

Location analysis

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The *Location and Related Problems Network* (<http://redloca.ulpgc.es/>) is a group of researchers from several universities working in the field of location and related problems. Besides facility location models, they study transportation and routing, network design, logistics, among others. Network activities are focused on achieving several goals. The objectives are to promote and strengthen cooperation among researchers in the group, establish relationships with other research groups, disseminate results, increase the Network's presence in the international arena, as well as to connect with the business world and society in general.

The Network was created in 2002 from the *Spanish Location Group* (GELOCA, <http://geloca.seio.es/>), being financed since its creation by the Spanish government. From 2002 to present, the Network has been coordinated by Juan A. Mesa (Universidad de Sevilla), Elena Fernández (Universitat Politècnica de Catalunya), Alfredo Marín (Universidad de Murcia), Dolores R. Santos-Peñate (Universidad de Las Palmas de Gran Canaria), and Antonio M. Rodríguez-Chía (Universidad de Cádiz). The Network currently includes eight research groups, *Network Design*, coordinated by Elena Fernández, *Competitive Location*, coordinated by Blas Pelegrín, *Continuous Location*, coordinated by Antonio M. Rodríguez-Chía, *Plant Location*, coordinated by Alfredo Marín, *Location in Complex Networks and Logistics Networks*, coordinated by Justo Puerto, *Location in Transportation of Passengers*, coordinated by Juan A. Mesa, *Global Optimization and Location*, coordinated by Emilio Carrizosa, and *Routing Problems, Distribution and Logistics*, coordinated by Ángel Corberán. Researchers in the location and transportation areas have been invited to present their research in activities organized by the Network. These include Matteo Fischetti, M. Grazia Speranza, Martine Labbé, Gerhard Reinelt, Andrea Scozzari, Jack Brimberg, Mark. S. Daskin, Jorge Urrutia, Richard Church, Manuel Laguna, Aníbal Ollero, Stefan Voß, Jean-Claude Till, Robert Aboolian, Vladimir Marianov, Rolf H. Möhring, Luis Gouveia, Roberto Cominetti, Nenad Mladenovic, Francisco Barahona, Sergey Bereg, Richard Eglese, and Gilbert Laporte, among others.

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Since 2010, among other activities, the Network has organized the annual *International Workshop on Locational Analysis and Related Problems*, open to people interested in issues related to the location field. The initial idea of this special volume of the *Annals* arose from the meeting held in May 2012 in Granada as a form of celebrating the tenth anniversary of the Network. Papers in this volume deal with different topics connected to locational analysis.

Competitive location models are the research subject in the papers by Drezner and Drezner, Hendrix, Marianov and Eiselt, and Pelegrín, Fernández, and García Pérez. Drezner and Drezner investigate a sequential location problem considering different location strategies for the first firm, three different objectives, minisum, minimax, and competitive, and different assumptions on the demand. Hendrix studies a continuous Stackelberg location-design model, some equilibrium problems and the co-location phenomenon. Marianov and Eiselt analyze the agglomeration forces in facility location. Pelegrín et al. consider a facility location model for an expanding chain whose objective is to maximize profit assuming that cannibalized facilities are compensated by side payments so that the cannibalization effect is reduced. Also in a competitive environment, and referring to the capacitated restructuring problem in a bank network, is the paper by Ruiz-Hernández and Delgado-Gómez. It addresses the problem of closing capacity facilities considering uncertainty in the demand reaction.

Papers by Angulo, García-Ródenas, and Espinosa-Aranda; Canca, De-Los-Santos, Laporte, and Mesa; and Canca, Barrena, Laporte, and Ortega study transportation and network design problems. Angulo et al. propose MIP models and solution methods to solve the problem of improving an existing road network in the context of strategic planning through the creation of new highway corridors. Canca et al. integrate the strategic and tactical phases of the rapid transit planning process by means of a mathematical programming model that simultaneously determines the infrastructure network, line planning, train capacity of each line, fleet investment, and personnel planning. Canca et al. propose a tactical approach to determine optimal policies for dealing with situations appearing in rapid transit systems that require the application of strategies that guarantee a reasonable user waiting time with small increases of operation costs, preserving a certain level of the service quality. Connected to transportation, Díaz-Báñez, Korman, Pérez-Lantero, and Ventura study a location problem in a geometric framework presenting an extension of the rectilinear 1-center problem.

