Amity Journal of Energy & Environment Studies
2016, Volume 2, Number 2

Enabling Criteria for Modal Shift in Surface Cargo Transportation and Effect of RoadRailer

Jugal Kishore Vashist* **Shiv Kumar Chowdhri**** **Preeti Dwivedi*****

Purpose – The purpose of this paper is twofold: to identify the criteria of choice and enablers for modal shift from road to rail between Delhi and Chennai in India, and to understand the requirements of users who might adopt the new bimodal RoadRailer.

Design/methodology/approach – With the help of questionnaires**,** responses of 251 shippers, who moved automobile and components, electrical and electronics, capital goods and fast moving consumer goods (FMCG)/retail, were collected. Shippers with more than 5 years of experience in logistics industry and who mostly used road transport between Delhi and Chennai, but had experience of using other modes, were selected. Structural equation modeling is used to find out the causal relationship between criteria of choice and profile of the shippers.

Findings – Six criteria of selecting a particular mode and three profiles of shippers were uncovered. The six criteria are: safety; direct cost; value added services; seamless convenience - transit time trade off; seamless convenience - external cost trade off and direct cost-value added services trade off. Three distinct profiles of users were found to be: those who wish to switch from road to intermodal container; those who wish to stick to road and those who wish to switch from road to rail. Causal relationships between the criteria and shippers' profile as determined by structural equation modeling helped the researcher to identify enablers of shift from one mode to another.

Further, the profiles of users, who are likely to adopt RoadRailer bi-modal transport and their motivational triggers to switch**,** have been identified.

Research limitations/implications –Findings pertain to only one study done on Delhi-Chennai route which is over 2200 kilometers long. For other destinations and shorter routes the motivating factors to shift between modes may vary. While the six criteria influencing the modal choice may hold well, the effect on different profiles of users may vary. The influence of bimodal RoadRailer has been estimated by capturing perception. To understand the reality, the study should be repeated after the RoadRailer is introduced.

Practical implications – The findings will help Indian Railways (IR) to formulate strategies to enhance its percentage share in freight transportation on Delhi-Chennai route. The study distinguishes between the expectations of road users who are potential users of Intermodal transport, rail wagon and RoadRailer when introduced. Separate strategies will be needed to convert them. The findings will also help the providers of road transport service to strategize by adopting the bimodal RoadRailer because bimodal RoadRailer is the missing link between road and rail mode of transport, hence complements both modes of road & rail modes.

Originality/value – This work introduces 'seamless convenience' as a new criterion for selection of mode of transport. It further suggests that many criteria are not used as standalone parameters for exercising modal choice. There is always a trade-off. Accordingly, six criteria for mode selection have been identified.

Keywords – Bimodal, RoadRailer, Intermodal container, Rail wagon, Road truck, Structural equation model

INTRODUCTION

The major cause of concern for the freight marketing division of Indian Railways is rapidly losing share of freight cargo to road transport. The percentage freight share of railways in India has continuously declined from 89% in 1950-51 to 30% in 2015-16. Cargo movement in India is unevenly skewed in favour of road. It makes roads congested, prone to accidents, unsafe and contributes to atmospheric pollution besides affecting the drivers' personal lives. Currently, movement by road has to pass through many check posts and barriers that make total transit time highly unpredictable and pushes the cost up. Implementation of Goods and Services Tax (GST) may bring some relief. Further, road transportation sector in India is highly unorganized. Over 82% of the total road fleet is owned by small transporters who have 2-3 trucks. Due to lack of resources deployed by small transporters, the quality of service is poor. If the share of rail in freight transport is increased, it will benefit the railways as well as the society. This is the primary motivation

* *Chief Executive Officer, Kirloskar Pneumatic Co Ltd (RoadRailer Division)*

** *Former Executive Director freight Marketing & Chief Operations Manager, Indian Railways*

*** *Research Scholar, Amity University*

for undertaking this research. The study identifies the criteria of choice of modes of transport and determines the possible enabling parameters that can influence users of road transport to shift to rail mode.

In surface transportation, rail and road are considered as the two modes of transportation but the authors of this research paper have categorized surface transportation in India based on the unit in which cargo is stuffed and its medium of transportation, therefore, have considered four modes i.e. road truck, rail wagon, intermodal container and bimodal RoadRailer.

Indian Railways has also announced introduction of new mode of transport i.e. RoadRailer which is a bimodal form of surface transport. In RoadRailer, the same equipment is used on rail tracks as well as on road providing seamless and safe transport of goods with no human intervention; handling or stuffing-destuffing enroute (Štrumberger, Perić, & Štefančić, 2012). This study maps the perception based acceptance of RoadRailer among the potential users so that railways can develop a suitable communication pitch for marketing the capacity of RoadRailer. The choice of modes of surface transport is an under researched area in India (Cook, Das, Aeppli, & Martland, 1999). This study fills the gap by studying shippers' perspective to find out the various criteria in choosing mode of surface transportation; the enabling parameters for inter modal shift of cargo and the shippers' perception about bimodal transportation system (figure 1).

The longest route of Delhi and Chennai in India and four commodity segments, the major users of road transport, of automobile and components; electrical and electronics; capital goods; fast moving consumer goods (FMCG)/retail along with logistics service providers have been selected for the research.

REVIEW OF LITERATURE

The review of literature is divided into three sections: introduction to modes of surface transport; criteria for modal choice and review of the methodology. The review of literature led to the gaps in knowledge in the area that has dictated the identification of research topic.

