TRANSPORT & *LOGISTICS:*
the International Journal

Article history:
Received 08 November 2016
Accepted 15 November 2016
Available online 19 December 2016

ISSN 2406-1069

Article citation info: Thavalingam, G. - Rupasinghe, T. D., The Applicability of an Advanced Shipment Notice (ASN) for Transportation Modelling. Transport & Logistics: the International Journal, 2016; Volume 16, Issue 41, December 2016, ISSN 2406-1069

THE APPLICABILITY OF AN ADVANCED SHIPMENT NOTICE (ASN) FOR TRANSPORTATION MODELLING: A CASE STUDY FROM APPAREL AND FOOTWEAR INDUSTRY

Giritharan Thavalingam[1], Thashika D. Rupasinghe[2]

[1]Sheffield Hallam University, Faculty of Arts, Computing, Engineering and Sciences, United Kingdom tel: +94 779533599, e-mail: giritharan81@gmail.com

[2]University of Kelaniya, Faculty of Sciences, Sri Lanka tel: +94 (0)11 2914482, e-mail: thashika@kln.ac.lk

Abstract:
Organizations are striving to gain competitive advantage. They look for every opportunity that can flourish their business. Transportation is one of the key elements that organizations are increasingly focusing on to gain competitive advantage. There are several methods and techniques available for solving transportation problems. The data for such transportation problem solvers come from many different sources. It includes, but not limited to trade documents such as Purchase Order, Commercial Invoice, etc. As the global trade grows, new trade documents are also introduced into the business functions. While organizations introduce new trade documents, they also restrict the visibility of those documents for selected parties. Consequently, parties such as logistics service providers, consolidators, and agents are provided with limited number of documents or data. As a result of this, certain parties are required to solve business problems with limited amount of data. This situation leads to find data from different sources. This research work aims to discover a new source for such data and extends the current literature on leveraging EDI (GS1 XML) for transportation modelling. Particularly, on how Transport Orders can be planned and optimized into shipments, and how carriers can be selected and goods can be picked up and dropped off. This study attempts to carry out the aforementioned tasks by leveraging the Advanced Shipment Notice (ASN) document, an EDI message for tools for transportation modelling.

Key words:
Advance Shipment Notice , Apparel and Footwear Industry, Transportation Modelling

1 INTRODUCTION

This research study aims to elaborate that the use of Advance Shipment Notice (ASN) documents to solve transportation problems. Particularly, it seeks to address the transportation modelling problems using the ASN document.

The authors observed that enterprises, particularly the key players like Adidas, Levis, Columbia, etc., in the apparel and foot wear industry create electronic ASN documents in order to notify the receiving party about an inbound shipment. Further, the authors see that almost all these brands use the ASN document solely for one purpose. That is to inform the receiving party in advance. Nevertheless, the authors believe that ASN document can also be used in a few other business functions. Particularly, the authors see the possibility of using ASN for transportation modelling. Furthermore, this research is necessary because the outcome of this study may lead to the automation of transportation modelling.

Purpose of the Study

The main purpose of this study is to analyze the possibilities of using the ASN document as a source of data for transportation modelling; to study the necessity of alternative data sources that has been discussed in the literature; how an ASN document is being used in the current business processes; collect ASN data from companies and study the collected data with the help of operational research models; and share the outcome of the study with the industry.

Hypotheses

Previous studies carried out in this area give emphasis on several areas of data collection methods. For example, a report produced by the Transportation Research Board (Quiroga et al.[3] states the necessity of alternative data collection methods by warning that many ongoing freight data collection efforts are frequently inadequate in terms of scope, coverage, geographic and/or temporal resolution, quality, and access to data. Specifically, it mentions about the EDI programs as an alternative data collection method. When it comes to the transaction of ASN documents, in most of the cases it is transmitted via EDI. According to the comparisons done by Notto [1], the ASN document is used only when the EDI is employed; in the absence of EDI, shipments are received and manually checked off a list. Unlike surveys, EDI programs will help to gather real-time business data.

According to Tavasszy and Jong [2], the way the surveys are conducted is changing very rapidly. They argue that the data capture is becoming digital, from paper-based surveys to web-based. It could be noticed that Quiroga et al. [3], and Tavasszy and Jong [2] agree on the fact that future data sources are likely to be based on EDI/digital means. Tavasszy and Jong [2] also advice the business community to follow these technological developments and create safe environment for experimentation, to allow development of models based on as much data as possible.