Different continuous location problems are analyzed in Drezner, Brimberg, Mladenović, and Salhi; Drezner and Menezes; and Plastria. Drezner et al. present three new heuristic approaches for the solution of the multi-source Weber problem in the plane, Drezner and Menezes investigate the relationships between the Condorcet solution and the optimal Weber point, and Plastria studies the upgrading and downgrading versions of the 1-median problem.

Redondo, Marín, and Ortigosa study a flexible discrete location model which includes as particular cases the p -median, the p -center and the k -centrum problems, among others. Barbati, Bruno, and Marín investigate a discrete two-stage location problem incorporating an equity measure in order to balance the arrival times of users and reduce the risk of congestion. Alumur, Nickel, Saldanha-da-Gama, and Seçerdin propose a modeling framework for multi-period hub location. They extend the classical hub location problems to the situation in which the hub network can be progressively built and its capacity gradually expanded over time. Sen, Krishnamoorthy, Rangaraj, and Narayanan address the data location problem in information networks and present a literature survey of facility location models to formulate data location problems as decision problems. Drezner, Marianov and Wesolowsky propose and analyze a stochastic model for the location of emergency facilities. They consider that availability is not an issue in most systems and circumstances and their objective is to minimize the probability of not providing timely service in normal circumstances. Finally, the paper by Huang is a

short note that studies the problem of locating facilities on a path so that a load range equity measure is optimized.

Two of the above-mentioned papers were invited contributions: “On agglomeration in competitive location models,” by Vladimir Marianov and H.A. Eiselt, and “Up and downgrading the Euclidean 1-median problem and Knapsack Voronoi diagrams,” by Frank Plastria. Both Vladimir Marianov and Frank Plastria have maintained a close relationship with several members of the Network.

Marianov and Eiselt present a selective review of the literature dealing with agglomeration forces in a linear market, classifying these forces into weak and strong. They point out that, although agglomeration of competitive facilities is common in real life, operations research models prescribing locations in a competitive environment result normally in patterns that show dispersion, with occasional co-location of some of the facilities. They explain this discrepancy between practice and modelling, arguing that the only agglomeration forces considered in these models are those in Hotelling’s principle of minimum differentiation, which are weak agglomeration forces. Strong agglomeration forces, which cause facilities to become close to each other, have been studied in economics but scarcely considered in prescriptive models in operations research. With this paper, the authors want to promote a discussion about the subject of dispersion and agglomeration of facilities and open new research lines in the operations research field.

Frank Plastria, currently retired from BUTO/MOSI (Vrije Universiteit Brussel), has been closely involved in research in the location field. He was the coordinator of the *Euro Working Group on Locational Analysis* (EWGLA), a research group integrated into EURO, from 1994 to 2007, and has collaborated with members of the Network in several joint papers. In this volume, his paper studies the upgrading and downgrading versions of the 1-median or Fermat-Weber problem considering Euclidean distances and uncertainty in the weights. This uncertainty is modelled as possible changes within given bounds and a single budget constraint on the total cost of change. The upgrading (respectively, downgrading) problem consists of minimizing (respectively maximizing) the optimal 1-median objective value over these weight changes. He shows that both versions, upgrading and downgrading, may be solved in polynomial time to any wanted precision. Moreover, using geometrical properties, He introduces and studies here for the first time a novel planar partition, the Knapsack Voronoi Diagram, which allows a reduction of the polynomial number of standard Fermat-Weber location problems required to solve the regrading problems. Some open research lines are proposed, along with the study of the precise minimal complexity of the construction of these diagrams, and other subjects on the efficiency improvements in the construction of the diagrams and its application in other problems.

I would like to thank the Spanish Government for their support, which has allowed the continuity of the Network, as well as the universities that provided the facilities where the annual meetings were held during the period in which I was the coordinator of the Network. I also want to thank the members of the group for their collaboration in the organizational tasks and their participation in the activities. I am especially thankful to the local organizers of these meetings: Pablo Dorta-González, and Rafael Suárez-Vega (Universidad de Las Palmas de Gran Canaria), Victor Blanco (Universidad de Granada), Enrique Domínguez-Merino (Universidad de Málaga), and Francisco A. Ortega (Universidad de Sevilla). I also want to thank the invited speakers who participated in the meetings organized by the Network, and the authors and reviewers who contributed to the publication of this special volume.