Introduction to modes of surface transport operational definitions

Users of the surface mode of transport decide to transport their cargo not merely by selection of mode of transport i.e. road or rail mode but also the type of the equipment used for cargo stuffing and its further mode of transportation enroute (Johnston &

1. First RR unit is aligned with RR rail bogie positioned on track. It is then pushed back by PM to couple with top of RR rail bogie
2. With the RR unit resting on its landing gear & bogie, PM couples 2nd RR Unit with another RR bogie further ahead on track and the combination is pushed back to couple with the first unit.
3. Likewise 50 RR units are coupled together in blocks to form a rake.
4. RoadRailer rake is pulled by a locomotive to destination where reverse operations are carried out and individual RR unit is taken for door delivery of cargo.

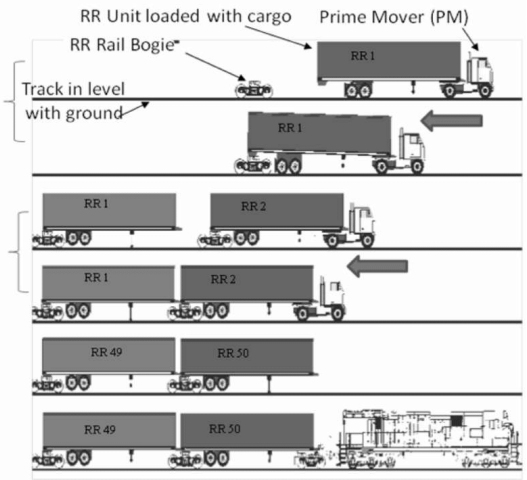

Figure 1: A brief overview of bimodal RoadRailer operations

(Source: www.indianrailways.gov.in RoadRailer services on Indian Railways: No 2000/M (N)/60/2/Wagon Census New Delhi, 2013).

Marshall, 1993). Hence four modes of surface transport are under study viz: road truck, rail wagon, intermodal container and bimodal RoadRailer.

Road Truck: In this mode, the cargo {Full Truck Load (FTL) or Less than Truck Load (LTL)} moves only by road truck mode either from origin to destination directly or transshipped at various hub locations en-route (Harper & Evers, 1993).

Rail Wagon: In this mode, cargo loading in rail wagons takes place in two ways: (a) the commodities like automobiles, bagged cargo, parcel etc are stuffed/de-stuffed in rail wagons at the rail siding which is situated away from cargo generating areas and the cargo is brought to the point of loading by truck loads (b) the commodities like coal, cement, ore etc are loaded/unloaded in rail wagons at the rail siding which is situated within users' premises where cargo is generated and no further transportation is required by road truck (Raghuram & Shukla, 2008). The respondents using only category (a) were included for study because cargo of these respondents can be transported using any mode of surface transport. The commodities like coal, cement, ore etc (belonging to category b) which normally move as full train load, are excluded from study.

Intermodal Container: In this mode, cargo is stuffed in a container at end users' premises and locked by the user to ensure safety. It is then loaded onto the road trailer. Trailer is pulled by a prime mover. Prime mover is a motor vehicle which draws the trailer on road. The container is transshipped at the rail terminal from a road trailer to 'trailer on a flat car (TOFC)'of rail. At the destination rail terminal, container is again transshipped from TOFC to road trailer for further delivery to the end user. It is important to note that prime mover, trailer, container and TOFC are four independent equipments, which are used in cargo transportation. Intermodal transport is defined as the use of at least two different modes of transport in an integrated manner, in a door-to-door transport chain (Organization for Economic Development and Cooperation, 2001). Holcomb and Jennings (1995) provided the most appropriate definition of intermodalism as "a logistically linked movement using two or more modes of transportation.".

Bimodal RoadRailer: A vehicle which operates both on the road and on the rail tracks had been called RoadRailer (Štrumberger, Perić, and Štefančić 1998). In this mode, the cargo is stuffed in the RoadRailer, which operates as a wagon on rail, while the same unit operates as a semi-trailer on road. RoadRailer provides seamless door-to-door transportation of goods because it does not require any handling or transshipment at rail terminals (www.indianrailways.gov.in). This kind of transportation is called bimodal system. Unlike the conventional road-railway system, the bimodal transport technology has certain advantages due to the hassle free of transition from road to railway and vice versa, without needing any special handling equipment and specially constructed terminals.

Comparison among modes of surface transport: Intermodal routings helped shippers to minimize the total transportation costs (Barnhart & Ratliff, 1993). The initial capital costs, in terms of track and mobile equipment, were significantly higher in the case of conventional container terminals than RoadRailer terminals (Ferreira & Sigut, 1995). By combining the advantages of each mode, intermodal transport enabled the system to be more efficient, cost-effective and sustainable (Jugovic, Debelic, & Brdar, 2011). Johnston and Marshal (1993) concluded that there was no single type of equipment that dominated the shipper favor. Preference for Trailer-on-flat car (TOFC) was perceived to be high for cubic and weight capacity and flexibility between modes, but low for protection at loading stage and cleanliness. Containers were perceived to be high on ease of loading and unloading, protection at loading and cleanliness, but low for flexibility. RoadRailer trailers were perceived high for modal flexibility, safety and cleanliness, but low for capacity. The authors concluded that shipper perceptions of intermodal equipment were mixed, but some general impressions could be derived. RoadRailer technology might be a missing link that makes intermodal transport work (Albright, 1992).