It is interesting to note that Hoel, Garber and Sadek [4] and Quiroga et al. [3] discuss about using surveys to gather transportation data. In many aspects, it is difficult to use surveys for modelling a business entity's transportation. Especially in the light of globalization, business events and transactions take place with a high degree of dynamic changes. The data become outdated very soon; the data that has been captured at a particular time frame may not be valid at a different time in the future. Thus, nature of business demands the capturing of data as the business events take place. In this way, this research study focuses on capturing the actual business data from ASN documents and use those data for modelling the transportation.

The following condition will be tested in order to verify if the objectives have been met:

- Data gathered from ASN documents can be used on transportation problem solving methods such as NorthWest Corner and MODI methods.

The Research Problem and the Research Questions

The use of ASN documents for different business functions has been identified as the research problem by the authors. This research problem is derived from the observations that have been made by the authors for last six years. During this period of time, the authors observed how ASN documents were being used. The continuous observation and the involvement in product (software) development helped the authors to identify the research problem, and thereupon the below research question has been formulated from the identified research problem.

> *Can the applicability of an Advanced Shipment Notice (ASN) for Transportation Modelling be verified using the Operations Research models and via a set of case studies from apparel and footwear industry?*

A typical ASN will contain a summary of purchase orders, cartons, and equipment/containers. In addition to those data, it will also contain a section called shipment details. The following list contains a few variables that come from an ASN's shipment details section. These variables will be used in transportation problem solving methods (NorthWest Corner and MODI methods).

- Name of manufacturing place
- Country of manufacturer
- Name of Ship-From place
- Name of Ship-From country
- Name of Final Destination place
- Name of Final Destination country

Operations Research models such as NorthWest Corner and MODI methods primarily aim to optimize transportation. Liyanage and Rupasinghe [6] and Cooray and Rupasinghe [7] discuss about Green Logistics and Green Vehicle Routing Problem where it is stated that the problem of finding optimal routes for delivery to or pick-up from one or more depots to many customers who are geographically dispersed has been at the core of many operations research problems.

The study starts with a preview of existing literature where topics like the existing data sources used in transportation modelling, the necessity for an alternative data sources, and how ASN documents are being used currently will be discussed.

The section on the methodology of the research study discusses the rationale for choosing questionnaire as a method of data collection. In addition to that, this section outlines what kind of information will be requested in the questionnaire. Further, this section also talks about the targeted audience of the questionnaire.

The Results and Data Collection section starts off with an introduction to linear programming and then portrays how the data that has been captured will be processed using the two dominant operational research transportation modelling methods. This section takes a step-by-step approach for modelling the transportation and the outcome of the analysis is also presented.

The conclusion section briefs about the objectives of the study, and describes how they have been achieved using the operational research models. Finally, this sections makes a call for awareness.

The study concludes with giving directions on future work, particularly it predicts the possibilities of automating the transportation modelling. This section also talks about the limitations of the study in terms of industries.

2 Methodology of the Research Study

Interviews, surveys, documents, and databases are the most commonly used data collection methods. In this research project, it is decided to use surveys. Survey has been chosen for a number of reasons. This research project requires asking questions to a large group of people. As a result, doing individual interviews is harder to manage. It is said that surveys are very useful when we have to cover large number of audience.

The Open-Ended Questions

There had been a couple of options when the questionnaire was being designed. For example, the questionnaire may contain closed questions or open-ended questions. Closed questions such as multiple choice, true/false, yes/no, and rating on a scale give a certain set of possible responses so that they can be easily compared with the responses from other participants. On the other hand, open-ended questions allow participants to give more information, but responses are not as easily compared as answers to closed questions. Since exclusive information are required to carry out the analysis, it is felt that closed questions will not help to find the answers to the research questions. In this way, open-ended questions are chosen to be part of the questionnaire. Because of the open-ended nature of the questions, the participants of this survey have the flexibility to provide information that nearly matches their context. Primarily, ASNs' location-specific data such as ship-from location and final destination were collected using this approach. The full set of questions can be found in Appendix A. A qualitative analysis has been carried out in order to uncover and understand the big picture of the data gathered. The Table 1 presents the full view of this analysis whereas Figure 1 and Figure 2 represents the analysis of ship-from and final destination data respectively.

The Targeted Audience

Major multinational apparel companies are the targeted group of people for carrying out this survey. Thirty such companies have been contacted as part of this survey and ten companies have been kind enough to take part in this survey by providing the least necessary data. Origin of Goods, Ship-From Location, and Final Destination are the most critical data required to carry out the analysis. In addition to the above location-specific data, trivial information such as organization name and country name have also been asked in the questionnaire. No organizations have come forward to show their identity may be because they wanted to maintain the trade secrets.

