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## Dynamic location of distribution centres, a real case study

Esther Segura<sup>a\*</sup>, Rafael Bernardo Carmona-Benitez<sup>b</sup>, Angélica Lozano<sup>a</sup>

<sup>a</sup>Universidad Nacional Autónoma de México (UNAM), Institute of Engineering, Torre de Ingeniería Piso 2 ala Norte, Mexico City, 04510, Mexico.

<sup>b</sup>Universidad Anáhuac México Norte, School of Business and Economics, Col. Lomas Anáhuac, Huixquilucan, 52786, Mexico.

### Abstract

A review of literature indicates that a problem related with Distribution Networks Design (DND) involves several decisions to be optimized, such as location, allocation, inventory, and routing. In this paper, we focus only on the location decision, proposing and exemplifying the following hypothesis: *the location of Distribution Centres (DCs) changes whether the product demand at each demand node has extremely high and unexpected variability through time and investment costs for the location of DCs are low (mobile infrastructure)*. The aim is to exemplify with a real case that location is not always a strategic decision.

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### Nomenclature

DC	Distribution Centre
V	set of demand nodes
p	number of DCs to be located
h	demand

\* Corresponding author. Tel.: +52-55-56233600; fax: +52-55-56233600.

E-mail address: [esegurap@iingen.unam.mx](mailto:esegurap@iingen.unam.mx)

d	operational cost between demand node $i$ and candidate site $j$
X	decision variables to locate distribution centres
Y	decision variables to assign demand nodes to distribution centres
$i$	demand node $i$
$j$	distribution centre $j$
f	location or investment cost

## 1. Introduction

The problem of distribution network design (DND) involves a set of decisions to be optimized, some of which are location, allocation, inventory management and routing (Ambrosino et al., 2009). In this paper, we study the location decision to propose and exemplify the following hypothesis: *the location of Distribution Centres (DCs) changes whether the product demand at each demand node has extremely high and unexpected variability through time and investment costs for the location of DCs are low (mobile infrastructure)*. This is a real problem; hence, companies in a similar situation must be flexible to change the location of their DCs in the short time (less than one year) to minimize costs.

Three levels of planning can be distinguished depending on the time horizon, namely strategic (decisions with horizon of more than a year to reach), operational (decisions with horizon of days, hours, or even minutes), and tactical (decisions with horizons between strategic and operational) (Miranda and Garrido, 2004). Vidal and Goetschalckx (1997) mention some examples of strategic decisions: transport mode choice, number of warehouses and DCs, location of warehouses and DCs, and capacity of warehouses and DCs. Current et al. (1997) explain that when the location of DCs involves a high capital investment, this location is a long-term decision or strategic decision. Owen and Daskin (1998) appoint that high costs associated with property acquisition and facility construction make facility location or relocation projects long-term investments, hence facilities are expected to remain operable for an extended time period. Drezner (1995) presents a case study to locate DCs when the demand of the product is variable and location costs are paid by customers. In this study, once a demand node is located as DC, it will remain as DC in the long term, and then the location of DCs is a strategic decision. In our study case, we show that the decision of location DCs can be also tactical for products with unexpected extremely high demand and with low investment costs for the location of DCs (mobile infrastructure), contrary to what is mentioned by Vidal and Goetschalckx (1997), Ratick and Revelle (1997) and Owen and Daskin (1998).

This paper presents a real case study to exemplify the hypothesis. The case study is the problem of a hazardous material company. The company wants to optimize its current distribution network. The problem is identified as a problem of Distribution Network Design (DND), which involves location of DCs, allocation of demand nodes to DCs, inventory and routing decisions. This problem of DND is solved by Carmona Benitez et al., (2013), for just a time period. For this reason, this paper is focused on the location of DCs, showing that the best location changes depending on the variability of the demand through time. Some real cases present unexpected high changes in the demand, which are difficult to forecast. These changes could be influenced by social or cultural factors, natural disasters, epidemics, and any other unexpected phenomenon.

In this case study, the company is vertically integrated but the product transportation is outsourced. The product demand is high and extremely variable, and investment costs are low because storage infrastructure is mobile. Annually, the company issues a tender to determine which transportation company will distribute the material. This decision is taken by the manager of the company, trying to minimize total cost. According to Vidal and Goetschalckx (1997) and Ratick and Revelle (1997), transportation is a strategic decision that companies must take every year. However, whether our hypothesis is true, the tender shall be made in a period of less than one year, what is a tactic decision rather than a strategic decision.

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