

Multi-objective model for the location of distribution centres with cost evaluation, road access and insecurity

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Abstract

This paper presents an alternative to the location of distribution centres considering a multi-objective model minimising insecurity cost and road access for a case study in the City of Barranquilla (Colombia). For the solution of the model, 15 different scenarios of variation of the importance of the proposed objectives are considered. As a basis for the design of the modelling, the characterisation and classification of the variables with the highest incidence in the location of distribution centres or warehouses are posed. It is possible to demonstrate the impact of the evaluation and analysis of the mathematical model for the location of this type of facility.

Keywords:

Costs; Distribution centres; Location of facilities; Multi-objective model; Road access; Security

Referencias

- 1 Adly, A.A., Abd-El-Hafiz, S.K. A performance-oriented power transformer design methodology using multi-objective evolutionary optimization (Open Access) (2015) *Journal of Advanced Research*, 6 (3), pp. 417-423. Cited 25 times.
http://www.elsevier.com/wps/find/journaldescription.cws_home/722881/description#description doi: 10.1016/j.jare.2014.08.003
- 2 Akgün, İ., Erdal, H. Solving an ammunition distribution network design problem using multi-objective mathematical modeling, combined AHP-TOPSIS, and GIS (2019) *Computers and Industrial Engineering*, 129, pp. 512-528. Cited 16 times. doi: 10.1016/j.cie.2019.02.004
- 3 Bolori Arabani, A., Farahani, R.Z. Facility location dynamics: An overview of classifications and applications (2012) *Computers and Industrial Engineering*, 62 (1), pp. 408-420. Cited 190 times. doi: 10.1016/j.cie.2011.09.018
- 4 Báez, M.
(2011) *Apoyo a la Decisión Para el Diseño y La Planeación Integrados de Una Cadena de Suministro* Doctoral thesis, Universidad Autónoma de Nuevo León, Monterrey, México
- 5 Benyoucef, L., Xie, X. Supply chain design using simulation-based NSGA-II approach (2011) *Multi-objective Evolutionary Optimisation for Product Design and Manufacturing*, pp. 455-491. Cited 6 times. Springer, London
- 6 Bilir, C., Ekici, S.O., Ulengin, F. An integrated multi-objective supply chain network and competitive facility location model (Open Access) (2017) *Computers and Industrial Engineering*, 108, pp. 136-148. Cited

22 times. <https://www.journals.elsevier.com/computers-and-industrial-engineering> doi: 10.1016/j.cie.2017.04.020

7 Caballero, R., González, M., Guerrero, F.M., Molina, J., Paralera, C. Solving a multiobjective location routing problem with a metaheuristic based on tabu search. Application to a real case in Andalusia (2007) European Journal of Operational Research, 177 (3), pp. 1751-1763. Cited 119 times. doi: 10.1016/j.ejor.2005.10.017

8 Cardona-Valdés, Y., Álvarez, A., Ozdemir, D. A bi-objective supply chain design problem with uncertainty (2011) Transportation Research Part C: Emerging Technologies, 19 (5), pp. 821-832. Cited 77 times. www.elsevier.com/inca/publications/store/1/3/0/ doi: 10.1016/j.trc.2010.04.003

9 Chukwuma, E.C. Facility location allocation modelling for bio-energy system in Anambra State of Nigeria: Integration of GIS and location model (2019) Renewable Energy, 141, pp. 460-467. Cited 8 times. <http://www.journals.elsevier.com/renewable-and-sustainable-energy-reviews/> doi: 10.1016/j.renene.2019.04.022

10 Klose, A., Drexl, A. Facility location models for distribution system design (Open Access) (2005) European Journal of Operational Research, 162 (1), pp. 4-29. Cited 632 times. doi: 10.1016/j.ejor.2003.10.031

11 Labbé, M., Leal, M., Puerto, J. New models for the location of controversial facilities: A bilevel programming approach (Open Access) (2019) Computers and Operations Research, 107, pp. 95-106. Cited 8 times. www.elsevier.com/inca/publications/store/3/0/0/ doi: 10.1016/j.cor.2019.03.003

12 Lee, C.Y. The multiproduct warehouse location problem: Applying a decomposition algorithm (1993) *International Journal of Physical Distribution & Logistics Management*, 23 (6), pp. 3-13. Cited 16 times. doi: 10.1108/09600039310044858

13 Liang, T.-F. Fuzzy multi-objective production/distribution planning decisions with multi-product and multi-time period in a supply chain (2008) *Computers and Industrial Engineering*, 55 (3), pp. 676-694. Cited 152 times. doi: 10.1016/j.cie.2008.02.008

14 Liang, W.Y., Huang, C.-C., Lin, Y.-C., Chang, T.H., Shih, M.H. The multi-objective label correcting algorithm for supply chain modeling (2013) *International Journal of Production Economics*, 142 (1), pp. 172-178. Cited 11 times. doi: 10.1016/j.ijpe.2012.11.002