3 Data Collection

In this research work, ASN document and its fields are the key to answer the research question.
Particularly, its fields such as Origin of Goods, Ship-From Location, and Final Destination will directly be used in the analysis.

The Location Data from ASN Documents

Although thirty companies were contacted for this survey, only about ten companies have responded to the survey questionnaire. Table 1 presents a snapshot view of how certain location data are presented in the ASN document of those ten companies. In spite of the fact that organizations were encouraged to reveal their identity, no organization have come forward to do so. Therefore, organizations were named with the alphabetical letters, as shown in the Table 1. Further, although Origin of Goods data were captured in the survey, it has been omitted from the Table 1 as 100% match found between Origin of Goods data and Ship-From location data.

The significant trend that can be observed in this table is that most of the freights are shipped from China to a final destination in the USA. Interestingly, it is also observed that both the ship-from location and the final destination happen to be in the same continent. For example, both the ship-from location and the final destination happen to be "California" for a given organization. There are also a few European buyers who get their freight shipped from a location in the Asia.

Tab. 1 *Ship-From and Final Destination Data categorized by Organization*

Organization	Ship-From Location	Ship-From Country	Final Destination	Final Destination Country
Organization A	Bangkok	Thailand	North Carolina	USA
Organization B	Madanur	India	Pennsylvania	USA
Organization C	Hangzhou	China	Le Mose	Italy
Organization D	Gurgaon Haryana	India	South Carolina	USA
Organization E	Taipei	Taiwan	Västra Gõtaland	Sweden
Organization F	Zhucheng	China	Kentucky	USA
Organization G	Guangxi	China	California	USA
Organization H	Jiaxing	China	Johor	Malaysia
Organization I	California	USA	California	USA
Organization J	Mahiyangana	Sri Lanka	Tennessee	USA

Ship-From Location Data

The data that has been presented in the Table 1 is further refined in the Figure 1 by extracting the ship-from location data. By sharing the ship-from location data, all the participants of this survey confirm that they transmit ship-from data via ASN document. As we can see, majority of the companies ship their freight from China (40%) and India (20%) whereas 40% of companies ship their freight from four other countries with each sharing just 10%. As a consequence, ship-from locations from China and India will be used in the Transportation Problem solvers.

