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Green logistics: Reducing Air Pollutant Emissions by using Horizontal Cooperation in Road Transportation

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Abstract Reducing air pollutant emissions is a way to shorten the environmental footprint. We show that horizontal cooperation in road transportation can be useful to reduce the delivery costs and, at the same time, pollutant emissions. The results obtained with our proposal are shown more complete than the traditional ones without environmental aspects, minimizing simultaneously pollutant emissions and delivery costs.

Keywords: Horizontal Cooperation in Transportation; Air Pollutant Emissions; Vehicle Routing Problem; Heuristics; Analysis of Scenarios; Small and Medium Enterprises.

This contribution deals with the way of reducing air pollutant emissions. Using horizontal cooperation in road transportation is a feasible solution, and we have tested the relevance of this praxis as a way of reducing delivery costs and greenhouse gas emissions. Comparing our proposal results with the traditional ones without environmental considerations, we can state that cost and emissions have been reduced in a conjoint way.

Horizontal cooperation is defined as “concerted practices among companies operating at the same level(s) in the market”. (European Union, 2001) These companies can be either competing or unrelated suppliers, manufacturers, retailers, receivers or logistic service providers that share information, facilities or resources with the goal of reducing costs and/or improving service. Another way of defining it could be as “a business agreement between two or more companies at the same level in the supply chain or network in order to allow ease of work and co-operation towards achieving a common objective” (Bahinipati et al., 2009).

Some recent papers show the horizontal cooperation is a good approximation to reduce cost in logistic activities related to production companies. Schmoltzi and Wallenburg (2011) state that around 60% of German logistic service providers use horizontal cooperation and even 28% of these providers are enhancing the use of horizontal cooperation. If we consider the analysis made in the American companies, horizontal cooperation is defined as mandatory to be able to offer

adequate services to customers, and not only to increase their profit (Kilcarr, 2007).
Nowadays, road transportation is the most usual transportation system. In the European Union, 47% of total transportation uses road transportation, and in USA it accounts to 32% of the total, and in Japan, it raises till 64% (European Commission, 2011). Considering that it is expected an increase of freight transportation worldwide about a 50% in the period 2000-2020 (European Commission, 2006), it is important to study how to reduce air pollutant emissions. Around 18% of the greenhouse gas emissions in the European Union are due to road transportation (Hill et al., 2012).

In the transportation arena, one typical scenario consider one company with different providers (Logistic Service Providers, LSP) with their own depots deliver products to their own customers. Each customer is assigned to a LSP considering only the product specificity and ignoring variables related with distance. Different LSPs can collaborate by reassigning customers to LSPs (depots) based on distance.

We study different scenarios, cooperative and non-cooperative ones, so that different results can be compared to determine the improvement in the reductions of air pollutant emissions and distance savings at the same time. We have adapted the multi-depot vehicle routing problem to show the use of horizontal cooperation using a set of well-known benchmarks for this kind of problems (obtained in this website: http://neumann.hec.ca/chairedistributique/data/mdvrp). It is also proposed an iterated local search algorithm in order to get high-quality solutions for this collaborative scenario, while non-collaborative scenarios are solved using a well-tested algorithm for the capacitated vehicle routing problem. The savings in routing costs –both regarding distance-based and environmental costs– are calculated using different geographical distributions of customers with respect to their assigned service providers.

In our approach, the group of instances pr01 to pr10 presents an average gap of 23%, with extreme gaps close to 50% for some instances, when we compare the cooperative and non-cooperative strategies.

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