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RESEARCH PAPER

Outbound logistics management practices in the automotive industry: an emerging economy perspective

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Abstract Outbound logistics management practices, specific to India have drawn limited attention in the past. Recently though, this sector has garnered renewed attention of researchers and practitioners. Through an exploratory study, we attempt to understand and illustrate the outbound logistics management practices of automotive industry in India. Outbound logistics is divided into a set of interlinked functions based on a logistics framework and described accordingly. Based on findings from the exploratory study and extant literature in this field, a framework for the development of integrated logistics management practices in the automotive industry in India is derived and several research directions are proposed.

Keywords Outbound logistics · Automotive industry · Logistics management · Logistics Services Provider, India

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Introduction

The automotive industry has been one of the primary drivers of global macroeconomic growth, employment and technological advancement in many countries across geographies. Academic research on automotive industry has spanned over several decades and it has continued to remain the focus of researchers and practitioners alike (Martínez and Manuela 2005; Iyer et al. 2009; Choi and Janet 1996; Shin et al. 2000; González-Benito et al. 2013). Studies related to automotive industry have focused on several aspects including buyer–supplier practices, product design, manufacturing processes, warehousing and transportation and inventory management, to name a few. While most of this body of literature has focused on the North America and Europe, studies on automotive industries in the context of emerging economies have assumed significance in the recent past (Emerging-Market Companies Shaking Up Global Competition in Automotive 2015; Göl and Çatay 2007; Karakadılar and Bülent 2012; Scavarda et al. 2015; Zhang et al. 2007). This study attempts to understand the management practices unique to outbound logistics of finished vehicles in India. We undertake an exploratory approach to derive a broad outline for strategic development of this sector.

India has generated renewed interest in its automotive sector largely owing to the focused governmental approach to support the automotive industry (Luthra et al. 2014; Sunil et al. 2014). As per estimates, India's

share stood at 3.2 % of the world's passenger car production (Vasiliauskas et al. 2010). In addition, India has gradually become a hub for study of several supply chain management practices, thanks largely to its growth as a source of products and services. For example, Sahay et al. (2006), analyze the state of supply chain management practices followed in Indian organizations including the automotive sector. In another study Sahay and Mohan (2006), study the Third Party Logistics (3PL) practices employed in India encompassing the automotive sector. Jharkharia and Shankar (2006), study sectoral dissimilarities in Indian manufacturing industry. Their results are based on surveys of automotive companies among others. These studies reveal increasing focus of Indian companies on supply chain management practices and efforts to align supply chain strategies with their business strategies. While most of these studies have focused on supply chain practices, our approach is a further deep dive into an important aspect of automotive supply chains called outbound logistics.

By definition, the downstream chain responsible for vehicle distribution from the factory to the dealer is known as "outbound logistics" (Miemczyk and Holweg 2004). "Inbound logistics" in contrast, comprises of the logistics operations between component suppliers and vehicle assembly plants (Holweg 2003). The inbound and outbound logistics of finished vehicles are managed separately worldwide as they offer distinct challenges. The outbound logistics accounts for a significant portion of the total order-to-delivery lead-time in the automotive supply chain (Holweg 2003). In India, as per the findings of this study, the cycle time for the upstream part of the automotive supply chain from Tier-1 suppliers to the automobile manufacturer's factories roughly varies from 15 to 45 days; the manufacturing cycle time approximates to roughly 30 hours; however the outbound distribution from factory to the dealers or the final customers may vary significantly from 3 days to 3 months. In India, thus, outbound logistics forms a major component of total automotive cycle time and directly impacts the responsiveness of the automobile supply chain (Miemczyk and Holweg 2004). This subsequently drives the motivation for this study.

Outbound logistics also requires separate infrastructure in terms of transportation equipment, like specially designed ships and trucks, specialized handling equipment, port facilities, warehouses, distribution centers and so on. In contrast, though inbound logistics of certain components can have a high cycle time, but these variations are easier to decouple from the variations in direct customer orders through component inventory. Component inventory is usually cheaper and easier to hold than finished goods inventory.

Further, the distribution of finished vehicles requires extreme damage prevention measures and enhanced cargo visibility across the entire chain. The cost of a single unit of cargo is quite high and so are the maintenance and holding costs. This cargo cannot be consolidated with other types of cargo and most of the times it is difficult to consolidate even similar goods from different manufacturers. The manufacturers compete fiercely amongst each other in terms of quality, cost, after-sales services and other aspects. When it comes to outbound logistics, they all face problems which depend mostly on their scale and type of operations. These aspects increase the challenges of managing outbound logistics in India manifolds and motivate our study.