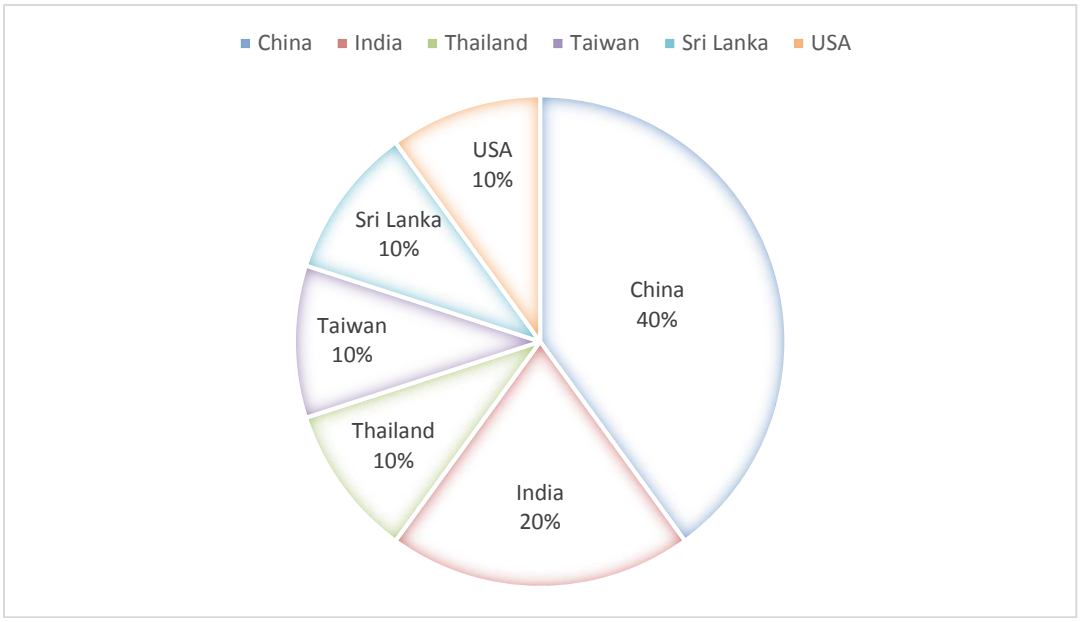

Fig. 1 *Ship-From Countries as found in ASN Documents*

Final Destination Data

The Figure 2 presents the view of Final Destinations that come from ASN documents; this pie chart was created by extracting the final destination data from the Table 1. By sharing the final destination data, all the participants of this survey confirm that they also transmit final destination data via ASN documents. As shown in the Figure 2, 70% of the freight are, according to ASNs, destined to USA. The remaining 30% of the final destinations are located in three different countries with each having the same number of final destinations. Hence, it was decided to use the final destinations in USA in the Transportation Problem solvers.

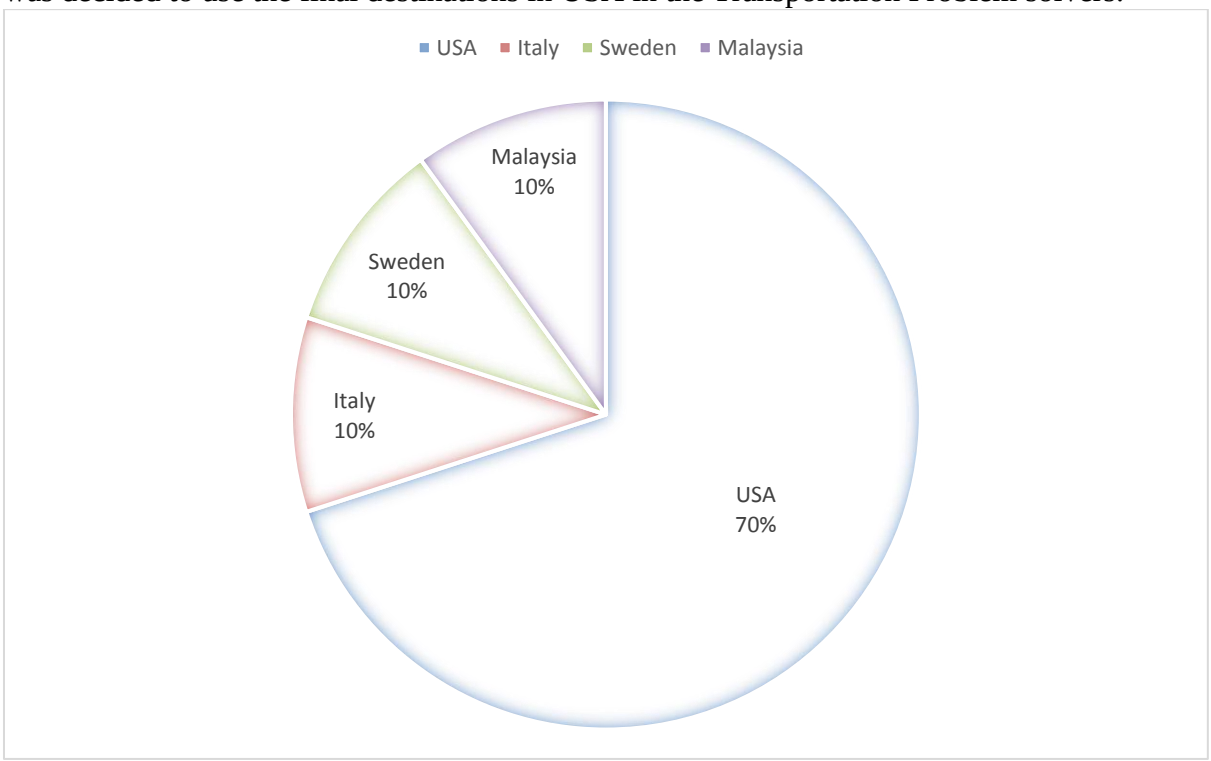

Fig. 2 *Final Destination Countries as found in ASN Documents*

Transportation Cost

As discussed in the previous two sections, it has been decided to use the Ship-From locations in China and India. As for final destinations, it has been decided to use the locations in the USA. The next step is to gather the freight transportation cost between the ship-from locations and the final destinations. An online Freight Calculator[1] has been used to find a rough transportation cost. Table 2 shows the transportation cost in relation to ship-from locations and final destinations. In a real world scenario, the transportation cost may differ from one LSP to another.