15 Mahalakshmi, S., Arokiasamy, A., Fakrudeen Ali Ahamed, J. Productivity improvement of an eco friendly warehouse using multi objective optimal robot trajectory planning (2019) *International Journal of Productivity and Quality Management*, 27 (3), pp. 305-328. Cited 3 times. <http://www.inderscience.com/ijpqm> doi: 10.1504/IJPQM.2019.101571

16 Mangiaracina, R., Song, G., Perego, A. Distribution network design: A literature review and a research agenda (2015) *International Journal of Physical Distribution and Logistics Management*, 45 (5), pp. 506-531. Cited 39 times. <http://www.emeraldinsight.com/info/journals/ijpdlm/ijpdlm.jsp> doi: 10.1108/IJPDLM-02-2014-0035

17 Melachrinoudis, E., Min, H. Dynamic relocation and phase-out of a hybrid, two-echelon plant/warehousing facility: a multiple objective approach (2000) *European Journal of Operational Research*, 123 (1), pp. 1-15. Cited 102 times. doi: 10.1016/S0377-2217(99)00166-6

18 Melo, M.T., Nickel, S., Saldanha-da-Gama, F. Facility location and supply chain management - A review (2009) *European Journal of Operational Research*, 196 (2), pp. 401-412. Cited 1190 times. doi: 10.1016/j.ejor.2008.05.007

19 Min, H., Melachrinoudis, E. The relocation of a hybrid manufacturing/distribution facility from supply chain perspectives: A case study (1999) *Omega*, 27 (1), pp. 75-85. Cited 88 times. doi: 10.1016/S0305-0483(98)00036-X

20 Mirzapour Al-E-Hashem, S.M.J., Malekly, H., Aryanezhad, M.B. A multi-objective robust optimization model for multi-product multi-site aggregate production planning in a supply chain under uncertainty (2011) *International Journal of Production Economics*, 134 (1), pp. 28-42. Cited 254 times. doi: 10.1016/j.ijpe.2011.01.027

21 Niño-Vargas, J., Lamos-Díaz, H. Mathematical model to determinate distribution centers location in a real context (2014) *Scientia et Technica*, 19 (4), pp. 385-391.

22 Nurjanni, K.P., Carvalho, M.S., da Costa, L.A.A.F. Green supply chain design with multi-objective optimization (2014) *Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management*, pp. 7-9. Cited 9 times. Bali, Indonesia

23 Obredor-Baldovino, T., Barcasnegras-Moreno, E., Mercado-Caruso, N., Salas-Navarro, K., Sana, S.S. Coverage Reduction: A Mathematical Model (Open Access) (2018) *Journal of Advanced Manufacturing Systems*, 17 (3), pp. 317-331. Cited 2 times.
<http://www.worldscinet.com/jams/jams.shtml> doi: 10.1142/S0219686718500191

24 Olhager, J., Pashaei, S., Sternberg, H. Design of global production and distribution networks: A literature review and research agenda (2015) International Journal of Physical Distribution and Logistics Management, 45, pp. 138-158. Cited 43 times.
<http://www.emeraldinsight.com/info/journals/ijpdlm/ijpdlm.jsp> doi: 10.1108/IJPDLM-05-2013-0131

25 Özcan, T., Elebi, N., Esnaf, A. Comparative analysis of multi-criteria decision making methodologies and implementation of a warehouse location selection problema (2011) Expert Systems with Applications, 38 (8), pp. 9773-9779. Cited 189 times. doi: 10.1016/j.eswa.2011.02.022

26 Pourrousta, A., Tavakkoli-Moghaddam, R. A multi-objective particle swarm optimization for production-distribution planning in supply chain network (2002) Management Science Letters, 2 (2), pp. 603-614. Cited 7 times.

27 Pulgarín, C.A., Ríos, M.A., Acosta, C.A., Hincapié, R.A., Granada, M., Gallego, R.A. Localización óptima de reconectores normalmente abiertos para transferencia de carga (2013) Revista Mundo Eléctrico, 90 (2), pp. 38-44. Cited 6 times.

28 Razi, N., Karatas, M. A multi-objective model for locating search and rescue boats (2016) European Journal of Operational Research, 254 (1), pp. 279-293. Cited 31 times. doi: 10.1016/j.ejor.2016.03.026

29 Roa, A.F. (2011) Método Para Localización Óptima de Centrales de Energías Renovables Doctoral dissertation, Universidad de Santiago de Chile, Santiago, Chile

30 Ruvalcaba, L., Correa, G. Ubicación de instalaciones industriales: metodología para reducción del impacto ambiental (2011) Teorías, Enfoques y Aplicaciones en las Ciencias Sociales, 4 (7), pp. 69-84.

