Scientific Report

Alternative techniques for solving supply chain network design with special emphasis on supply frequencies

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1. Purpose of the STSM

The aim of the STSM (reference number: TD1207-29748) was to start a preparation to research project on supply chain networks design (SCND) methodology. This research is concentrated on the distribution network design for the drug-stores sector in Poland, and the project is dedicated for one of the key market player. The goal of the research is defined as a development a comprehensive methodology for SCND optimisation under the conditions of highly increasing of e-commerce in revenue structure. The key research objective is to develop an optimisation methodology (mathematical model and appropriate solution), that allow reducing annual operating costs of the distribution network of approx. 10-15%.

In the literature the formulation of SCND consists a pure facility location problem as a standard. A key cost factor in such an analysis is cost depended on location and cost resulted from relative distance between locations. Very rarely capacity extension is considered in the research (e.g. Azaron *et al.,* [3], Ko & Evans [6]). Significant part of the research extends classical problem by inventory and ordering components, using inventory holding cost (e.g. Tsiakis *et al.* [10], Daskin *et al.* [4]) or shortage cost factors (e.g. Listes [7], Pishvaee & Torabi [9]) and ordering cost factor (e.g. Tsiakis *et al.* [10], Daskin *et al.* [4]). Another group of the research links to production (e.g. Melachrinoudis & Min [8], Chakravarty [4]) or more advanced transportation aspects i.e. routing (e.g. Ambrosino & Scutellà [1], Aksen & Altinkemer [2]) or mode selection (e.g. Cordeau *et al.* [5]). There is, however a lack of consideration of supply frequencies as a key business factor. Thus, the purpose of the following research is to consider this aspect of SCND more extensively.

2. Description of the work carried out during the STSM

Since the considered problem of SCND has a mixed-integer programming nature, the STSM was a great opportunity to learn how to implement MIP model into SCIP framework proposed and designed by Zuse Intitute in Berlin. This framework consists of several alternative methodology for solving MIP problems, including Gurobi, CPLEX, XPRESS, MOSEK, ThinkCubic and others. The advantage of the considered STSM is personal progress in modelling, solving and analysis of decision problem using alternative techniques than classical solvers with extended user interface, e.g. solvers produced by Frontline Solvers [11].

The application of SCIP during workshop proved the efficiency of using this approach and is very promising in the area of SCND problem.

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3. Future collaboration with the host institution

The considered STSM was the starting point of the work and further research visits are planned. It should be scheduled, however, after first results of computation will be available.

4. Foreseen publications

It is planned to publish the obtained results as a research paper. A special emphasis will be placed on modelling of decision problem in term of MIP and supply frequency factor as well. The important part of the research will be the comparison of computation efficiency using alternative techniques.

Finally, the paper is going to be submitted for publication to the Mathematical Problems in Engineering, by Hindawi Publishing Corporation.

5. Confirmation by the host institution of the successful execution of the STSM

A certificate is prepared and signed by Prof. Thorsten Koch from ZIB, koch@zib.de, Chair of the workshop CO@work 2015; see attachment.

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