Tab. 2 *Transportation Cost (in hundreds)*

Ship-From / Final Destination	Zhucheng (China)	Guangxi (China)	Madanur (India)	Haryana (India)
Kentucky	80	90	55	100
California	130	50	40	85
Pennsylvania	120	70	80	90
South Carolina	140	120	90	80

Supply Data

Even though ASN documents carry information about cartons, particularly the number of cartons that were dispatched with a shipment, the data collecting instrument does not attempt to collect those data. Unlike location data, the carton information may vary arbitrarily from one ASN to another. Therefore, the number of cartons that may be dispatched from the identified ship-from locations were made-up based on observations.

Tab. 3 *Number of Cartons Dispatched*

Ship-From Locations	**Supply of Cartons**
Zhucheng	130
Guangxi	100
Madanur	140
Haryana	75

Capacity of LSP

The capacity of an LSP may be defined in terms of availability and capacity of equipment/containers and ships, man power capability and computing resources. Above factors influence how many cartons can be handled by an LSP at a given time. In practice, LSPs are legally bound to handle all the cartons that are part of an ASN. In this research study, **the LSP capacity** means the number of cartons than can be handled by an LSP for a given final destination. The LSP capacity is also believed to be a transferable resource so that excessive resources can be allocated to the locations where shortages arise. As depicted in the Table 11, hypothetical values were assigned for LSP capacity.

Tab. 4 *LSP's Capacity to cater for Final Destinations*

Final Destinations	**LSP Capacity** (in terms of number of cartons)

Kentucky	120
California	165
Pennsylvania	110
South Carolina	50

4 Results and Data Analysis

The objective of this research study is to analyze the possibility of using the ASN document for solving transportation problems. A solution procedure has to be adopted in order to analyze such possibility. The solution procedure is based on linear programming since the task at hand relates to minimization problem.

Linear Programming

Linear programming is commonly used to solve problems that affect the minimization of costs or maximization of profits. In this case, the solution procedure will be an iterative one that begins with an initial solution that is feasible, but not necessarily optimal. The solution will be progressively tested and improved upon until an optimal solution is reached. The optimal solution is expected to satisfactorily distribute LSP capacity at the lowest total cost. There have been several methods developed for obtaining initial and optimal solutions; Table 5 lists a few such solutions.

Tab. 5 *Initial and optimal solutions for solving transportation problems*

Initial/Feasible Solutions	Optimal Solutions
1. Minimum Cost	1. Stepping-Stone
2. Northwest Corner	2. Modified Distribution (MODI)
3. Vogel's Approximation (VAM)	

This research study adopts the Northwest Corner method to find the initial solution, and the MODI method will be used to find an optimal solution.

NorthWest Corner Method

It is considered that the northwest corner method is the most straightforward way of solving the transportation problem and allocating product to routes. Starting at the top left-hand cell (the north-west corner of the matrix), goods are allocated in such a way so that all the requirements are satisfied for the destination or all the capacity is used from the source. The following features of the northwest corner method have been considered when deciding on the initial solution methodology:

01. The allocation is made from the left hand side top corner irrespective of the cost of the cell.
02. As no consideration is given to the cost of the cell, naturally the total transportation cost will be higher than the other methods.
03. It takes less time. This method is suitable to get basic feasible solution quickly.

Initial Solution Step-by-Step

1. Identify different data of:
   - Cost coefficients
   - Ship-from locations and their supply capacity
   - Final destinations and LSP's capacity to cater for those destinations

This step was completed in the "Data Collection" section. Particularly, the tables 8-11 identify the above data.

2. Setup the transportation tableau with the data that have been captured in the previous step.

Tab. 6: *Transportation tableau with the initial data*

Ship-From / Final Destination	Zhucheng	Guangxi	Madanur	Haryana	**LSP Capacity**
Kentucky	80	90	55	100	120
California	130	5	4	85	165
Pennsylvania	120	7	8	90	110
South Carolina	140	120	90	80	50
Supply	130	100	140	75	445

3. Select the smaller quantity of the supply or capacity and assign it to the northwest corner cell of the transportation tableau. In this case, we select the LSP capacity of 120 cartons and bring it down to zero, whereas the supply quantity at related ship-from location is reduced to 10 from 130 cartons. Since the supply has leftover of 10, we move to the next cell downward in the direction of the supply and further allocate the 10 cartons in that cell to deplete the supply. The rule of thumb is, if the original capacity is depleted, then we move to the next cell downward in the direction of the leftover supply. Likewise, we move to the right in the direction of the leftover capacity if the supply is satisfied.
4. Next we move to the cell on the right. Since the remaining the LSP capacity is 155 cartons and the supply is 100 cartons, we opt for whichever the lowest value. In this situation, we place 100 cartons in this cell to exhaust the original supply to zero.
5. We continue to move to the cell on the right since LSP has a remaining capacity for 55 cartons. We place 55 cartons in this cell to exhaust the LSP capacity to zero.
6. Then we move to the next cell downward in the direction of the supply and allocate 85 cartons to deplete the original supply to zero.
7. Next we move to the cell on the right and allocate 25 cartons to exhaust the LSP capacity to zero.
8. Finally, we move to the bottom-left-most cell and allocate 50 cartons to exhaust both the supply and LSP capacity.
9. The last step is to determine the total cost of assignment which is expressed as follows:

