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Results

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Project Title:

UTC - A Cost Allocation Model for
Horizontal Supply Chains

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UTC - A Cost Allocation Model for Horizontal Supply Chains

Shed some insights into the practicability of cost allocation in a dynamic vehicle routing environment.

WHAT IS THE NEED?

With the increasingly market for world trade, massive amounts of goods are constantly transported to satisfy the needs of customers all over the world. Logistics has become the crucial force to drive the productivity and mobility of various industries. Meanwhile, numerous problems exist inside the logistics sector, including low capacity usage, excessive packaging, high energy consumption, low work force welfare, etc. Among efforts that target these deficiencies for improvement, horizontal cooperation stands out as the one that has seen both theoretical development and real world application. In particular, the pooling of transportation networks helps companies to reduce and share operating costs and alleviate the impact on traffic congestion by reducing the number of total vehicle miles.

In the freight transportation industry, however, such cost sharing systems are still in their infancies. One of the biggest challenges of implementing a freight cost sharing transportation system is how to fairly allocate cost to each participant in the cooperation. Yet, this problem remains rarely studied in the literature. Also, lean manufacturing and just-in time (JIT) delivery constraints challenge us to consider the cost sharing transportation system in a dynamic environment, where new customers request service in real time. Indeed, the problem of allocating costs in a real-time cost sharing transportation system is highly nontrivial and is ranked among the top impediments for successful horizontal cooperation. Therefore, an online cost allocation mechanism addressing dynamic vehicle routing problem is studied in this research.



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integrated and efficient transportation
system to enhance California's
economy and livability.



WHAT WAS OUR GOAL?

The goal of this research is to shed some insights into the practicability of cost allocation in a dynamic vehicle routing environment. It would also advance the applicability of horizontal cooperation to help reduce the environmental, economical, and social impact of logistic activities.

WHAT DID WE DO?

We studied fundamentals of cost allocation in horizontal cooperation and designed a hybrid proportional cost-sharing (HPOCS) mechanism. Then we tested and analyzed its performance through simulation results. We have also made several extensions including concepts of discounts and re-optimization to help boost HPOCS performance in certain scenarios.

WHAT WAS THE OUTCOME?

This research addressed the cost allocation problem in a real-time cost sharing transportation system, which results from horizontal cooperation among multiple suppliers. The developed HPOCS mechanism is proven to possess desirable properties, namely online fairness, budget balance, immediate response, individual rationality and ex-post incentive compatibility but does not provide sufficient incentives for customers to request service early in some scenarios. Thus, two extensions were made to compensate for this and the experimental results support their ability to incentivize customers. Together with the two extensions, the resulting model and HPOCS mechanism shows how horizontal cooperation could reduce the total transportation cost, and potentially lower the cost barrier for new businesses to enter the market.

WHAT IS THE BENEFIT?

Pooling of transportation networks help companies to reduce and share operating costs and alleviate the impact on traffic congestion by reducing the number of total vehicle miles. It would also advance the applicability of horizontal cooperation to help reduce the environmental, economical, and social impact of logistic activities.