



Ride service outsourcing for profit maximization

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ABSTRACT

Transportation service subcontracting is becoming an effective means of business for many leading carriers to maintain their market dominance and profitability. This research is based on an outsourcing practice in one of the few largest limousine fleet companies in the US, whose (mostly advance) demand for services often exceeds its capacity. We develop a model for ride service outsourcing. A column generation method is proposed. The outsourcing decision is made simultaneously with pre-scheduling of in-house ride services as well as staffing. Test with services data indicates that the developed method dramatically improves the carrier's outsourcing decision.

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1. Introduction

In today's world of transportation services, it is typical that a large carrier has a number of affiliated smaller carriers such as owner–operators. They often operate in a collaborative relationship. Transportation services contracted to these large carriers are frequently subcontracted, or outsourced, to their affiliated smaller carriers at a reduced rate. This service outsourcing harnesses the complementarity of service capacities among carriers, and in the same time helps the large carrier maintain its market dominance and profitability. In this case, the subcontracting carrier serves as both a service provider (to directly serve the selected requests:) and a business intermediary (to bridge the affiliated carriers and the unmet requests). An important challenge to the large carrier in this context is to decide which service requests to subcontract out when its own capacity is in shortage.

This study is based on a real application at BostonCoach Inc., a premier worldwide provider of executive sedan, limousine and event transportation services. The customers include corporate executives, celebrities and leisure travelers. Its primary business is in the large metropolitan areas in the United States such as New York, Boston, Washington DC, Philadelphia, Chicago, etc. The operations are independent of each other between service areas. Take the sub-fleet in Boston as an example. Boston is one of BostonCoach's major service areas. Generally on a typical day, about 50% of the requests were booked three days advance, inclusively 70% two days advance and 85% one day advance. During the daily operation, new demand are called in for service (called spot demand later), which account for the remaining 15% services. Subcontracting decisions, according to the agreements between BostonCoach and its collaborating companies, have to be made one day (24 h) early. When BostonCoach projects to have demand exceeding its capacity the next day, it subcontracts some of its currently booked rides to those smaller affiliated fleets. The rides subcontracted are equivalently called vended rides later.

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In addition, if the number of subcontracts is not enough, denials of ride requests could take place. Request denial is costly in terms of loss of customer's goodwill. BostonCoach experienced about 5% denials before our proposed new outsourcing system. When using our proposed method, the average denial rate dropped to below 1.5% in the benchmark tests. Experience shows that it is very important to have a good estimate of its service capability in relation to the future (projected) demand. An efficient scheduling system is such a means to determine the need for subcontracting and to make in-house ride pre-assignment.

In practice, the service capacity has a rather complicated array of features. There are several full time driver shifts including split shifts, and a mix of part time drivers available at different time intervals of the day. There are also many different types of ride requests. For example, some rides are just road shows that require specific vehicle models and drivers as well as a designated route within a specific time period. Among several major cost factors, driving hours and distance are the two dominating ones. In addition, one day notice of vended rides constitutes a challenge to the fleet dispatcher as he/she faces uncertainty of next day demand in the spot market. The requirement of one-day notice together with the inability of optimizing the outsourcing decisions contributed to frequent over and under-subcontracting, undermining the potential profitability of BostonCoach. Note that although a little flexibility exists that allows subcontracting at a shorter notice, this one-day notice rule is observed in this study.

The day-to-day operations are clearly independent as drivers are ready at their home locations at the beginning of each day. Therefore, it is sufficient to only consider one day operation in the model. After about 85% of the next day demand have called in, a forecast for additional demand is made based on the historical record and current information about new events. Based on the total next day demand estimate, an outsourcing decision is made for the next day by solving a static assignment problem. Note that it is different to assign the resources to demand once for all (e.g. offline) from that assuming the demand being unfolded gradually over the time (e.g. online) in terms of the total cost and revenue. Value of early information attributes to this difference. However, we believe that our static algorithm represents a good approximation to the dynamic counterpart by allowing for enough slack time in traveling and handling. In addition, the Operations Research at BostonCoach has developed a model to forecast the next day demand based on both temporal and spacial features of ride requests, which is briefly introduced in a later part of this paper.

In the static problem, critical to the subcontracting decision is to efficiently pre-schedule the available drivers and vehicles to have a measure about service capability. In what follows, we are going to introduce a snapshot of the static problem and our developed algorithm.

1.1. Problem definition

A limousine fleet company operates within a certain geographic area providing ride services to its customers. The fleet has a fixed number of vehicles of certain different types. The fleet company has its full time shift drivers and part time drivers available for call to service during specified time intervals. Affiliated with this fleet company is a group of ride service providers within the same geographic area. At a certain time, the fleet company has a set of ride service requests, each bringing in a certain amount of revenue. In the case that the ride service requests exceed the fleet service capacity, a subset of the service requests have to be subcontracted to these affiliated service providers at pre-determined rates. The fleet dispatcher needs to make a decision about which rides to subcontract to its affiliated operators so that the total profit may be maximized.

Our objective in this paper is to serve as many rides in-house as possible. This is because the revenue from keeping a ride in house is much larger than from subcontracting it out. In this paper, we do not focus on how vended rides are assigned to affiliated operators regardless of the nuances of tradeoffs between in house services and vendor selection.

To further clarify this practical problem, each service request has the following characteristics:

- An origin for pickup and a destination for drop-off.
- A time window for pickup, and/or for drop-off.
- In some cases, a specified vehicle type(s) for some services, or even a specified driver or vehicle number.
- Trip types including normal trip, road show, and trips that require multiple stops.

The fleet drivers have the following characteristics:

- There is a set of drivers available for a set of shifts (12 h/9 h), respectively, shared shifts, plus part time drivers available during specified time intervals of the day.
- Each driver can only be assigned to a specific set of vehicle types. To simplify the problem, we assume that each driver corresponds to a specific type of vehicle.
- There is a maximum number of hours each shift-driver works, beyond which an overtime pay rate is activated. The starting time of each driver could be made one hour earlier if needed on a particular day.
- Driver's hourly wage is \$5 plus a commission, a certain percentage of the total revenue from ride services. However, a full time driver has to be paid for a minimum of 4 h per work day. As commission constitutes an important component of their total compensation, assignment of at least 2–3 rides each day to a full time driver is necessary to maintain the full time work force. Experience shows that each full time driver serves on average about five rides per day.

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