31 Saffar, M.M., Hamed Shakouri, G., Razmi, J. A new multi objective optimization model for designing a green supply chain network under uncertainty (Open Access) (2015) International Journal of Industrial Engineering Computations, 6 (1). Cited 28 times.

http://www.growingscience.com/ijiec/IJIEC_2014_34.pdf doi: 10.5267/j.ijiec.2014.10.001

32 Salas Navarro, K., Chedid, J.A., Caruso, N.M., Sana, S.S. An inventory model of three-layer supply chain of wood and furniture industry in the Caribbean region of Colombia (Open Access) (2018) International Journal of Systems Science: Operations and Logistics, 5 (1), pp. 69-86. Cited 13 times. tandfonline.com/toc/tsyb20/current doi: 10.1080/23302674.2016.1212428

33 Salas, K., Acosta Villa, C., Sandoval Cortes, L., Pacheco, G., Mercado Caruso, N. Strategic analysis of cluster of logistics services (2016) Espacios, 37 (28), art. no. 5. Cited 9 times. <http://www.revistaespacios.com/a16v37n28/16372805.html>

34 Salas, Y.J.C., Ledón, R.A. Estrategia de localización con enfoque multiobjetivo para almacenes intermedios en procesos de reciclaje de envases de vidrio (2009) Ingeniería Industrial, 30 (1), pp. 1-6.

35 Latha Shankar, B., Basavarajappa, S., Kadadevaramath, R.S., Chen, J.C.H. A bi-objective optimization of supply chain design and distribution operations using non-dominated sorting algorithm: A case study (2013) Expert Systems with Applications, 40 (14), pp. 5730-5739. Cited 27 times. doi: 10.1016/j.eswa.2013.03.047

36 Umar Sherif, S., Sasikumar, P., Asokan, P., Jerald, J. Bi-objective optimisation model with societal constraints for green closed loop supply chain network-a case of battery industry (2019) International Journal of Productivity and Quality Management, 27 (3), pp. 276-304. Cited 2 times. <http://www.inderscience.com/ijpqm> doi: 10.1504/IJPQM.2019.101518

37 Silva, S., Alçada-Almeida, L., Dias, L.C. Multiobjective programming for sizing and locating biogas plants: A model and an application in a region of Portugal (Open Access) (2017) Computers and Operations Research, 83, pp. 189-198. Cited 16 times. www.elsevier.com/inca/publications/store/3/0/0/ doi: 10.1016/j.cor.2017.02.016

38 Soto-de la Vega, D., Vidal-Vieira, J.G., Vitor-Toso, E.A. Methodology for distribution centers location through multicriteria analysis and optimization (Open Access) (2014) DYNA (Colombia), 81 (184), pp. 28-35. Cited 8 times. <http://dyna.unalmed.edu.co/en/ediciones/184/articulos/v81n184a03/v81n184a03.pdf> doi: 10.15446/dyna.v81n184.39654

39 Tarôco, C.G., Takahashi, R.H.C., Carrano, E.G. Multiobjective planning of power distribution networks with facility location for distributed generation (2016) Electric Power Systems Research, 141, pp. 562-571. Cited 21 times. doi: 10.1016/j.epsr.2016.08.020

40 Medina Tapia, M., Cerda Troncoso, J. An optimal location model of undesirable facilities applied to the solid wastes in the metropolitan región (2008) Ingeniare, 16 (2), pp. 211-219. <http://www.scielo.cl/pdf/ingeniare/v16n2/ART11.pdf>

41 Xu, J., Liu, Q., Wang, R. A class of multi-objective supply chain networks optimal model under random fuzzy environment and its

application to the industry of Chinese liquor (2008) *Information Sciences*, 178 (8), pp. 2022-2043. Cited 112 times. doi: 10.1016/j.ins.2007.11.025

42 Yang, L., Jones, B.F., Yang, S.-H. A fuzzy multi-objective programming for optimization of fire station locations through genetic algorithms (Open Access) (2007) *European Journal of Operational Research*, 181 (2), pp. 903-915. Cited 114 times. doi: 10.1016/j.ejor.2006.07.003

43 Yerovi, C. (2012) *Propuesta Para la Localización de Zonas Industriales en Ecuador*

44 Farahani, R.Z., SteadieSeifi, M., Asgari, N. Multiple criteria facility location problems: A survey (Open Access) (2010) *Applied Mathematical Modelling*, 34 (7), pp. 1689-1709. Cited 369 times. doi: 10.1016/j.apm.2009.10.005

45 Zhang, S., Lee, C.K.M., Wu, K., Choy, K.L. Multi-objective optimization for sustainable supply chain network design considering multiple distribution channels (2016) *Expert Systems with Applications*, 65, pp. 87-99. Cited 47 times. doi: 10.1016/j.eswa.2016.08.037