Total Cost = \$80(120) + \$130(10) + \$50(100) + \$40(55) + \$80(85) + \$90(25) + \$80(50)
= \$9600 + \$1300 + \$5000 + \$2200 + \$6800 + \$2250 + \$4000
= \$31,150

***Tab. 7** Initial Solution using the NorthWest corner method*

Ship-From / Final Destination	Zhucheng	Guangxi	Madanur	Haryana	**LSP Capacity**
Kentucky	120 [80]	[90]	[55]	[100]	120
California	10 [130]	100 [5]	55 [4]	[85]	165
Pennsylvania	[120]	[7]	85 [8]	25 [90]	110
South Carolina	[140]	[120]	[90]	50 [80]	50
Supply	130	100	140	75	445

Modified Distribution Method (MODI)

Once the initial solution has been found out for the transportation problem and a check for degeneracy has been done, the next step in the problem is to find out the optimal solution. The MODI Method is an efficient procedure which helps to achieve an optimal solution. The optimality is achieved by calculating the opportunity costs (savings in the transportation cost) for all the empty cells.

The MODI method is useful when the size of problem is large. Further, this method provides a better transportation schedule by evaluating the unfilled cells or those cells which do not have scheduled shipments. The MODI method chooses a particular empty cell that will produce the most improvement by a set of index numbers calculated for the rows and columns. The movement of maximum units are then made for that empty cell. In a similar manner, revised index numbers indicate the next best empty cell. This is an iterative process which continues until there are no more minus values, i.e., indicating no possibility of improvement in the solution.

Iteration – I

In the initial solution, NorthWest Corner method has been used to find out the basic feasible solution. In general, MODI method is a continuation of the NWC method. As shown in the Table 8, the carton allocation remains same as the NWC method. However, Table 8 also shows how empty cells were evaluated in order to find an optimal solution.

Tab. 8 *Evaluation of empty cells after the initial solution*

Ship-From / Final Destination	Zhucheng V_1=80	Guangxi V_2=0	Madanur V_3= -10	Haryana V_4=0	**LSP Capacity**
Kentucky U_1=0	120 [80]	* [90]	* [55]	* [100]	120
California U_2=50	10 [130]	100 [5]	55 [4]	* [85]	165
Pennsylvania U_3=90	* [120]	* [7]	85 [8]	25 [90]	110
South Carolina U_4=80	* [140]	* [120]	* [90]	50 [80]	50
Supply	130	100	140	75	445

***** - Denotes empty cells
Kentucky – Guangxi = 90 – 0 – 0 = 90
Kentucky – Madanur= 55 – (-10) – 0= 65
Kentucky – Haryana= 100 – 0 – 0= 100
California – Haryana= 85 – 0 – 50 = 35
Pennsylvania – Zhucheng = 120 – 80 – 90= **-50**
South Carolina – Zhucheng= 140 – 80 – 80= **-20**
South Carolina – Guangxi= 120 – 0 – 80= 40
South Carolina – Madanur= 90 – (-10) – 80= 20

Iteration – II

In the Iteration - I, the evaluation of empty cells resulted in negative values for the following combinations of ship-from locations and final destinations:

- Pennsylvania – Zhucheng
- South Carolina – Zhucheng

Since negative values were received, it is concluded that the solution is not optimal and therefore required another iteration for assigning cartons to empty cells based on the highest negative opportunity cost. Table 9 shows how 10 cartons were re-assigned accordingly.

Tab. 9 *Allocate cartons to empty cell in the Iteration - II*

Ship-From / Final Destination	Zhucheng	Guangxi	Madanur	Haryana	**LSP Capacity**
Kentucky	120 [80]	[90]	[55]	[100]	120
California	10-10 [130]	100 [5]	55+10 [4]	[85]	165
Pennsylvania	+10 [120]	[7]	85-10 [8]	25 [90]	110
South Carolina	[140]	[120]	[90]	50 [80]	50
Supply	130	100	140	75	445

After re-assigning the cartons, it is necessary to check whether the solution is optimal. Table 10 shows the cells (denoted in red asterisk) that need to be evaluated.