Given the rising demand of new vehicles and logistics resource availability, executives representing the automobile manufacturers, henceforth termed as original equipment manufacturers (OEMs) have time and again emphasized the development of a multimodal logistics industry in India and for regional OEMs to partner for collaborative planning and knowledge sharing (2011a, b). The rise of independent Logistics Services Providers (LSPs) in the form of 3PL companies in India is an indication that many of the OEMs are keen on developing their core capabilities and outsource a major part of outbound logistics operations (Sahay and Mohan 2006). To illustrate, the Indian logistics firm Transport Corporation of India (TCI) developed its Supply Chain Solutions division as a medium asset based 3PL provider with supply chain consulting, warehousing/distribution center management and outbound logistics as its core services. The auto sector contributed to almost 70 % of the division's revenue (Narayanan and Chaturvedi 2013). One of the biggest challenges faced by the automakers in India is reducing lead-time to customers. As per a report in 2011, the waiting time for certain top selling models in India was as long as 8 months, despite one of the worst slowdown in years (Doval 2011). It is well established that shorter lead-

times lead to increased responsiveness to market changes, reduction in pipeline inventory and improved customer satisfaction (Eskigun et al. 2005). Immense potential remains for outbound logistics lead-time improvement in India as distribution related costs comprise a significant part of the final product cost (Abernathy et al. 2000). It has been estimated that logistics costs form a high 14 % of Indian GDP which is higher than that of most developed economies (Sahay and Mohan 2006). In addition, service reliability of logistics in India is low leading to high indirect variable costs (Raghuram and Shah 2004).

In contrast, manufacturing and inbound logistics of automobiles have witnessed major productivity improvements owing to the adoption of world-class practices like JIT and adoption of advanced information and collaboration systems between the OEMs and component suppliers (Holweg and Miemczyk 2002). Indian automotive industry has also successfully adopted some of these practices in the upstream supply chain. As per the findings of a study by Saranga et al. (2009) in the Indian automotive sector, tier-1 suppliers have managed to reduce component inventories significantly with the help of TQM and lean efforts. Despite these advancements, automotive OEMs still sell majority of their finished goods based on customer demand forecasts. A typical automotive dealer in India may carry up to 40 days of finished goods inventory to meet customer demand.

Thus, the unique challenges involved in outbound logistics as outlined above make it a fertile area for exploration and research. This subsequently drives our motivation for this study. In contrast to the specific studies that have looked at supply chain management practices in India in general, in this study we propose to delve into the logistics management processes specific to outbound logistics of finished vehicles, as practiced in India. In particular we aim to answer the following research questions:

RQ1 What are the key inhibitors in the current outbound logistics performance in the Indian automotive sector?

RQ2 How do the vehicle distribution and stock management practices vary in India vis-à-vis developed economy outbound logistics practices?

RQ3 How to improve and develop outbound automotive logistics performance in India?

This study follows a two-step process to derive workable insights. First a comprehensive review of extant literature focusing on the outbound logistics of finished vehicles is carried out. Those studies which do not explicitly discuss the outbound part of automotive logistics are not considered in the literature review. The synthesis and interpretation of literature review on outbound automotive logistics guides the development of a broad conceptual framework. This type of prior development of a conceptual framework guides further data collection and analysis (Eisenhardt 1989). Our investigation revealed scant academic literature in this area focusing on the emerging markets context, especially India. Given the broad nature of the conceptual framework we argue to position our research approach as exploratory in nature with the aim to develop more precise hypothesis on the relations between different variables (Stuart et al. 2002; Yin 2013). This exploratory research uses in-depth semi-structured interviews with managers in the outbound logistics division of automotive manufacturers in India, to develop a framework for the strategic development of automotive outbound logistics practices in India. We believe the findings of this study which are founded in the experience and background of the logistics managers would benefit researchers and practitioners alike. The study also seeks to advance understanding of logistics management practices in an emerging economy context and contribute to the burgeoning literature in this area.

The paper is organized as follows. In the next section, we discuss the outbound logistics framework which is followed by the section on various aspects of outbound logistics practices. Before the concluding section, we discuss our key findings. Conclusions are detailed in the last section.

