ABSTRACT

Transportation of goods along the supply chain is the critical part of the business and each product demands different method of transportation. Similarly, in today’s globalised market situation, a product may be transported through combination of different modes before it reaches the end customer. Most of the manufacturers try to find suitable service providers for moving their products along the supply chain. Normally, they establish contract for the period of 2 or 3 years with the carriers to move their products continuously between specific locations. Auction procedure is very common in transportation service procurement especially in full truckload service. In auction setting, carriers bid for lanes based on the information available in call for bidding given by the manufacturer (shipper). Shipper has to allocate lanes to various carriers participating in the procurement auction so that, the total cost of procurement is minimum. This problem is popularly known as Winner Determination Problem (WDP) or Carrier Assignment Problem (CAP).

Also, the bidding may be either as individual lane bids or combinatorial bids. CAP is an NP-hard problem in the combinatorial bidding format and hence, it is very difficult to solve. In this research work, truckload procurement process is studied with the interest of identifying the most influencing non-price and environmental sustainability factors in addition to the cost objective. Case studies are conducted in five different companies and Analytical Hierarchy Process (AHP) methodology is followed for the studies. Environmental sustainability factors considered for the study include route optimization, energy efficiency, carbon footprint and electronic documentation. Similarly, the set of non-price factors such as on time delivery, equipment availability, area coverage and cargo insurance are included for analysis. A questionnaire is framed for this purpose and interviews are conducted in the case companies considered. Among
the five case companies, four are automotive companies and one is logistic service provider. The study reveals that the respondents prefer environmental sustainability factors over non-price factors and more specifically, carbon footprints and route optimization factors are given importance. The case study implies the need of considering the above mentioned environmental sustainability factors in the procurement of truckload service provider. It is believed by the shipper that it is very much essential to attain sustainability in their entire business. This initiative by the shipper will also encourage the carriers to take measures for cutting down carbon emissions in their operations.

Apart from the environmental sustainability factors, on-time delivery is given far attention by the respondents and it plays crucial role for the successful running of the business. Delay in supply at any stage of the supply chain will have adverse effect on the entire chain of business. Hence, the performance of the service provider in terms of service level should be considered as an important criterion while procuring truckload service. Sensitivity analysis is also carried out to understand the robustness of the AHP methodology. Two scenarios such as equal weight and reverse weight to main factors, environmental sustainability and non-price, are considered for the sensitivity analysis. The result shows that the influence of cargo insurance has been increased in the reverse weight scenario for the case of logistic service provider.

Then, CAP with combinatorial bids is modeled with cost objective and it is modeled based on the real life data obtained from the petroleum based company. The model developed is closer to reality because of the fact that demand and lane information are purely based on real data. Two different methodologies such as complete search algorithm and heuristic approach are developed to solve the formulated CAP model. The complete enumeration method gives exact minimum value for the cost minimization CAP. But the computation time is the major cause of concern with this technique. For this
reason, a heuristic method is introduced and it provides a reasonably good quality solution to the problem considered. The results obtained by using both the methodologies are compared for their effectiveness in terms of solution quality and computational time.

The assumption of combinatorial bids in CAP allows the carriers to utilize the economy of scope. Thereby, they are able to utilize the opportunity of minimizing empty returns and hence, the associated carbon emission can also be reduced. CAP is also modeled in a multi objective framework considering environmental sustainability and non-price objectives in addition to cost objective, and it is solved by using the heuristic proposed already for solving single objective CAP. As a whole, this research work attempts to identify the factors that are to be considered in allocating lanes to the carriers in order to achieve sustainability in their operation including logistics.