected Interval AHP model with the efficiency scores computed by DEA models.

Wen-Pai Wang et al [20] known position of provider. Enterprises figure suppliers for a superfluity of inputs. Such like suppliers may can results in a tremendous impact on the firm's bottom line as vital resources are typically devoted to organizational procurement. Moreover, these suppliers will influence the perceptions that downstream customers hold concerning the organizations merchandise still because the rate with that merchandise reach the market. Thus, it's become wide accepted that foremost acquisition practices will offer a basis for securing a competitive advantage. With all the strategy concern, evaluating strategic suppliers ought to be associate applicable mechanism for firms to collaborate for gaining the core vantage and guide the corporate within the face of the challenge within the future; likewise, it might advantage mangers to effectively persevere enhanced current supplier's capabilities within the light weight of

numerous performance level of criteria and connected sides.

Sanjay K. Paul et al [21] discovered that within the international competitive business atmosphere, makers should maintain optimum amount of finished merchandise inventory to cut back price and to maximise the potency of supply chain. Firms aim to provide the specific quantity of finished merchandise in right place and at right time with right price. An ANN model has been developed for improvement of finished merchandise inventory as a function of requirement, configuration cost, holding and material price. The model was tested to be reach success in terms of agreement with actual values for a manufacturing industry.

Manish Gupta and Rakesh Narain et al [22] says an honest e-procurement provides a organized manner for open communication and get in touch with the throughout a business process. Indian organisations are giving importance to cooperative relationship with their suppliers that ends up in better communication and interaction between the client organisation and suppliers on each issue. Indian organisations do powerfully believe taking the suppliers into confidence before taking any major choices or initiating for embarking on something new. This approach would beyond any doubt build a some way of confidence, pride and belongingness within the minds of the suppliers.

Charles A Weber et al [23] Artificial intelligence based models like ANN are used extensively to manage supplier selection problems as a results of it permits solutions to problems wherever multiple constraints should be glad at the same time, easily integrated with other methods, easily implemented to the software, provides additional precise results, possess the potential to generalise, will predict new outcomes on past trends, exhibit mapping capabilities, can process information at high speed. ANN is extremely helpful in practical and dynamic applications.

Chirawat Woarawichai Krishna et al [24] GA is search and optimisation algorithm that derive their computational mechanisms from natural selection and natural adaptation. GA uses mechanisms impressed by biological evolution such as reproduction, selection, crossover, mutation. GA has been wide used as a results of it'll solve multi-dimensional, non-differential, non-continuous and even non-parametrical problems, GA searches from one population of solutions to a different, instead of from individual to individual, GA solely uses objective function information to guide themselves through solution space and not derivatives, GA are

easily transferred to existing simulations and models.

Siyang Wei et al [25] given a model supported integration of ANN and GA to pick the supplier, here GA was answerable for finding the weights of the neural network model. ANN was then use to choose the best supplier.

METHODOLOGY

As already mentioned within the literature review that there exists variety of criterion for supplier selection which they additionally vary product to product and organisation to organisation thus consecutive step is that the selection of supplier selection criteria. Since the info was to be collected from the auto organisation, thus the foremost are selected for supplier selection and are: quality, delay time, unit cost, quantity and service. The on top of elect criteria are in accordance with the discussion held with the executives of the automobile sector.

The next is that the choice of the methodology of supplier selection. Among the present methodologies, GA and ANN are integrated along for the MCDM downside. The reason for using the ANN model to solve supplier selection problem are: ANN permits solutions to issues wherever multiple constraints should be glad satisfied simultaneously, weights within the ANN may be changed with any EAs/ other techniques very easily, ANN possess the potential to generalise, will predict new outcomes on past trends, ANN can be simply integrated with alternative ways, ANN exhibit mapping capabilities. The reason for using GA in supplier selection process are: GA will solve multi-dimensional, non-differential, non-continuous and even non-parametrical problems, GA searches from one population of solutions to a different, instead of from individual to individual, GA solves problems with multiple solutions, GA solely uses objective function information to guide themselves through solution space and not derivatives, GA are easily transferred to existing simulations and models, GA will simply solve the matter if variety of parameters are terribly massive.

Therefore the ultimate deciding model during this study consists of the combination of GA and ANN. The projected model consists of 2 parts:

Part 1 applies GA to find out the optimal value of functions of quality, delay time, unit cost, quantity, service. Linear objective functions of the above criteria of the form $\sum W_i X_i$ are formed. Weights 'W_i' are obtained by relative comparison of information assorted suppliers. Based on the

industrial data and company policy bounds of variable 'Xi' are also defined.