The outbound automotive logistics framework

Studies on outbound logistics have spanned over several decades. However, an emerging economy context relating logistics components has evolved only in the recent years. We survey literature related to the key outbound logistics components. A summary of relevant works is presented in Table 1. Several studies in the area of outbound logistics have focussed on

supply chain structures and discussed outbound functions as a component of it, in what follows we discuss such works where outbound logistics have been included. Studies with focus on outbound logistics literature can broadly be classified into three broad categories: logistics organization, logistics networks and logistics functions. Within these, studies have focused primarily on two key objectives namely, minimization of cost and improving responsiveness to the customers.

Logistics organization

Academic research on the organizational aspects of outbound automotive logistics, from the early 21st century, has given considerable focus on the adoption of built-to-order (BTO) strategy in the automotive supply chains and structure of organizations around this strategy. However, it can be inferred from this body of research that despite being the early adopters of management practices like advanced manufacturing planning and control systems, and information systems for planning and information exchange, automobile industry still primarily relies on the build to stock (BTS) supply chain. As a result, high inventory carrying cost, customer dissatisfaction, etc. are commonly cited as problems with the current system. Holweg (2003) takes a holistic approach including manufacturers, component suppliers and logistics subsystems to identify the key factors inhibiting responsive order fulfillment. The root cause is identified as strategic misalignment of the internal order fulfillment process to external requirements. Four key inhibitors are identified that act as impediments to responsive order fulfillment and these are—order processing and scheduling system, demand uncertainty and throughput unreliability throughout all subsystems, inflexible and batch driven production

Table 1 Major contributions in outbound automotive logistics

Category	Research papers	Research problem
Logistics organization	Holweg (2003)	BTO strategy inhibitors/enablers
	Holweg and Miemczyk (2003)	BTO strategy inhibitors/enablers
	Carbone and Martino (2003)	Organizational role in supply chain
	Hall (2004)	Organizational role in supply chain
	Hall and Olivierz (2005)	SCM relationships/characteristics
	Zhang and Chen (2006)	BTO strategy need
	Jharkharia and Ravi (2006)	SCM relationships/characteristics
	Saad and Patel (2006)	SCM performance measurement
	Zhang et al. (2007)	SCM relationships/characteristics under BTO
	Dias et al. (2008)	SCM relationships/characteristics
	De Leeuw et al. (2011)	SCM relationships/characteristics
	Bhattacharya et al. (2014)	SCM inhibitors/enablers
	Katiyar et al. (2015)	SCM performance measurement
Logistics network	Miller et al. (1996)	Distribution network design
	Agbegha et al. (1998)	Combined carrier loading and route planning
	Eskigun et al. (2005)	Distribution network design
	Jin et al. (2008)	Combined production and distribution planning
	Lin (2014)	Distribution network design
	Hu et al. (2015)	Combined carrier loading and route planning
Logistics functions	Holweg and Miemczyk (2002)	Distribution process capability for BTO
	Mattfeld and Kopfer (2003)	Storage yard planning and scheduling
	Fischer and Gehring (2005)	Storage yard planning and scheduling
	Helo et al. (2010)	Information system design for BTO
	Volling and Spengler (2011)	Decision support system for BTO
	Herrmann et al. (2015)	RFID based information system implementation

systems decoupled from manufacturers' demand signal and large number of product variants leading to vehicle's technical complexity. In a similar context, Holweg and Miemczyk (2003) focus specifically on the inbound, outbound and maritime logistics aspects of automotive supply chains. The authors study various outbound specific logistics operations and organizational structures to investigate the inhibitors of responsive order fulfillment. Among other findings, they highlight that lack of information integration between different players of outbound logistics as the primary reason for order fulfillment delays. The authors also present a strategic framework for the future development of automotive supply chains. Parry and Jens (2013) investigate whether restructuring of automotive industry, post the global financial crisis, to a BTO enterprise is a sustainable strategy. The authors suggest that the success of an automotive enterprise lies in transformation of an automotive firm from a BTS enterprise to a BTO enterprise to improve overall financial position. The authors also suggest waste reduction at all levels, innovative vehicle design and integrated supply chain design to achieve the desired transformation.