Review of criteria for modal choice

The intense competition at the global level has turned the relationship between manufacturers and suppliers from antagonist to cooperative (Wu & Weng, 2010). Service quality and price are important factors influencing the choice of mode (Buehler, Pucher, & Kunert, 2009; Eng-Larsson & Kohn, 2012). Cost, transit time, reliability and frequency were considered to be the most relevant aspects in deciding which mode to adopt (Bergantino & Bolis,

2008; Feo, Espino, & García, 2011). Several scheduling combinations repeatedly demonstrated a significant impact on shipper modal selection (Strasser, 1992). López-Navarro (2013) found that modal choice did not take environmental aspects into account as a parameter that could affect the decisions made. Several criteria like freight charges, inland charges, schedule flexibility, warehousing capacity, track and trace system, port presence and custom clearance are considered important to select a suitable logistics service provider (Vijayvargiya & Dey, 2010). Çakir, Tozan, and Vayvay (2009) identified the decision criteria of cost of service, financial performance, operational performance, reputation of the 3PL service provider and long term relationships for selection of logistics service provider and mode of transport. Some important themes i.e. concerns about polluting the environment and use of energy; security in the supply chain; resilience of a chain; supply chain integration; international growth; and the role of the internet and emerging information technologies are under-represented as revealed by Meixell and Norbis (2008). Johnston and Marshall (1993) examined six characteristics of equipment i.e. cubic capacity; gross weight capacity; ease of loading and unloading; protection of loading; cleanliness and flexibility. Liberatore and Miller (1995) developed a methodology for evaluating the basic trade-off among inventory carrying cost, inventory investment cost and transportation cost. The methodology emphasized the significance of considering both total network logistics cost and inventory investment costs in making decisions about the mode of transport and carrier. The decision to select carrier alternative was based on the direct cost and quality factors (Liberatore & Miller, 1995). Yang, Hui, Leung, and Chen (2010) examined the significance of integration and consolidation of shipments, the trade-offs between costs, benefits and risks within activities of the logistics process and the differing roles of traditional freight forwarders and integrators. Modal decisions for exports are impacted by the cost of capital and the gross margin ratio (Ke, Windle, Han, & Britto, 2012). Premeaux and Phelps (2005) focused on the identification of significant differences in the assessment of the importance of 36 carrier selection variables by both carriers and shippers. Shippers were increasingly demanding better quality service from carriers (Crum & Allen, 1997). Evans and Southard (1974) found that there were five perceptual differences between shippers and carriers. Shippers rated carrier response in emergency or unexpected situations, carrier's leadership in offering more flexible rates, information provided by carriers, computerized billing and tracing and a web-enhanced electronic data interchange (EDI) higher than mode of transport. The concept of innovation was regarded in most organizations as an effective tool to create and sustain competitive advantages. Adding value through innovation has transformed from the business concept of transportation to that of serving the entire logistical needs of customers (Soosay & Hyland, 2004). The service component offered a very good chance of gaining sustainable competitive advantage in the hypercompetitive global market. Conversely, poor service or a reluctance to innovate offered a fairly good chance of losing customers (Chapman & Corso, 2005; Esper, Fugate, & Davis-Sramek, 2007). Chapman & Corso (2005) also found that the advances in technology and communication have compelled this industry to strive permanently for new products and solutions. The optimal choice of mode was shown to involve a trade-off among freight rates, speed, dependability (variance in speed) and en-route losses (Baumol and Vinod, 1970). It was shown that faster, more dependable service simply reduced the shipper's or receiver's inventories, including his safety stock and his inventory in transit. Hence inventory theory made possible a direct comparison of the attributes on which mode selection was based and led to a model of rational choice in transport demand. There have been major changes in the share of road and rail traffic in India as the economy and the population has grown and become more urbanized (Cook, Das, Aeppli and Martland, 1999). Researchers identified cost, service, product characteristics, relationships, and capacity as some of the primary factors influencing the choice of mode. However, an important finding of Roberts (2012) was that many of these factors often influenced the mode and carrier selection decision simultaneously. For choice of mode, the first level of choice depends on the nature of the product. It must make economic sense given product characteristics to ship on a given mode. If product characteristics allow a modal choice to exist, the decision was heavily weighted towards cost and capacity. With environmental awareness on the rise, firms are increasingly motivated, both by regulations and corporate citizenship, to factor in environmental concerns in their decision. It was the economic variable that appeared to influence modal choice in

freight transportation in expected manner with shippers patronizing the qualitatively superior road mode when per capita state domestic product goes up (Chaudhary, 2005). The author found that freight share of rail did not go up with increase in user cost difference or cost ratio between road and rail. Vashist and Dey (2016) reported eight crietria i.e. transit time, direct cost, external cost, safety, reliability, capacity, value added services and seamless convenience for modal selection in India.

Review of Modal Shift

The focus of this study is to determine parameters that will enable shifting traffic from road to rail – be it intermodal container or rail wagon. All respondents of this study have experience of using all the three modes but more than 50% of their cargo moves by road between Delhi and Chennai. Hence, they are mainly users of road transport. A little probing suggests that such a user can be grouped into three types of profiles based on the intended behavior to shift to another mode: (1) those that are willing to switch to intermodal container or (2) stick to road or (3) switch to rail wagon. For these three profiles, the triggers to shift will also vary.

The study by Vannieuwenhuyse et al. (2003) revealed that users of a specific transport mode gave that mode a higher score than non-users, thus implying that often the bias towards other modes is due to lack of experience or knowledge about other modes. On the other hand, study by Golias and Yannis (1998) found that a majority (78%) of the carriers included in the study were ready to transfer from road to intermodal road-rail transport if it would positively affect their profits. Forwarders' study showed that willingness to switch was much weaker (52%), and both groups indicated that more financial support is necessary to enable the shift.

