CIO 2019

13th International Conference on Industrial Engineering and Industrial Management

XXIII Congreso de Ingeniería de Organización

Organizational Engineering in Industry 4.0

BOOK OF ABSTRACTS

Gijón, 11th-12th July 2019

Book of Abstracts

“13th International Conference on Industrial Engineering and Industrial Management” and “XXIII Congreso de Ingeniería de Organización (CIO2019)”

Book of Abstracts

“13th International Conference on Industrial Engineering and Industrial Management” and “XXIII Congreso de Ingeniería de Organización (CIO2019)”

COORDINADORES

DAVID DE LA FUENTE GARCÍA

RAÚL PINO DIEZ

PAOLO PRIORE

FCO. JAVIER PUENTE GARCÍA

ALBERTO GÓMEZ GÓMEZ

JOSÉ PARREÑO FERNANDEZ

ISABEL FERNÁNDEZ QUESADA

NAZARIO GARCÍA FERNÁNDEZ

RAFAEL ROSILLO CAMBLOR

BORJA PONTE BLANCO

Servicio de Publicaciones de la Universidad de Oviedo
Campus de Humanidades. Edificio de Servicios. 33011 Oviedo (Asturias)
Tel. 985 10 95 03 Fax 985 10 95 07
http: www.uniovi.es/publicaciones
servipub@uniovi.es

I.S.B.N.: 978-84-17445-38-6
DL AS 1875-2019

Imprime: Servicio de Publicaciones. Universidad de Oviedo

13th International Conference on Industrial Engineering and Industrial Management
XXIII Congreso de Ingeniería de Organización
Gijón, Spain, July 11-12, 2019

Structural Complexity Mitigation in Network Design and Rationalization

Pinar Pérez JM[69], Ruiz-Hernández D[70], Menezes M[71]

Keywords: p-Median, Complexity, Network Design, Location, Supply chain

1 Introduction/Objectives

Facility location problems are well known combinatorial problems where the objective is to minimize certain measure of the cost incurred for (or the benefit attained from) serving customers from a set of facilities. A typical location problem will either aim at maximizing the demand covered by strategically locating a given number of facilities, or at finding the optimal number and location of facilities necessary for satisfying the total demand in a region (see, e.g., Daskin, 2013).

Our aim is to bring to the field of facility location the concept of supply chain structural complexity, opening up a new research line. Broadly speaking, structural complexity refers to the negative effects of the proliferation of products, distribution channels and markets. Focusing on locational complexity, the main objective of this work is to create awareness about the need of considering complexity issues –and their impact on profitability- when deciding the location and size of a distribution network. The rationale behind our argument is that an oversized distribution network may cause hidden costs that hinder the capacity of the supply chain for translating revenue into bottom-line benefits.

2 Methods

In this work, using an entropy-based measure for structural complexity developed by the authors in previous research (Ruiz-Hernández, 2019), we propose a variant of the traditional p-median problem that includes a complexity parameter in the model's formulation, the K-MedianPlex problem:

---

[69]Jesús María Pinar Pérez (✉e-mail: jesusmaria.pinar@cunef.edu)
Quantitative Methods Dept., University College for Financial Studies (CUNEF) Madrid, Spain

[70]Diego Ruiz Hernández (e-mail: d.ruiz-hernandez@she_eld.ac.uk)
Sheffield University Management School, Sheffield, UK

[71]Mozart B.C. Menezes (e-mail : mozart.menezes@neoma-bs.fr)
NEOMA Business School, Rouen, France

$$\max_{S\subset N\,:\,|S|=K} Z^{K}_{Plex} = \sum_{k\in S} R^{(k)}\left(1-\alpha C_p^{(k)}\right) - \phi K \qquad (1)$$

with

$$C_p^{(k)} = \sum_{i\in\mathcal{N}_k} \omega_i \log_2\left(\frac{1}{\omega_i}\right), \quad k\in S\ ;$$
$$R^{(k)} = \sum_{i\in\mathcal{N}_k} (r-\gamma d_{ik})\, W_i\,, \quad k\in S$$
$$\alpha:\ \ \alpha C_p^{(k)} < 1\,, \quad k\in S$$

where $\mathcal{N}$ is the set of network nodes; $S\subset N$, the set of open facilities; W_i, the weight of demand node $i\in\mathcal{N}$; ϕ, a fix facility cost; r, the revenue per unit; α, a profit loss factor due to complexity; γ, a generic transportation cost; and $\omega_i = W_i/\sum_{i\in\mathcal{N}} W_i$ for all $i\in\mathcal{N}$.

Given the strongly combinatorial nature and non-convexity of the objective function, we propose an algorithmic approach based on solving a K-median problem and sequentially reassigning demand nodes across facilities and solving local 1-Median problems aiming at maximising the function $Z^{K}_{Plex}(\mathcal{N}^{|S'|}, S')$, where $\mathcal{N}^{|S'|}$ represents the collection of allocation sets associated to a given solution S'.

Additionally, location complexity is not typically a result of network design, but a problem that arises from successive network expansions aimed at capturing market share and achieving profit growth (Fisher et al., 2017). In order to reduce complexity, firms may find it profitable abandoning certain markets (although they are usually reluctant under the rationale that lost sales will affect profit negatively). With this aim, we propose a strategy for successively uncovering demand nodes until no profit improvement can be further attained.

3 Results/Conclusion

A number of numerical experiments have been conducted on networks designed over all cities with more than 50 thousand inhabitants in France, Italy and Spain. Experimental results suggest that higher profits can be attained by reallocating demand nodes across facilities, relocating facilities and/or eliminating non-profitable demand nodes. As it may be expected, the improvement routines return better results for larger values of the complexity cost parameter α (representing high cost of complexity) and for larger transportation costs.

References

Daskin MS (2013) Network and Discrete Location: Models, Algorithms and Applications, John Wiley & Sons

Fisher M, Gaur V, Kleinberger H (2017) Curing the addiction to growth. Harvard Business Review, 95(1):66-74

Ruiz-Hernández D, Menezes MBC, Amrani A (2019) An information-content based measure of proliferation as a proxy for structural complexity. International journal of production economics, 212:78-91