Extending the discussion on BTO automotive supply chains in the emerging markets context, Zhang and Chen (2006) investigate the necessity of making the strategic transition to customer-order driven automotive supply chain in the fast developing market of China. The drivers and inhibitors to mass customization are explored and benefits of this strategy in the long term are discussed. The authors find that the customer-order-driven strategy enables vehicle manufacturers to avoid high levels of finished products and costly price discounts. Zhang et al. (2007) attempt to explore the relationship between response time, product variety and firm performance under BTO scenario in the Chinese automotive industry. The empirical findings suggest that for an automotive firm, order-to-delivery (OTD) times are independent of production times. The study also suggests that more model variety significantly increases order processing time while more types of variation does not significantly increase production time. Studies in the context of Indian automotive industry have also explored organizational linkages within supply chain functions including outbound logistics. Sanjay and Ravi (2006) investigate sectoral dissimilarities in the Indian manufacturing sector including automotive industry. The findings suggest that OEMs in India hold key positions in the supply chain and develop relationships with their partners. The authors also suggest that OEMs can use their strategic position in the supply chain for more information sharing and upgradation of IT systems for improved performance. Saad and Patel (2006), through their study of supply chain performance (SCP) measures in the Indian automotive supply chain, reveal that the concept of supply chain performance is not fully embraced by the Indian automobile sector. Among other impediments in the adoption of successful supply chain management (SCM) practices, it is found that performance improvement is essentially focused on the acquisition of technical and tangible factors. It is not seen as a common task based on shared learning and joint problem solving. Bhattacharya et al. (2014) discuss the current status of SCM as practiced in the Indian automotive sector, specifically the complexities and challenges involved. Consistent with earlier works, the authors suggest that logistics organizations can work to establish collaborative relationships with supply chain partners, while leveraging technology. In a related study, Katiyar et al. (2015) identify 20 key factors of supply chain performance measurement and use interpretive structural modeling to examine the interactions among the key factors of supply chain performance measurement in the Indian automotive industry. The factors-order lead time and order entry method are identified as most dominant. These factors are found to have high driving power to measure supply chain performance whereas the post-transaction measure of customer service and customer query time are found highly dependent on other factors. The authors suggest top management and organizational focus on the factors identified to improve supply chain performance.

While previous works have dealt with supply chain organizational linkages in general and discussed outbound logistics structure as a component of it, our study primarily focuses on outbound logistics within automotive industry as an area of interest. We delve further into strategic and operational components of outbound logistics in the Indian context which previous studies have not dealt with.

Additional studies have primarily focussed on global outbound logistics and discuss various organizational linkages through such works. For example, De Leeuw et al. (2011) investigate the effect of decentralized control on finished goods inventory

levels in an automobile distribution system and identify the factors that determine the overall inventory levels. In contrast to the common assumptions that distribution outlets or dealers are homogenous and their behavior is uniform in response to centralized control, the authors show that there is significant variability in inventories across each distribution outlet of an automotive OEM. Another body of research deals with the role of seaports in the distribution of vehicles. Carbone and Martino (2003) discuss the changing roles of ports as supply chain integrators. They analyze the role of port of Le-Havre in carmaker Renault's supply chain and suggest higher integration between logistics organizations. Hall (2004) discusses freight shippers in the context of US seaports and automobile imports into US to argue for logistics organization centric approach towards freight transportation studies. In a similar study, Hall and Olivierz (2005) also carry out an initial exploration of inter-industry relationships and linkages in the context of automobile imports to the US. Dias et al. (2008) focus primarily on outbound distribution and present a functional framework for maritime mode integration concerning the roll on–roll off (ro–ro) port terminals and short-sea shipping of finished vehicles in the context of Western European outbound automotive supply chain. They carry out a multi-case study of value adding role of ro–ro port terminals investigating and emphasizing decoupling points in the automotive supply chain. The authors emphasize on the role of logistics organizations and ability of ro–ro port terminals to reduce logistical delays.

Logistics network

Logistics network studies primarily related to outbound logistics networks of automotive industry are discussed below. At the strategic level distribution planning, Miller et al. (1996) discuss the problem of determination of optimal long run transport mode and rail network location strategy for an automobile manufacturer for supply to its North American dealers. They suggest an optimization model and the solution results analyze four different distribution scenarios. Eskigun et al. (2005) describe in detail a network design model of an outbound automotive supply chain with capacitated vehicle distribution center (VDC). The problem involves decisions related to location and size of VDCs, delivery route and mode selection, and volume at each distribution location. An integer linear programming (ILP) model is developed and a Lagrangian heuristic based solution approach suggested for the same. Lin (2014) presents a mathematical model and solution technique for a distribution network design problem for an automobile company in China. As an additional consideration in modeling the problem, demand is considered dependent on lead time. Strategic planning works on network designs have applied mathematical programming approaches and various scenario analyses techniques to develop solutions. Our work in contrast explores application and adoption of scientific methodologies by automotive firms in India in outbound logistics sector.