Experiences of shippers with a particular mode of transport shape their attitudes. Attitudes and perceptions play important roles in the selection of a mode. Gaining and distributing information and knowledge about different modes is crucial to breaking these barriers (Jensen, 2008).

Review of Methodology

Structural Equation Modelling (SEM) is a valuable tool for analyzing problems in operations management (Shah and Goldstein, 2006). Punniyamoorthy, Mathiyalagan and Parthiban (2011) used SEM and fuzzy analytic hierarchy process technique to develop a composite model, based on criteria that influence the selection of a supplier. They further stated that the number of available alternatives in the current market is on a rise, and hence it was difficult to select a supplier from among a large lot because of increasing global competition. Wu, Huang, and Hsu (2007) proposed a supplier selection model. Through exploratory factor analysis (EFA), the key factors affecting supplier and modal selection were identified. These factors included capabilities of price response, quality management, technological issues, delivery commitment, flexibility, management support, commercial image and financial. Joreskog and Sorbom (1996) mentioned that the structural equation model specifies the causal relationships among the latent variables, describes the casual effects on the basis of the explained and unexplained variances. Structural equation modeling resembles path analysis by providing parameter estimates of the direct and indirect links between observed variables.

Fit indices of a structural equation model are relative to progress in the field. Although there are rules of thumb for acceptance of model fit (e.g. CFI should be at least .90). Bollen (1989) observed that these cut-offs are arbitrary. A more salient criterion may be simply to compare the fit of one's model to the fit of other, prior models of the same phenomenon. For example, a CFI of 0.85 may represent progress in a field where the best prior model had a fit of 0.70.

RESEARCH OBJECTIVES

The overall aim of this study is to investigate the motivational triggers that will enable shift of road transport users to intermodal or rail wagon. The specific research objectives are:

1. To identify the reduced set of selection criteria for the mode of transport from the perspective of shippers after taking cognizance of the trade-off among the criteria
2. To determine the enabling parameters to shift the modal choice for cargo transportation in favour of rail
3. To study the shippers' perception about bimodal transportation system (RoadRailer) at pre-launch stage

RESEARCH METHODOLOGY

Through survey with a structured questionnaire responses of 251 participants were captured. The questionnaire had three sections. Total 32 statements were used to find out criteria for modal choice; 28 statements were used to determine the shippers' profiles and 13 statements were used to map the perception about RoadRailer. Causal relationship is established using structural equation modeling to find the factors influencing the modal choice. SPSS and AMOS software were used to analyze the data. Target shippers included respondents from four commodity groups of the market which are mainly (more than 50% by value) moving their cargo by road. The respondents represented their companies and these companies are using more than one mode of surface transport and the respondents have experienced all the three modes of surface transport i.e. road truck; rail wagon and intermodal container. Four commodity groups included are: automobiles and components; electrical & electronics; capital & engineering goods and fast moving consumer goods (FMCG)/Retail. These four groups have been selected because these commodities move mainly by road and most of them do not figure in commodities carried by Indian Railways (IR). Two stage sampling is used i.e. stratified sampling to select firms in a sector for ensuring representativeness and purposive sampling within a stratum (respondents with specified characteristics are selected). Data is collected from respondents who have minimum 5 years experience in logistics function; respondents 'companies having minimum turnover of $10 million; location of the manufacturing facility is within 100 km radius of Delhi and Chennai and respondents' company was having minimum one full truck/wagon/container load of shipment between Delhi and Chennai. Data is analyzed using t-test, correlation, Exploratory Factor Analysis (EFA); Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM).

DATA ANALYSIS AND RESULTS

The data analysis and the results have been divided into three sections. All the 32 variables in first section; 28 variables in second section and 13 variables in third section, obtained from the review of literature and from interviews of the experts, are subjected to the exploratory factor analysis to determine the criteria for modal choice, the shippers' profiles and the perception about bimodal RoadRailer respectively. The section 1, which determines the final 6 criteria for modal choice and three shipper profiles using exploratory factor analysis, which is then confirmed by confirmatory factor analysis (CFA). Section 2 develops the measurement model of criteria for modal choice and the shipper profiles, followed by development of the structural equation model (SEM) to find out the enabling parameters for modal shift. The last section studies the perception of shippers for RoadRailer by developing a measurement model and structural equation model of criteria for modal choice and all modes of surface transport including RoadRailer.

Section 1 determines the criteria for modal choice which is six. The shippers do not always take decisions to select a particular mode of transport based on single criterion; therefore, there is a trade-off between two criteria in some constructs.

The six criteria determined for modal choice (Table 1) are: C1:- Seamless Convenience - Transit Time Trade off: The extent to which shippers make a trade-off between seamless convenience and transit time for modal choice; C2:- Seamless Convenience-External Cost Trade off: The extent to which shippers make a trade-off between seamless convenience and external cost for modal choice; C3:- Safety: The extent to which shipper pays attention to the safety of their cargo in selecting a mode of transport; C4:- Direct Cost: The extent to which shippers pay attention to the direct cost for transporting the cargo through a particular mode of transport; C5:- Value Added Services: The extent to which the shippers pay attention to the value added services in modal choice; C6:- Direct Cost-Value Added Services Trade off: The extent to which shippers make a trade-off between direct cost and value added services for modal choice.