Part 2 uses optimum value of the functions within the ANN model to work out the supplier score. Best supplier is one that has minimum score. Figure 1 represents the neural network deciding model that is created to search out the supplier score supported the input criteria's.

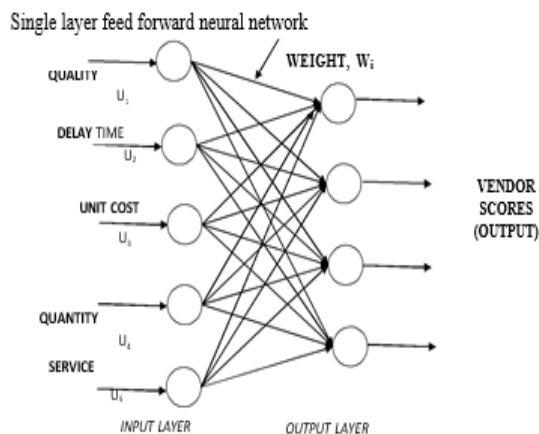


Fig 1. Neural Network model

The step by step procedure for calculation of supplier score is given below:

1 Calculation of weights of neural network for each input and output layer. The input layer weights are calculated by pair wise comparison of the criteria's. The output layer weights (W_i) are calculated by relative comparisons of suppliers with relation to particular criteria

2 Formulation of the objective function, with constraints. An objective functions of the form

Minimise $\sum W_i X_i$ or Maximise $\sum W_i X_i$

Subject to $W_1 + W_2 + \dots + W_i = 1; L < X_i < U$ is formed.

Here 'Xi' are the criteria's and 'L', 'U' are its lower and upper bound.

3 Optimisation of formulated objective function using GA. The optimisation tool box of MATLAB is used to optimise the function, and find the optimum value of specific criteria for every supplier.

4 Using the optimised value obtained from GA as an input to the INPUT layer for calculation of the output of the INPUT layer.

5 Using the output value of the INPUT layer as an input for OUTPUT layer for calculation of the output of the OUTPUT layer i.e. supplier score.

6 Validating the model with the manager/supervisor's ranking of suppliers through industrial visits and discussion with the executives of the organisation.

CONCLUSION

This paper presents a study of the supplier selection problem. During this paper, an attempt is made to pick the best and optimal supplier based on the evaluating criteria using ANN and GA. The integrated model developed is best in managing the complexness related to the supplier selection problem. The results of the study not solely offer head to pick the best supplier from the available potential suppliers however additionally rank the suppliers, so that the resolution maker may choose the substitute.

REFERENCES

- [1] Nitesh Asthana and Manish Gupta "Supplier selection using artificial neural network and genetic algorithm", Int. J. Indian Culture and Business Management, Vol. 11, No. 4, 2015
- [2] C. Lakshmanpriya, Dr. N. Sangeetha & Clinandria "Vendor Selection in Manufacturing Industry using AHP and ANN", The SIJ Transactions on Industrial, Financial & Business Management (IFBM), Vol. 1, No. 1, March-April 2013
- [3] Jitendra Kumar & Narhari Roy "A Hybrid Method for Vendor Selection using Neural Network", International Journal of Computer Applications (0975 – 8887) Volume 11– No.12, December 2010
- [4] Rajesh A. Cubed & Rd.Satish. Bandos "The Analytic Hierarchy Process Based Supplier Selection Approach for Collaborative Planning Forecasting and Replenishment Systems", International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 7, September - 2012 ISSN: 2278-0181
- [5] RashadHidaka "Supply Chain Management Supplier Selection Using Fuzzy-Data Envelopment Analysis (DEA)", International Journal of Engineering Research & Technology (IJERT) Vol. 3 Issue 1, January – 2014 IJERTIJERT ISSN: 2278-0181
- [6] Dr Bhatt Rajiv & Dr. Bhatt Darshana "Supplier Selection for Construction Projects Through 'TOPSIS' and 'VIKOR' Multi-Criteria Decision Making Methods", Vol. 3 Issue 5, May – 2014 International Journal of Engineering Research & Technology (IJERT) IJERT ISSN: 2278-0181
- [7] Huan-Jyh Shyura, Hsu-Shih Shih "A hybrid MCDM model for strategic vendor selection", Mathematical and Computer Modelling 44 (2006) 749–761
- [8] Masoud Rahiminezhad Galankashi, Ali Chegeni, Amin Soleimanyanadegany, Ashkan Memari, Ali Anjomshoea, Syed Ahmad Helmi*, Ahmad Dargi "Supplier selection in automobile industry", Procedia CIRP 26 (2015) 689 – 694
- [9] Ahmad Dargia, Ali Anjomshoea, Masoud Rahiminezhad Galankashia, Ashkan Memaria*, Masine Binti Md. Tapa