At the operational and tactical level transportation planning, Agbegha et al. (1998) address the problem of 'auto-carrier loading' in the US context with the objective to assign finished vehicles of various sizes in carrier slot in a configuration that does not violate the space restrictions and minimizes the combined cost of routing, unloading and reloading of vehicles from plants/point of import to different dealers. A loading algorithm based on branch-and-bound is developed as a solution technique. A heuristic to solve the complete auto-carrier loading problem based on this algorithm has been developed combining it with routing of carriers across various dealers. In another work, using analytical approach to outbound logistics problem, Jin et al. (2008) address the combined modeling of production and outbound logistics planning at the operational level. They state that although the distribution costs form a major part of total vehicle cost, yet the production planning does not take care of these. They present a mixed integer-programming model for production sequencing, logistics planning, and the integrated scheme. Hu et al. (2015) present a finished vehicle distribution problem, where special carriers are used for delivering finished vehicles. The contribution of the paper is suggested as considering three dimensional (3-D) shapes of both the carrier loading space and the vehicles while considering loading patterns in the combined loading and carrier routing problem. The problem is termed as finished vehicle transporter routing problem (FVTRP) and is presented as an extension to 3-D vehicle routing problem. An MILP formulation along with a met heuristic based solution algorithm is proposed for the problem.

Clearly, outbound logistics network design has received extensive quantitative treatment in solving

design issues. Network design is hence, considered an important component of this study. Our focus however is in exploring processes and methods used in solving network design problems in India and consequently we explore these issues in the paper.

Logistics functions

Literature on outbound logistics functions has studied various aspects of distribution process capability, storage yard planning and scheduling and information system design and integration. Various studies related to these are subsequently discussed. Several of these components form the basis of our preliminary enquiry during the study.

Consistent with studies on BTO enterprises, we examine works that consider outbound logistics functions as a part of BTO structure. Holweg and Miemczyk (2002) assess the capability of the existing logistics systems for supporting the BTO approach for new vehicle supply chains in UK. They identify the vehicle distribution process as the core customer-facing process in this strategy. The authors also identify lack of forward planning, back-loading, transport fleet profile, dealer opening times and damage prevention measures in the outbound supply chain as key inhibitors. Information integration also is a key component of several BTO studies. Helo et al. (2010) present a comprehensive IT system framework termed integrated vehicle configuration system (IVCS) to enable mass customization in a BTO automotive supply chain environment. The IVCS system is designed to connect the customer order fulfillment system with the back-end product configuration planning system. In another work, Volling and Spengler (2011) propose a modeling framework comprising of two interlinked quantitative models for order processing and master production scheduling. The model framework is tested using a simulation study using empirical data from the automotive industry. The modeling and simulation framework is employed to generate order-delivery-processing (ODP) policies for a BTO automobile production setup. We consider information integration as an important aspect of exploring outbound logistics in Indian automotive sector.

Among other functions such as storage yard planning and operations, Mattfeld and Kopfer (2003) report the development of an automated planning and scheduling system supporting terminal operations of the vehicle trans-shipment hub in the port of Bremerhaven. An integral decision model for manpower planning and inventory control is derived on a rolling horizon basis. The system model incorporates mid-term capacity planning and short term scheduling. As an extension to this work, Fischer and Gehring (2005) present a multi-agent system (MAS). They focus on storage allocation and deployment scheduling. Herrmann et al. (2015) present a case study investigating the stepwise implementation and subsequent evaluation of a cross-company radio frequency identification (RFID) based information system in the international distribution process of a car manufacturer. Our literature review reveals that several outbound logistics functions based works discuss integration and planning techniques using information technology and this forms the basis of our preliminary investigations in the paper.

So far, literature on outbound logistics has largely focused on developed markets. Studies on emerging markets are gradually gaining momentum. The practices differ in the context of emerging markets like India where the logistics processes need to be developed to sustain the increasing growth rates in production and demand in a changing business landscape (Raghuram and Shah 2004; Greenwood 2006). Hence, it becomes important to understand the current industry structure and practices. This provides the motivation for this paper.

Research methodology

Data sources Based on the literature review above, we conducted semi-structured interviews with management executives directly involved in the outbound logistics management of finished vehicles in India. The interview questions centered on logistics organization, logistics functions and logistics networks. Logistics organization consisted of questions on role of manufacturer, LSP, Freight forwarder and dealer. Logistics functions consisted of questions on order management, inventory management, material handling, information management, technical services and administrative functions. Logistics networks consisted of physical, informational and financial network flows related questions. Table 2 (Appendix) highlights key issues discussed in each category.

