



MIT SCALE RESEARCH REPORT

The MIT Global Supply Chain and Logistics Excellence (SCALE) Network is an international alliance of leading-edge research and education centers, dedicated to the development and dissemination of global innovation in supply chain and logistics.

The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

For more information, contact
MIT Global SCALE Network

Postal Address:

Massachusetts Institute of Technology 77
Massachusetts Avenue, Cambridge, MA 02139 (USA)

Location:

Building E40, Room 267
1 Amherst St.

Access:

Tel: +1 617-253-5320
Fax: +1 617-253-4560

Email: scale@mit.edu
Website: scale.mit.edu

Research Report: ZLC-2016-7
Determining the optimum Mode of Transport (MOT)
Dhrupad Bhavsar and Jose Luis Meri Celma

For Full Thesis Version Please Contact:

Marta Romero

ZLOG Director

Zaragoza Logistics Center (ZLC) Edificio

Náyade 5, C/Bari 55 – PLAZA 50197

Zaragoza, SPAIN

Email: mromero@zlc.edu.es

Telephone: +34 976 077 605

Determining the optimum Mode of Transport (MOT)

By Dhrupad Bhavsar and Jose Luis Meri Celma
Thesis Advisor: Susana Val, Ph.D. Industrial Engineering

Summary:

This thesis aims to develop a holistic and analytical model for Mode of Transport (MOT) selection for a given product, origin-destination combination in a multi-objective environment while considering different factors affecting decision making, trade-offs applicable and applying unique and generic logistical constraints to each Mode of Transport (MOT). It also provides an optimal solution for consolidation of shipments considering the order pipeline at a given point in time.

This thesis also strives to deliver analysis and comparison of different modes of transport based on the total cost that will be incurred, time to deliver, maximizing asset utilization and minimizing holding costs over a period of time. Post validation of the model, it could be evaluated for integration in the sponsor's ERP system.



Dhrupad Bhavsar
M. Eng. in Logistics and
Supply Chain Management,
Zaragoza Logistics Center,
2016
B. Eng., Mechanical
Engineering, University of
Mumbai,
India, 2005



Jose Luis Meri Celma
M. Eng. in Logistics and
Supply Chain Management,
Zaragoza Logistics Center,
2016
B. Eng., Industrial
Engineering,
Polytechnic of Valencia,
Spain, 2012

KEY INSIGHTS

1. Factors affecting Mode of Transport (MOT) selection need to be analyzed for each MOT while balancing the trade-offs between transport costs and holding costs for an optimal solution based on directional parameters. Additionally, analysis is subject to unique as well as generic constraints for each MOT.
2. Opportunities to save costs are presented by consolidation of shipments. It is dependent on order visibility and available time for delivery.
3. Optimal solutions could vary with respect to time and visibility of the same in an interactive way could help users in decision making and make it feasible to integrate research results into an ERP system.

Introduction

The complexity and size of transport network, range of product-mix, varying government regulations and taxation, erratic customs clearance procedures, response times and varying constraints applicable make the selection and analysis of optimal Mode of Transport (MOT) for a product at a given time extremely critical, complex and significant.

The selection of optimal MOT calls for detailed analysis and balancing the trade-offs between transport costs and holding costs. Considering the frequency and value of shipments, this analysis would be detrimental to huge cost

savings potential. Furthermore, based on the availability of order pipeline, it would be a value addition to capitalize opportunities to consolidate shipments and gain efficiencies. Another important factor to account is that optimal solutions could vary over time periods and therefore a visibility of the same adds value to the analysis.

Within this scenario, a multinational Oil & Gas services company is looking for innovative ways to analyze and choose the optimal Mode of Transport (MOT) at a very high frequency in their global network for all product categories, compare MOTs over time periods and intends to integrate successful research solutions in their ERP system.

The current analysis relies, to an extent, on the experience and intuition of the personnel and presents an opportunity to improve, standardize and quicken the same.

Optimization process

The optimization process follows a multi-objective fulfilment scenario in terms of delivery times and lowering costs while additionally evaluating consolidation options. Also, the applicable constraints for each MOT are generic and unique as well. For example in case of Air MOT, constraints on weight and volume vary based on the type of aircrafts deployed on a given route.

Multiple research papers partly address some of the issues this thesis attempts to tackle like multi-objective optimization problems, intermodal freight transport

models and the different costs in freight transport. In Janic (2007), the analysis of different costs involved in intermodal freight transport are discussed at a comparable level. Hanssen et al. (2012) analyzes the generalized intermodal transport costs while expressing the relation between the distances of the haul in respect to situations such as when (1) handling costs at terminals increases, (2) total transport distance increases, (3) pre and post-haulage costs increase.

