# Designing e-commerce supply chains

## A stochastic facility–location approach

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***Abstract*— e-Commerce activity has been increasing during recent years, and this trend is expected to continue in the near future. e-Commerce practices are subject to uncertainty conditions and high variability in customers' demands. Considering these characteristics, we propose two facility–location models that represent alternative distribution policies in e-commerce. These models take into account stochastic demands as well as more than one regular supplier per customer. Two methodologies are then introduced to solve these stochastic versions of the well-known capacitated facility–location problem. The first is a two-stage stochastic-programming approach that uses an exact solver. However, we show that this approach is not appropriate for tackle large-scale instances due to the computational effort required. Accordingly, we propose a simheuristic approach that solves large-scale instances in short computing times. An extensive set of benchmark instances contribute to illustrate the efficiency of our approach, as well as its potential utility in modern e-commerce practices.**

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### I. The e-commerce supply chain design problem

The e-commerce in developed countries is steadily increasing, reaching a noticeable share of all commerce during the last years. One of the main strategic decisions that e-commerce enterprises must face is the location of their facilities or distribution centers (DCs). Note that this decision has an impact on the daily logistics activity and, consequently, on the customers' quality of service.

This summary presents the work of Pagés-Bernaus (2017) [1] published recently. The work presents mathematical models that represent the decisions how the online distributors select the DC locations and how to perform the subsequent assignment of customers to these facilities.

The goal of this work is to study this supply-chain design problem and to analyze the impact of different delivery policies in the presence of uncertainty. Since the capacity at each DC is limited, the problem is modeled as a Capacitated Facility Location Problem (CFLP) with stochastic demands. There are two CFLP variants differing in whether customers can be served from one DC (single source) or more (multiple source). In this paper, it is assumed that customers can be served from a number R of different facilities. So, each customer will have at most R facilities as regular providers. This variant is denoted as the CFLP with regular providers (CFLPrp).

### II. Solution approach and computational results

To solve the proposed models, we propose two approaches: one based on Deterministic Equivalent Model (DEM) and another based on simheuristics methods, which in this case the method proposed hybridizes an ILS metaheuristic with simulation. The SimILS is an Iterated Local Search based method, where the local search stage focuses on providing configurations of open/closed facilities, as well as on the selection of the regular DCs. In the simulation stage, customers' assignment decisions are made. Since the simulation stage is time-consuming, only "promising" solutions are tested in a stochastic environment.

The computational experiments are performed on the Beasley. For the small–medium instances, both approaches provide solutions of similar quality (with an average gap of −0.18% for model A and −0.41% for model B in favor of the stochastic-programming approach). However, the time employed by the SimILS approach is one order of magnitude smaller. Moreover, for the larger instances G4 the SimILS increases the required computing time but is able to provide feasible solutions.

### III. Conclusions

This summary presents two facility–location models, which consider stochastic demands as well as a restricted number of regular suppliers per customer. These models were inspired in

a real e-commerce supply design problem. We propose two different approaches to solve the models representing this problem. On the one hand, we use a two-stage stochastic-programming methodology. On the other hand, we propose a simheuristic algorithm, combining an ILS metaheuristic with simulation. According to the computational results obtained, the stochastic-programming approach is efficient but limited to small- and medium-sized instances. On the contrary, the proposed simheuristic approach is able to solve large-sized instances in reasonable computing times, while providing also competitive results for smaller instances

## References

[1] Pagès-Bernaus A., Ramalhinho H., Juan A.A., Calvet (2018), Designing E-commerce Supply Chains: a stochastic facility-location approach, International Transactions in Operational Research (First published: 3 July 2017). DOI: 10.1111/itor.12433.