Logistics managers who participated in this study belonged to leading automobile OEMs and LSPs in India. Among OEMs, we interviewed logistics managers from three prominent Indian automakers. As per estimates, these three firms together accounted for 64 % of total new production of the Indian automotive sector in 2010. Among LSPs, we interviewed logistics managers from two largest international logistics providers operating in India; these two firms manage the maritime logistics for most of the prominent automobile exporters from India. Overall, we interviewed ten managers from these five companies. Interviews were carried out in two rounds. In each firm we interviewed two managers; first a mid-level operations manager with minimum 5 years' experience and second a senior manager with a minimum 10 years' experience in managing vehicle distribution. In addition to the interviews, direct observations regarding final vehicle flows outside the factories and visible management processes in distribution offices were carried out and recorded. The scope was to understand the detailed operations involved in the entire outbound logistics process, understand logistics organization structures and derive specific insights from current and future outbound logistics planning and operations. Subsequent interviews were carried out in multiple sessions with the respondents to clarify specific details.

Data collection and analysis Data collection occurred in three phases from 2011 to early 2015. In the first phase we requested permissions from all OEMs and major LSPs for data collection related to the research study. Requests in most cases were made through personal contacts in the firms. Four of the OEMs and two international LSPs allowed visit. In a period of around 1 year we visited head offices of three OEMs, two of the plants, head offices of both the LSPs and one port stockyard for international delivery. Data analysis was initiated after this phase was over. In the second phase of data collection additional rounds of interviews were conducted with all the previous respondents and some new respondents from the same firms. Post this phase; data was compiled to form a single transcript of findings. In the third phase of data collection, respondents were requested to read the transcript and suggest any changes. Few corrections were made at this stage. Some respondents were called up again for clarification related to some observations.

Data analysis was conducted based on collected data, in which the researcher interprets the data using what he/she knows about a subject and the context within which the data was gathered (Ludwig 2012). A list of specific issues was formulated within each of the categories identified in the outbound logistics framework. During the first rounds of interviews, respondents were first allowed to describe the whole outbound logistics management process. This was followed by raising specific points for which further clarifications were deemed appropriate. Most of the respondents did not allow voice recording of the interviews and direct quotation, so quick notes were prepared at the end to summarize each interview. Subsequent rounds of interviews were conducted with specific pointers on which answers were solicited. To analyze the data, interview transcripts were compiled to generate common insights on each point. To triangulate our findings from the interviews, individual observations of the researchers along with findings from industry publications, government reports and other sources were compared. Table 2 in the Appendix lists the key insights captured for each of the specific issues in outbound automotive logistics management.

Outbound automotive logistics practices

India is the 6th largest manufacturer of finished vehicles in the world and contributes to around 7 % of India's GDP and 7−8 % of India's total employed population (Bhattacharya et al. 2014). It is well positioned to become a manufacturing hub for small fuel-efficient cars, owing to its sound manufacturing base and engineering expertise (Kurczewski 2009). Many major world auto-manufacturers have either already set up manufacturing bases in India or have planned it in the near future. As per one of the 2010 estimates, the major players are Maruti Suzuki India Ltd. (MSIL) with a share of 34 %, followed by Tata Motors and Hyundai Motors, with 22 and 17 % shares, respectively (Production statistics OICA Website 2011). The other significant players are Mahindra & Mahindra (M&M), Honda, GM, Ford, Toyota and several others. The automobile manufacturing bases have developed around three main clusters in India. MSIL has its production base in Gurgaon, Haryana in the northern part of India. Honda has recently started

production in its Greater Noida plant in the northern state of Uttar Pradesh. Another major cluster has come up in Chennai, Tamil Nadu with Hyundai Motors, Ford, Nissan, BMW, Mercedes Benz, etc. setting up their manufacturing units. The third major cluster has emerged in the western part of India with Tata Motors, M&M, Volvo, Volkswagen, etc. running their manufacturing operations in the states of Maharashtra and Gujarat. Hyundai Motors is the leading exporter of finished vehicles from India, followed by MSIL, Tata Motors and M&M. To export the finished vehicles *MSIL* uses the Mundra port in Gujarat. OEMs based in and around Chennai use the port of Chennai, and the western cluster uses the port of Mumbai as their major outbound transportation node for intercontinental trade.