The model fit parameters (Table 2) of the criteria for modal choice have been found satisfactory i.e. normed $\chi 2$ =2.407; GFI = .922; CF1 = .807; RMSEA = .075 and SRMR = .066. Fit indexes are relative to progress in the field: Although there are rules of thumb for acceptance of model fit (ex., that CFI should be at least .90), Bollen (1989) observes that these cut-offs are arbitrary. A more salient criterion may be simply to compare the fit of one's model to the fit of other, prior models of the same phenomenon. For example, a CFI of .85 may represent progress in a field where the best prior model had a fit of .70.

Table 1: Constructs & Variables loadings of Criteria for Modal Choice

Constructs and Variables loadings of Criteria for Modal Choice				
Variables		Construct Loadings		
Variable Code	Variable Name	Construct Name	Construct Code	Loadings
csc29	c29. Number of trans-shipments of my cargo is an important factor	Seamless Convenience - Transit Time Trade-off	c1	0.74
csc32	c32. I do not mind dealing with more number of service providers for single shipment			0.71
ctt01	c01. Time spent for first mile connectivity is an issue for my cargo & needs improvement immediately			0.69
csc30	c30. Number of documents involved per shipment does not make me uncomfortable	External Cost - Seamless Convenience Trade-off	c2	0.76
cec16	c16. For cargo transportation I do not worry about minimizing social (pollution, quality of life etc.) cost			0.74
cec15	c15. I am not concerned about the cost due to under-utilization of equipment (truck, wagon, container)			0.71
csf21	c21. Pilferage of goods during transit is rampant and it is a serious matter of concern	Safety	c3	0.75
csf20	c20. I experience damages during my cargo transportation quite often			0.69
cdc08	c08. Cost incurred to collect from the destination hub is a matter of concern	Direct Cost	c4	0.78
cdc09	c09. I am concerned about my total direct cost only			0.77
cec17	c17. I will change my mode of transport for better fringe benefits	Value Added Services	c5	0.84
cvs28	c28. A customized transport equipment reduces my cost of logistics			0.73
cdc07	c07. Cost of first mile connectivity is an important factor for modal choice	Direct Cost - Value Added Services Trade-off	c6	0.81
cec12	c12. Fringe benefits play crucial role in selection of mode of transport			0.62

Table 2: Model fit summary of Criteria for Modal Choice

Model fit summary of Criteria for Modal Choice	
Particulars	Criteria for Modal Choice
CMIN/df	2.407
GFI	0.922
CFI	0.807
RMSEA	0.075
SRMR	0.066

Table 3: Construct Validity of Criteria for Modal Choice

Construct Validity of Criteria for Modal Choice			
Factor Name	Factor Code	Average Variance Extracted (AVE) for Discriminant Validity	Construct Reliability (CR) for Convergent Validity
Seamless Convenience-Transit Time Trade off	c1	0.51	0.76
External Cost-Seamless Convenience Trade off	c2	0.54	0.78
Safety	c3	0.52	0.68
Direct Cost	c4	0.60	0.75
Value Added Services	c5	0.62	0.76
Direct Cost-Value Added Services Trade off	c6	0.52	0.68

Almost all AVE and CR values (Table 3) are above 0.5 and 0.7 respectively, which establishes the construct validity.

The three identified shippers' profiles (Table 4) for modal choice are: Profile m1:- Users of truck (road mode of transport) who are willing to switch to intermodal container service; Profile m2:- Users of truck (road mode of transport) who would like to continue with road transport; Profile m3:- Users of truck (road mode of transport) who would like to switch to rail wagons.

The model fit parameters and construct validity of the shippers' profile for modal choice have also been found satisfactory as shown in Table 5 & Table 6 respectively.

Section 2 identified the significant paths to find out the causal relationship between criteria for modal choice and the shippers' profiles for modal choice for existing modes of surface transport. The model fit parameters for structural equation modeling (Table 7) i.e. normed $\chi 2$ =2.851; GFI = .863; CF1 = .760; RMSEA = .086 and SRMR = .075 have been accepted for this kind of pioneer empirical study of this complex nature.

Section 3 identified the shipper perception about the bimodal RoadRailer. Eight paths are significant for SEM model of criteria for modal choice and the shippers' profiles for existing three modes (Figure 2) and also for all the modes including RoadRailer (Figure 3).

Standardized regression weights for significant paths are within the acceptable limit. Squared multiple correlations are within the allowable limits. The four absolute fit statistics are i.e. Normed $\chi 2$ = 2.768; GFI = 0.851; RMSEA = 0.084; SRMR = 0 .075 and Incremental fit index CFI is = 0.745. Table 7 includes the model fit parameters at CFA and SEM level of crietria of modal choice and the shipper profiles for modal choice including bimodal RoadRailer.