This thesis takes a holistic approach in developing a model for the usage of end-users and integration in an ERP system. Figure 1 presents the summary of the process.

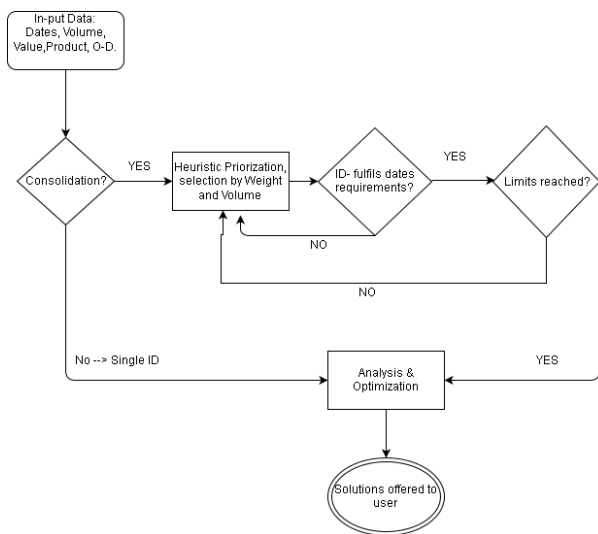


Figure 1: Process flow chart: Optimization

Scenarios considered

The frequently encountered scenarios considered in the model to deliver optimal results are described below

Scenario	Situation
1	origin-destination combination exists for all MOT and can meet delivery deadlines
2	Analysis need to be performed with a different target shipping date
3	origin-destination combination does not exist
4	some MOT cannot meet the delivery deadlines
5	Air MOT specific constraints apply
6	possibility of consolidation and analysis of the same

Table 1: Scenarios

Results and outcomes

Based on random data, Figure 2 depicts example of MOT costs comparison over time for a product and origin-destination combination. Sample comparison based on random data of total costs between consolidations versus

individual shipments for a set of products for Air MOT over a period of time is depicted in Figure 3.

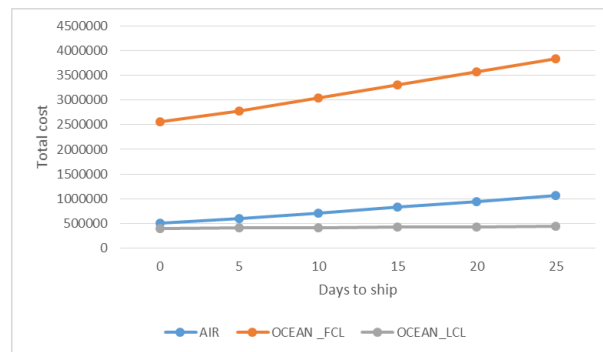


Figure 2: MOT costs over time

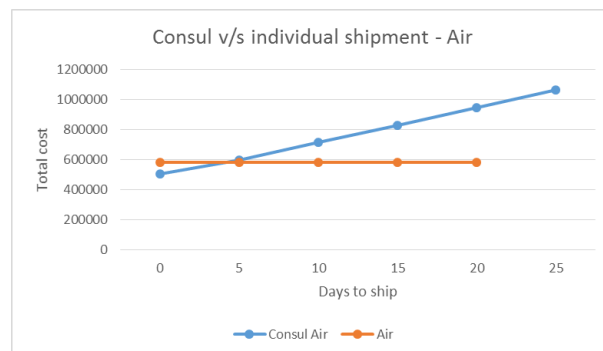


Figure 3: Consolidation versus individual shipments – Air

Conclusions

This thesis models the different costs incurred for each Mode of Transport (MOT) and provides analysis for optimal selection of MOT while balancing the trade-off between transporting a product, increasing the asset utilization versus the cost of holding the same. The model delivers the total logistics cost while meeting the delivery deadlines specified by the customer. For each Mode of Transport (MOT), the costs are calculated applying specific constraints on weight, volume, existing lanes and customer priority. It also provides the optimal solution for consolidation on the basis of available order pipeline and delivers the outcome through interactive charts for ease of decision making.

The model could be evaluated for integration in the sponsor’s ERP system to save costs, standardize MOT selection and to gain a competitive edge.

Cited Sources

Milan Janic (2007). *Modelling the full costs of an intermodal and road freight transport network*. Transportation Research Part D: Transport and Environment, Vol 12, issue 1

Hanssen, Mathisen, Jørgensen (2012). *Generalized transport costs in intermodal freight transport*, 15th Edition of the Euro Working Group on Transportation