The current state of logistics infrastructure in India is comparatively underdeveloped. According to a comparative analysis on cost structure of Indian automotive sector and that of Malaysia, Thailand and China, the deficiencies in logistics and infrastructure adds about 1.1–2 % in the total cost structure (EXIM Bank 2008). Semi-structured interviews with logistics managers reveal the following business objectives of the outbound Indian automotive supply chain:

- Minimizing logistics costs: transportation, inventory carrying, cargo handling, order processing and other costs.
- Improving response time: a major percentage of finished vehicles are delivered under build-to-stock (BTS) strategy and a small percentage is delivered under BTO strategy. Most of the passenger vehicles are manufactured under BTS, while BTO manufacturing is mostly carried out for group orders in commercial vehicle market. Our previous discussion on international automotive logistics literature also revealed that most of the finished vehicles are delivered under BTS strategy, with a small percentage manufactured under BTO strategy (Holweg 2003; Holweg and Miemczyk 2002). Under the BTO strategy, the average order-to-delivery time has been found to be 40.1 days in UK (Holweg 2003), while BTS vehicles can be purchased on the very day. In contrast, in India even while following the BTS strategy, due to the large number of varieties on offer and geographically dispersed locations of plants, ports of operation, dealers, and sales OEMs, maintaining the required service level is a challenge. The customers have witnessed long waiting times ranging from a month up to 8 months for some of the car models (Doval 2011; 2010). This has been partly attributed to sudden surge in demand for new models and secondly it has been used as a cost saving mechanism (Omkar 2012; Thakkar 2013). In India, consumers often have a tendency to prefer particular brands (Mishra and Rai 2009). The finding was further substantiated where a senior logistics manager from a leading OEM confirmed that Indian customers find more value in some of the specific models and are ready to wait for months for the same (Doval 2011). Long lead time for delivering finished vehicles coupled with demand and supply mismatch owing to inaccurate forecasts at the variant levels leads to large inventory stocks in the outbound supply chain for some models and long waiting times for others. Thus, to improve customer satisfaction in the long run and boost sales, the response time needs improvement both in terms of speed and accuracy.
- Quality control and damage prevention: minimizing damage to the cargo is of utmost importance in outbound automobile logistics. A small damage can render a new unit of cargo unsellable or the associated repair costs can be very high. Some examples to cargo damage include dents on the automobile body, damaged tires, cracked windshields, etc. Due to poor infrastructure and comparatively underdeveloped logistics sector in India, the damage rates tend to be marginally higher than the developed and comparable economies (2011; Ludwig 2011).
- Minimizing environmental damage: with increasing emphasis on environmental friendly operations, reducing carbon footprints, scrap minimization, recycling are other objectives (Gajanand and Narendran 2013; Mangla et al. 2014; Ravi and Shankar 2014; Luthra et al. 2014).

Logistics organization

Our exploratory study reveals that the major OEMs in India have in-house logistics division that manages the outbound logistics of their finished vehicles. This division is usually based at the corporate headquarters,

with offices located at each plant site. They receive production and demand information from the corporate headquarters and coordinate with the external service providers at various levels to plan, organize and execute the distribution of vehicles. While outsourcing logistics functions is the key trend in most economies (Holweg and Miemczyk 2002; Byrne 1993), the lack of complete logistics solutions providers in India is the major factor for most OEMs to spend significant time and effort in resolving logistics issues (Bhattacharya et al. 2014). OEMs internalize logistics functions and management primarily due to lack of external expertise on outbound logistics practices.

Our findings also reveal that there are several LSP's in India which consist of independent transportation and warehousing services providers with smaller asset bases. They are often hired by OEMs for their services directly. However, very few LSPs have the potential to become logistics integrators in the outbound logistics sector. The findings reveal that the outbound logistics sector also has presence of few international distributors of finished vehicles like Wallenius Wilhelmsen Lines (WWL) of Norway and Nippon Yusen Kaisha (NYK) of Japan [Adani group signs pact to develop auto hub at Mundra port (2008; NYK Auto Logistics India to Operate Finished-car Logistics Terminal In West Coast of India (2014)]. These players offer comprehensive logistics solutions to OEMs in India with a primary focus on exports. However, their presence remains limited in the outbound logistics sector. In summary, the outbound logistics organization is limited to within firm focus because of lack of major end-to-end outbound logistics solutions providers in India.