Table 4: Constructs & Variables loadings for the Shippers' profiles

Constructs & Variable Loadings for Shippers' Profile				
Variables		Construct Loadings		
Variable Code	Variable Name	Construct Name	Construct Code	Loadings
mtwvs27	m27. I do not prefer road truck because value added services are better in intermodal container	Switch from road to intermodal container (r2ic)	m1	0.77
mtsc11	m11. Road truck service does not provide me seamless equipment & seamless agency dealing			0.75
mcsf03	m03. Intermodal Container service is the safest mode of transport			-0.73
mwrl15	m15. Rail wagon service will have more users if it becomes more flexible in terms of door to door connectivity	Stick to road (s2r)	m2	0.84
mcrl02	m02. Container service by rail is inflexible			0.80
mwsc12	m12. Rail mode (rail wagon or intermodal container) is not preferred due to multiple handlings of the cargo	Switch from road to rail wagon (r2rw)	m3	0.88
mwsc13	m13. I prefer rail wagon or intermodal container due to lesser number of statutory compliances & documents			0.66

Table 5: Model fit summary of the Shippers' Profiles

Model fit summary of the Shippers' Profiles	
Particulars	The Modal Preference
CMIN/df	4.153
GFI	0.954
CFI	0.893
RMSEA	0.112
SRMR	0.073

Table 6: Construct Validity for the Shippers' Profile

Construct Validity for the Shippers' Profiles			
Construct Name	Construct Code	Average Variance Extracted (AVE) for Discriminant Validity	Construct Reliability (CR) for Convergent Validity
Road to intermodal container (r2ic)	m1	0.564	0.795
Stick to road (s2r)	m2	0.674	0.805
road to rail wagon (r2rw)	m3	0.610	0.754

Table 7: Model fit parameters with & without RoadRailer at CFA & SEM level

Model fit summary of Criteria for Modal Choice & existing Modes		
Particulars	CFA level	SEM Level
CMIN/df	2.866	2.851
GFI	0.860	0.863
CFI	0.761	0.760
RMSEA	0.086	0.086
SRMR	0.076	0.075

Model fit summary for Criteria for Modal Choice, existing Modes & RoadRailer		
Particulars	CFA level	SEM Level
CMIN/df	2.811	2.768
GFI	0.850	0.851
CFI	0.748	0.745
RMSEA	0.085	0.084
SRMR	0.076	0.075

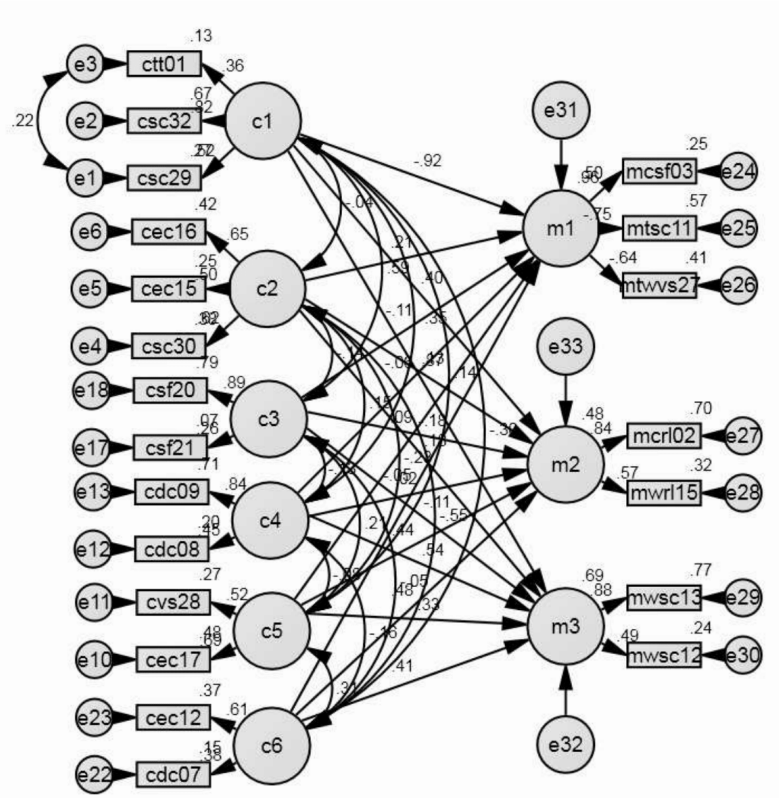

Figure 2: SEM of Criteria for Modal Choice & the Shippers' Profile for existing modes of transport

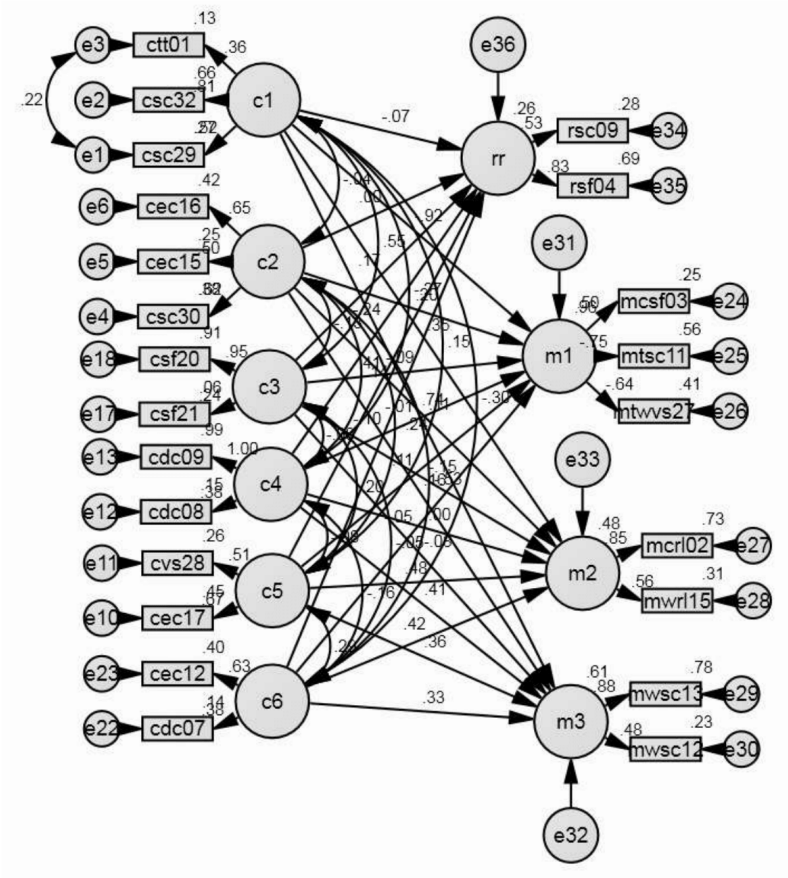

Figure 3: SEM of Criteria for Modal Choice & the Shippers' Profiles including bimodal RoadRailer