Tab. 10 *Evaluation of empty cells in the Iteration - II*

Ship-From / Final Destination	Zhucheng V_1=80	Guangxi V_2=50	Madanur V_3= 40	Haryana V_4=50	**LSP Capacity**
Kentucky U_1=0	120 [80]	* [90]	* [55]	* [100]	120
California U_2=0	* [130]	100 [5]	65 [4]	* [85]	165
Pennsylvania U_3=40	10 [120]	* [7]	75 [8]	25 [90]	110
South Carolina U_4=30	* [140]	* [120]	* [90]	50 [80]	50
Supply	130	100	140	75	445

***** - Denotes empty cells
Kentucky – Guangxi = 90 – 50 – 0 = 40
Kentucky – Madanur= 55 – 40 – 0= 15
Kentucky – Haryana= 100 – 50 – 0= 50
California – Zhucheng= 130 – 80 – 0 = 50
California – Haryana= 85 – 50 – 0 = 35
Pennsylvania – Guangxi = 70 – 50 – 40= **-20**
South Carolina – Zhucheng= 140 – 80 – 30= 30
South Carolina – Guangxi= 120 – 50 – 30= 40
South Carolina – Madanur= 90 – 40 – 30= 20

Iteration – III

The evaluation of empty cells resulted in negative values in the Iteration - II as well. The following combination of ship-from location and final destination has a negative value:

- Pennsylvania – Guangxi

In search of an optimal solution, Iteration - II proved to be a failure. Thus it is necessary to run another cycle by assigning cartons to empty cells based on the highest negative opportunity cost. Table 11 shows how 65 cartons were re-assigned accordingly.

Tab. 11 *Allocate cartons to empty cells in the Iteration - III*

Ship-From / Final Destination	Zhucheng	Guangxi	Madanur	Haryana	**LSP Capacity**
Kentucky	120 [80]	[90]	[55]	[100]	120
California	[130]	100-65 [5]	65+65 [4]	[85]	165
Pennsylvania	10 [120]	0+65 [7]	75-65 [8]	25 [90]	110
South Carolina	[140]	[120]	[90]	50 [80]	50
Supply	130	100	140	75	445

After re-assigning the cartons, the next step is to check whether the solution is optimal. Table 12 shows the new set of cells (denoted in red asterisk) that need to be evaluated.

Tab. 12 *Evaluation of empty cells in the Iteration - III*

Ship-From / Final Destination	Zhucheng V_1=80	Guangxi V_2=30	Madanur V_3=20	Haryana V_4=50	**LSP Capacity**
Kentucky U_1=0	120 [80]	* [90]	* [55]	* [100]	120
California U_2=20	* [130]	35 [5]	130 [4]	* [85]	165
Pennsylvania U_3=40	10 [120]	65 [7]	10 [8]	25 [90]	110
South Carolina U_4=30	* [140]	* [120]	* [90]	50 [80]	50
Supply	130	100	140	75	445

* - Denotes empty cells

Next, the opportunity cost for each non-allocated cell is calculated:

Kentucky – Guangxi = 90 – 30 – 0 = 60
Kentucky – Madanur= 55 – 20 – 0= 35
Kentucky – Haryana= 100 – 50 – 0= 50
California – Zhucheng= 130 – 80 – 20 = 30
California – Haryana= 85 – 50 – 20= 15

South Carolina – Zhucheng= 140 – 80 – 30= 30
South Carolina – Guangxi= 120 – 30 – 30= 60
South Carolina – Madanur= 90 – 20 – 30= 40

Since all opportunity cost of improved solution are positive, it is considered that an optimal solution has been reached. The cost of transportation is calculated as below:

Total Cost = \$80(120) + \$50(35) + \$40(130) + \$120(10) + \$70(65) + \$80(10) + \$90(25) + \$80(50)
= \$9600 + \$1750+ \$5200 + \$1200 + \$4550 + \$800 + \$2250 + \$4000
= \$29,350

Comparing the total cost obtained from NorthWest Corner method with that of MODI method, we can see that an LSP can save up to \$1800 by doing an efficient allocation of resources.

