

Transport Mode Selection under Lead Time Variability and Emissions Constraint

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Abstract : This study is focused on transport mode selection under lead time variability and emissions constraint. In order to reduce the carbon emissions generation due to transportation, organization has often faced a dilemmatic choice of transport mode selection since logistic cost and emissions reduction are complementary with each other. Another important aspect of transportation decision is lead-time variability which is least considered in transport mode selection problem. Thus, in this study, we provide a comprehensive mathematical based analytical model to decide transport mode selection under emissions constraint. We also extend our work through analysing the effect of lead time variability in the transport mode selection by a sensitivity analysis. In order to account lead time variability into the model, two identically normally distributed random variables are incorporated in this study including unit lead time variability and lead time demand variability. Therefore, in this study, we are addressing following questions: How the decisions of transport mode selection will be affected by lead time variability? How lead time variability will impact on total supply chain cost under carbon emissions? To accomplish these objectives, a total transportation cost function is developed including unit purchasing cost, unit transportation cost, emissions cost, holding cost during lead time, and penalty cost for stock out due to lead time variability. A set of modes is available to transport each node, in this paper, we consider only four transport modes such as air, road, rail, and water. Transportation cost, distance, emissions level for each transport mode is considered as deterministic and static in this paper. Each mode is having different emissions level depending on the distance and product characteristics. Emissions cost is indirectly affected by the lead time variability if there is any switching of transport mode from lower emissions prone transport mode to higher emissions prone transport mode in order to reduce penalty cost. We provide a numerical analysis in order to study the effectiveness of the mathematical model. We found that chances of stock out during lead time will be higher due to the higher variability of lead time and lead time demand. Numerical results show that penalty cost of air transport mode is negative that means chances of stock out zero, but, having higher holding and emissions cost. Therefore, air transport mode is only selected when there is any emergency order to reduce penalty cost, otherwise, rail and road transport is the most preferred mode of transportation. Thus, this paper is contributing to the literature by a novel approach to decide transport mode under emissions cost and lead time variability. This model can be extended by studying the effect of lead time variability under some other strategic transportation issues such as modal split option, full truck load strategy, and demand consolidation strategy etc.

Keywords : carbon emissions, inventory theoretic model, lead time variability, transport mode selection

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