DISCUSSIONS

Profile of shippers who wish to switch from road to intermodal container is influenced by criteria of seamless convenience-transit time trade off. This means that if a road transport user feels absence of seamless convenience, improper value added services and lack of safety, then he can be motivated to try out intermodal container service. Profile of shippers who wish stick to road is influenced by criteria of seamless convenience-transit time trade-off; value added services and direct cost-value added services trade off). They are comfortable with road transport because of flexible service and door-to-door pick up and drop facility. They can revise their decision and use rail if they get convinced of seamless convenience, value added services and lower direct cost. Profile of the shippers who wish to switch from road to rail is influenced by seamless convenience-transit time trade off; lower direct cost and value added services. This class of users are ready to switch to rail because they think that there are less number of statutory compliances and documents. But they are scared of multiple handling of cargo. The decision of such users can be influenced by making them aware about seamless conveniences of rail, lower cost and Value added services. All categories of users are influenced by seamless convenience-transit time trade off. When RoadRailer is introduced, the influencing criteria remain almost same except for one change. The criteria i.e. direct cost-value added services trade off, no longer influences profile of the shippers who wish to stick to road. Perhaps for this class of users

RoadRailer becomes more attractive. Further, two criteria i.e. direct cost and value added services influence the choice of RoadRailer.

CONCLUSIONS

Problem statement is appropriate since no such previous research could be found, particularly in India. Primarily, the modes of surface transport are categorized as road and rail but a new dimension has been added in categorization of the mode of surface transportation which is based on the unit in which the cargo is stuffed for further transportation and unit's mode of transportation. EFA, CFA and SEM are widely used analytical tools but perhaps for the first time these tools have been used to solve the problem under discussion. Sample size almost maps the eligible population i.e. respondents which had minimum 5 years in industry; companies having minimum turnover of $10 million; location of the manufacturing facility was within 100 km radius of Delhi and Chennai and respondents' company was having minimum one full truck/wagon/container load of shipment between Delhi and Chennai. Users of road mode of transport are willing to switch to intermodal container service due to safety and seamless convenience. Shippers would like to continue with road transport because they feel road mode of transport is more flexible and has less number of handling of the cargo. Shipper would also like to switch to rail wagons due to less number of statutory compliances and documents. RoadRailer is expected to increase rail share due to the perceived benefits of seamless convenience and reduced exposure to risk. It is also perceived that bimodal RoadRailer truly provides seamless transportation, which complements both modes of road and rail transportation; hence it is expected to be embraced by road as well as rail users. This study has added a new criterion of "seamless convenience" for modal choice in the field of logistics. This study will help the freight marketing of Indian Railways to devise strategies to capture cargo from road to rail and at the same time will assist the road transporters to strategise to retain their customers which can be through use of bimodal transportation. It will also help the logistics service providers to understand the customer behaviour in logistics sector and will guide them to select the modes of transportation suitably for servicing their customers efficiently. However, there are some limitation and future scope of research in this field. First the study is based on sample of experts from Delhi and Chennai therefore, cannot be generalized to other regions or countries. The second limitation is due to the selection of one time survey method of data collection. Satisfaction level of users may vary due to prolonged use of a service particularly in the presence of competitive offers. A longitudinal study would be useful to capture the varying intensity of factors of choice. There is a scope to recapture the feedback of the actual experience of bimodal RoadRailer, once the bimodal service is introduced in India.

REFERENCES

Albright, A 1992, 'A passenger RoadRailer?', Railway Age, January 1992, p. 98.

Barnhart, C & Ratliff, HD 1993, 'Modeling intermodal routing', Journal of Business Logistics, vol 14, no. 1, p. 205.

Baumol, WJ & Vinod, HD 1970, 'An inventory theoretic model of freight transport demand', Management science, vol 16, no. 7, pp. 413-421.

Bergantino, AS & Bolis, S 2008, 'Monetary values of transport service attributes: land versus maritime ro-ro transport. An application using adaptive stated preferences', Maritime Policy & Management, vol 35, no. 2, pp. 159-174.

Bollen, KA 1989, Structural Equations with Latent Variables, JohnWiley & Sons, New York.

Buehler, R, Pucher, J & Kunert, U 2009, Making transportation sustainable: insights from Germany, Metropolitan Policy Program at Brookings., Washington DC.

Çakir, E, Tozan, H & Vayvay, Ö 2009, 'A method for selecting third party logistic service provider using fuzzy AHP.', Deniz Bilimleri ve Mühendisliği Dergisi, vol 5, no. 3.

Chapman, RL & Corso, M 2005, 'From continuous improvement to collaborative innovation: the next challenge in supply chain management', Production planning & contro, vol 16, no. 4, pp. 330-344.

