UNIVERSITEIT GENT

FACULTEIT ECONOMIE
EN BEDRIJFSKUNDE

TWEEKERKENSTRAAT 2
B-9000 GENT
Tel. : 32 - (0)9 – 264.34.61
Fax. : 32 - (0)9 – 264.35.92

# WORKING PAPER

# Analysis of the Single-Vehicle Cyclic Inventory Routing Problem

**El-Houssaine Aghezzaf, Yiqing Zhong[*], Birger Raa[†], Manel Matteo[‡]**

September 2011

2011/737

[*] Department of Industrial Management, Ghent University
Technologiepark 903, 9052 Zwijnaarde, Belgium
elhoussaine.aghezzaf@ugent.be
[†] Department of Management Information and Operations Management, Ghent University
Tweekerkenstraat 2, 9000 Gent, Belgium
[‡] Department of Enterprise Management, ETSEIB, Universitat Politècnica de Catalunya

D/2011/7012/42

# ABSTRACT

The single-vehicle cyclic inventory routing problem (SV-CIRP) consists of a repetitive distribution of a product from a single depot to a selected subset of customers. For each customer, selected for replenishments, the supplier collects a corresponding fixed reward. The objective is to determine the subset of customers to replenish, the quantity of the product to be delivered to each, and to design the vehicle route so that the resulting profit (difference between the total reward and the total logistical cost) is maximized while preventing stockouts at each of the selected customers. This problem appears often as a sub-problem in many logistical problems. In this paper, the SV-CIRP is formulated as a mixed-integer program with a nonlinear objective function. After a thorough analysis of the structure of the problem and its features, an exact algorithm for its solution is proposed. This exact algorithm requires only solutions of linear mixed-integer programs. Values of a savings-based heuristic for this problem are compared to the optimal values obtained for a set of some test problems. In general the gap may get as large as 25%, which justifies the effort to continue exploring and developing exact and approximation algorithms for the SV-CIRP.



**KEYWORDS:** Inventory-Routing, Nonlinear Mixed Integer Programming, Exact Algorithms.