“Supplier Selection: A Fuzzy-ANP Approach”, *Procedia Computer Science* 31 (2014) 691 – 700

[10] Masjid Rahininezhad Valan kadhi, Ali chegeni, Amin soleimanyanadegany, Ashkan Me mari “Prioritizing Green Supplier Selection Criteria using Fuzzy Analytical Network Process”, *Procedia CIRP* 26 (2015) 689 – 694

[11] Luitzen de Boer*, Eva Labro*, Pierangela Morlacchi “A review of methods supporting supplier selection”, *European Journal of Purchasing & Supply Management* 7 (2001) 75-89

[12] Gul Polata, Ekin Erayb “An integrated approach using AHP-ER to supplier selection in railway projects”, *Procedia Engineering* 123 (2015) 415 – 422

[13] Chuda Basneta and Andres Weintraubb “A genetic algorithm for a bicriteria supplier selection problem”, *Intl. Trans. in Op. Res.* 16 (2009) 173–187

[14] S.H.Tang, N. Hakim, W. Khaksar, M. K. A. Ariffin, S. Sulaiman, and P. S. Pah “A Hybrid Method using Analytic Hierarchical Process and Artificial Neural Network for Supplier Selection”, *International Journal of Innovation, Management and Technology*, Vol. 4, No. 1, February 2013

[15] Vladimir Rankovic, Zora Arsovska, Slavko Arsovska, Zoran Kalinic, Igor Milanovi, and Dragana Rejman-Petrovic “Supplier Selection Using Multiobjective Evolutionary Algorithm”, G.D. Putnik and M.M. Cruz-Cunha (Eds.): *ViNORG 2011*, CCIS 248, pp. 327–336, 2012. © Springer-Verlag Berlin Heidelberg 2012

[16] Ashutosh Kumar Mishra, “Identification of suitable sites for organic farming using AHP & GIS (2014)”, *National Authority for Remote Sensing and Space Sciences (2014)*, *The Egyptian Journal of Remote Sensing and Space Sciences*,.

[17] Mani.Va, Agarwala, “Supplier selection using social sustainability: AHP based approach in India (2014)”, *Department of Management Studies, Indian Institute of Technology, Roorkee 247667, India*, *international strategic management review* page no [98]-[112]

[18] Kerem Toker, “Application of Combined SWOT and AHP: A Case Study for a Manufacturing Firm”, *8th International Strategic Management Conference, Procedia - Social and Behavioral Sciences* 58 (2012) [1525] – [1534]

[19] Josef Jablonsky, “Measuring the efficiency of production units by AHP models” (2007), *University of Economics, Department of Econometrics, Mathematical and Computer Modelling* 46 (2007) [1091]–[1098]

[20] F. Tunc, Bozbura, Prioritization of organizational capital measurement indicators using fuzzy AHP (2007), *Department of Industrial Engineering, Bahcesehir University, 34100, Besiktas, Istanbul, Turkey*, *International Journal of Approximate Reasoning* 44 (2007) [124]– [147]

[21] Jingfei YU, Study on the Status Evaluation of Urban Road Intersections Traffic Congestion Base on AHP-TOPSIS Model (2013), *13th COTA International Conference of Transportation Professionals (CICTP 2013)*, *Procedia - Social and Behavioral Sciences* 96 (2013) [609] – [616]

[22] Manish Gupta and Rakesh Narain “A survey on supplier relationship in e-procurement in Indian organisations”, *Int. J. Logistics Systems and Management*, Vol. 12, No. 1, 2012

[23] Siying Wei, Jinlong Zhang, Zhicheng Li “A Supplier-selecting System Using a Neural Network”, *1997 IEEE International Conference on Intelligent Processing Systems*

[24] Chirawat Woarawichai, Kritsana Kuruvit, Paitoon Vashirawongpinyo “Applying Genetic Algorithms for Inventory Lot-Sizing Problem with Supplier Selection under, stage

Capacity Constraints”, *IJCSI International Journal of Computer Science Issues*, Vol. 9, Issue 1, No 1, January 2012 ISSN (Online): 1694-0814

[25] Charles A. Weber, John R. Current and W.C. Benton “Vendor selection criteria and methods (1991)”,