Chaudhary, PD 2005, 'Modal split between rail and road modes of transport in India', Vikalpa, vol 30, no. 1, p. 17.

Cook, PD, Das, S, Aeppli, A & Martland, C 1999, 'Key factors in road-rail mode choice in India: applying the logistics cost approach', In Simulation Conference Proceedings, 1999 Winter, IEEE.

Crum, MR & Allen, BJ 1997, 'A longitudinal assessment of motor carrier-shipper relationship trends, 1990 vs. 1996', Transportation Journal, vol 37, no. 1, pp. 5-17.

Eng-Larsson, F & Kohn, C 2012, 'Modal shift for greener logistics-the shipper's perspective', International journal of physical distribution & logistics management, vol 42, no. 1, pp. 36-59.

Evans, RE & Southard, WR 1974, 'Motor carriers' and Shippers' perceptions of the carrier choice decision', Logistics and Transportation Review, vol 10, no. 2.

Feo, M, Espino, R & García, L 2011, 'An stated preference analysis of Spain freight forwarders modal choice on the south-west Europe motorway of the sea', Transp. Policy, pp. 60-67.

Ferreira, L & Sigut, J 1995, 'Modelling intermodal freight terminal operationspractice', Road and Transport Research: a journal of Australian and New Zealand research and practice, vol 4, no. 4, pp. 4-16.

Harper, DV & Evers, PT 1993, 'Competitive issues in intermodal railroad-truck service', Transportation Journal, pp. 31-45.

Holcomb, MC & Jennings, B 1995, 'Intermodal Freight Transportation, Transload Option', Transportation Quarterly, vol 49, no. 2.

Johnston, ML & Marshall, S 1993, 'Shipper perception of intermodal equipment', Transportation journal, pp. 21-29.

Jöreskog, KG & Sörbom, D 1996, LISREL 8: User's reference guide, Scientific Software International.

Jugović, A, Debelić, B & Brdar, M 2011, 'Short Sea Shipping In Europe Factor of the Sustainable Development Transport System of Croatia', Scientific Journal of Maritime Research, vol 25, no. 1.

Ke, JY, Windle, RJ, Han, C & Britto, R 2012, 'An Emperical Examination of Transport of Modal Selection in Global Supply Chains'.

Liberatore, MJ & Miller, T 1995, 'A decision support approach for transport carrier and mode selection', Journal of Business Logistics, vol 16, no. 2, p. 85.

López-Navarro, MA 2013, 'Unaccompanied transport as a strategy for international road hauliers in Ro-Ro short sea shipping', Maritime Economics & Logistics, vol 15, no. 3, pp. 374-394.

Meixell, MJ & Norbis, M 2008, 'A review of the transportation mode choice and carrier selection literature', The International Journal of Logistics Management, vol 19, no. 2, pp. 183-211.

Morris, S, Pandey, A, Raghuram, G & Rachna, G 2010, 'Introducing Competition in Container Movement by Rail', IIMA Working Papers, (WP2010-02-02).

Premeaux, SR & Phelps, L 2005, 'Perceptual differences between shippers and motor carriers regarding the importance of carrier selection criteria', Journal of Transportation Management, vol 38.

Punniyamoorthy, M, Mathiyalagan, P & Parthiban, P 2011, 'A strategic model using structural equation modeling and fuzzy logic in supplier selection', Expert Systems with Applications, vol 38, no. 1, p. 458=474.

Raghuram, G & Gangwar, R 2007, 'Marketing Strategies for Freight Traffic on Indian Railways: A Systems Perspective', IIMA Research and Publications.

Raghuram, G & Shukla, N 2008, ''Turnaround' of Indian Railways: Increasing the Axle Loading', Vikalpa, vol 32, no. 2, p. 87.

Roberts, KW 2012, 'Key Factors and Trends in Transportation Mode and Carrier Selection.', 2012.

Shah, R & Goldstein, SM 2006, 'Use of structural equation modeling in operations management research: Looking back and forward', Journal of Operations Management, vol 24, no. 2, pp. 148-169.

Soosay, CA & Hyland, PW 2004, 'Driving innovation in logistics: case studies in distribution centres', Creativity and Innovation Management, vol 13, no. 1, pp. 41-51.

Strasser, S 1992, 'The effect of railroad scheduling on shipper modal selection: A simulation', Journal of Business Logistics, vol 13, no. 2, p. 175.

Štrumberger, N, Perić, T & Štefančić, G 2012, 'The Efficiency of the Bimodal System Transportation', PROMET-Traffic&Transportation, vol 10, no. 1-2, pp. 89-92.

Vashist, JK & Dey, AK 2016, 'Selection Criteria for a Mode of Surface Transport: An Analytic Hierarchy Process Approach', Amity Global Business review, vol 11, pp. 86-95.

Vijayvargiya, A & Dey, AK 2010, 'An analytical approach for selection of a logistics provider', Management Decision, vol 48, no. 3, pp. 403-418.

Wu, MY, Huang, HC & Hsu, SH 2007, 'Constructing supplier selection criteria and measurement for information technology industry', journal of Data Analysis, vol 2, no. 5, pp. 69-94.

Wu, MY & Weng, YC 2010, 'A study of supplier selection factors for high-tech industries in the supply chain', Total Quality Management, vol 21, no. 4, pp. 391-413.

Yang, YH, Hui, YV, Leung, LC & Chen, G 2010, 'An analytic network process approach to the selection of logistics service providers for air cargo.', Journal of the Operational Research Society, vol 61, no. 9, pp. 1365-1376.