5 CONCLUSIONS

The main purpose of this study is to analyze the possibilities of using the ASN document as a source of data for transportation modelling. The following actions were taken in order to verify whether the objectives have been met:

i. A thorough literature review has been done in the context of requirement for alternative data sources, use of OR model for solving transportation problems, and how ASN document is being used currently. It has been observed that greater level of concern was raised in regard to the source of data.
ii. Location-specific ASN data were collected by circulating a questionnaire to major apparel and foot wear companies.
iii. The obtained data were initially formalized and then analyzed with the help of two OR models: North-West Corner and MODI methods. Further, it has been observed that Logistics Service Provider was able to save \$1800 by allocating resources efficiently. In this way, transportation problem was solved by collecting data from ASN documents and this knowledge is the key contribution to the exiting literature.

According to Kempkes [5], Unilever's carrier selection process is sequential. For example, if the carrier declines the assignment, the transport planner will retender the shipment(s) with a different carrier. On the other hand, in a general business context, an LSP works on multiple ASNs at a given time, and most importantly carriers in the ASNs would have already accepted the assignments. As presented in this research study, an LSP can model a transportation by efficiently allocating its resources and working parallel with multiple carriers. This has become possible because of the data found in ASN documents.

References

[1] NOTTO, Ralph W. (2005). Challenge and Consequence. Fenestra Books.

[2] TAVASSZY, Lóránt and JONG, Gerard De (eds.) (2014). Modelling Freight Transport. Elsevier.

[3] QUIROGA, Cesar, KONCZ, Nicholas, KRAUS, Edgar, VILLA, Juan, WARNER, Jeffery, LI, Yingfeng and WINTERICH, David (2011). NCFRP Report 9: Guidance for Developing a Freight Transportation Data Architecture. Transportation Research Board.

[4] HOEL, Lester A., GARBER, Nicholas J. and SADEK, Adel W. (2011). Transportation Infrastructure Engineering. Cengage Learning.

[5] KEMPKES, Fred (2009). Unilever's approach to Transportation. [online]. Last accessed 27 Oct 2016 at: http://www.gs1.org/sites/default/files/docs/gsmp/05_-_unilever_transportation_-_gs1_warsaw_conference_presentation_12102015.pdf

[6] LIYANAGE, R P and RUPASINGHE, T D, An Analytical Model Formulation to Enhance the Green Logistics (Gl) Operations: From The Perspective of Vehicle Routing Problem (VRP), American Journal of Engineering Research (AJER), e-ISSN: 2320-0847 p-ISSN: 2320-0936, Volume-5, Issue-8, pp-294- 299

[7] COORAY, P.L.N.UA and RUPASINGHE, T.," An Analysis of Green Vehicle Routing Problem (GVRP) Solving Methodologies: A Systematic Review of Literature", Research for Transportation and Logistics Industry (R4TLI), Colombo, Sri Lanka, June 2016

[8] SABRI, Ehap H., GUPTA, Arun and BEITLER, Michael A. (2014). Purchase Order Management Best Practices. Cengage India.

[9] PALEVICH, Robert (2012). The Lean Sustainable Supply Chain. FT Press.

[10] REYNOLDS, George (2015). Information Technology for Managers. 2nd ed., Course Technology.

[11] TATE, William H. (2012). Evaluation of the Use of Electronic Shipping Papers for Hazardous Materials Shipments. Transportation Research Board.

[12] AUTRY, Chad W., GOLDSBY, Thomas J., BELL, John E. and HILL, Arthur V. Hill. (2013). Managing the Global Supply Chain. FT Press.

[13] SABRI, Ehap H. and SHAIKH, Salim N. (2010). Lean and Agile Value Chain Management. J. Ross Publishing.

[14] FISHER, Colin (2010). Researching and Writing a Dissertation. 3rd ed., Trans-Atlantic Publications.

[15] KARUNANANDA, Asoka S. (2007). How To Write Your Thesis. University of Moratuwa.

[16] MILLER-COCHRAN, Susan K. and RODRIGO, Rochelle L. (2016). The Cengage Guide to Research. 3rd ed., Cengage Learning.

[17] RUBIN, Allen and BABBIE, Earl R. (2013). Research Methods for Social Work. 8th ed., Brooks/Cole Cengage Learning.

[18] RAHMAN, Syed (2000). Electronic Commerce: Opportunities and Challenges. Idea Group Publishing.

[19] Wikipedia 2016. [Online]. Available: https://en.wikipedia.org/wiki/Drop_shipping (23 September 2016).

[20] PRUSINSKI, Ben and GONZALEZ, Gustavo (2012). Oracle E-Business Suite Financials Handbook. 3rd ed., McGraw-Hill Education.