Logistics network

The outbound logistics networks of OEMs in India are fairly complex owing to the multitude of taxation structures, infrastructure issues and lack of full time service providers. From outbound logistics network perspective, the study reveals that outbound vehicles broadly follow two paths namely, domestic market logistics and export oriented logistics. The design and structure of these networks may vary according to manufacturer and location. The design networks are illustrated in Figs. 1 and 2. It is interesting to note the presence of 'distribution center' and 'dealer' in the logistics network. The vehicles meant for domestic market are mostly sent through specialized trucks to dealers, either directly or through a regional distribution center (DC). The vehicles meant for export are shipped mostly using ocean transportation, with vehicles from the factories delivered to seaports through car-carrier trucks/trailers or railways (Fig. 2). From these ports the vehicles are transported to vehicle processing centers (VPCs), which prepare vehicles for final delivery through their value added services like pre delivery inspection (PDI) and late configuration of parts. Finally the vehicles are despatched to dealers across the country via one or more distribution centers. For most of the new vehicles, dealers are used as inventory buffer as also found in other countries (Holweg 2003).

In developed markets outbound logistics is mostly outsourced to individual LSPs, which generally manage a hub and spoke distribution network for outbound distribution of finished vehicles from the OEMs factories to the vehicle dealers or final customers. A national or regional stockyard is used to consolidate the cargoes from different manufacturers. Further at these facilities re-grouping of vehicles is carried out as per dealer locations, PDI, cleaning and other value added activities are carried out before final delivery to respective dealers. Advanced information systems along with well-trained labor force are utilized at these facilities to enhance work efficiency and speed (Miemczyk and Holweg 2004; Fischer and Gehring 2005).

In contrast, in India, use of a centralized hub is restrictive and is often not economically viable given the regime of differential taxation structures owing to inter-state sales tax levied on every cross-border transfer of goods in India (Avittathur et al. 2005). With the implementation of goods and services tax (GST) however, cross border transfer issues are expected to improve. In addition, lack of logistics integrators in form of strong LSPs, low level of information and communication technology (ICT) implementation, lack of skilled labor force also impede implementation of scientific models of distribution. It was also found that due to the nature of the cargo and probable damage rate in transit especially in modal changes, mostly one-to-one deliveries from the factory to the dealer is practiced. This leaves little room for provision of consolidation and redistribution to save logistics costs and value

added services to ease the burden on the factory under an LSP.

The study reveals the need for researchers and practitioners to consider scientific models for effective design of outbound logistics networks. In addition, the imperative lies with public institutions to ease the complex network flows through better taxation regime, proper infrastructure and governance.

Logistics functions

One of the primary focus areas of outbound logistics managers in automotive supply chains is on logistics functions. Tactical issues in outbound logistics management have been discussed in (Miemczyk and Holweg 2004; Herrmann et al. 2015). However, in the emerging economy context, logistics functions assume importance in the light of complex distribution systems and infrastructure issues. Our study reveals distinct areas of focus for outbound logistics managers of automotive supply chains.

Order management for automotive firms closely follows the broad logistics network structure described earlier. For domestic distribution the distribution plan is based on a combination of point of sale (POS) data and forecasted demand data. In case of export vehicles, large auto-manufacturers operating from India have their own subsidiaries in the importing country, to co-ordinate with dealers. Other OEMs collaborate with local distribution agencies, which receive imported vehicles from different OEMs overseas. The periodic demand data is supplied to the OEM by their distribution agency operating in that country. The findings are in tune with the expected order management processes of firms. In a complex distribution environment in India, dealers play an important role in the outbound logistics service completion. As a result, automotive firms depend on dealers for estimating market demand and coordinating with the planning teams.

The second area of focus is transportation management in distribution of vehicles. The study reveals that transportation management is a complex activity in India owing to the varied business terrain and infrastructure issues. Various strategies are deployed by automotive firms to navigate the challenges. Closely following the network structure, transportation planning and execution is divided to cater to the domestic and export oriented markets. In the domestic market, the firms divide the market into various zones which are further divided into regions and cities. There is coordination between the production planning, logistics teams and zonal sales offices to undertake important operational and tactical decisions like quantity of vehicles to be transported, make of vehicles, network allocation decisions, etc. It is interesting to note that the primary mode of transportation in India is through the roadways, with railways carrying roughly 3.8 % of finished vehicles (2011) and coastal shipping usage in the nascent stage. MSIL initiated trial runs to transport its cars through coastal route using the services of a third party shipping liner (2011). Dependence on roadways is partly due to the lack of better, effective railroads for cargo movement. However, road transportation has implications in terms of higher costs and environmental damage (Holweg and Miemczyk 2003; Aperte and Baird 2013). In contrast, railways as a means of transporting finished vehicles are used extensively in the USA and Continental Europe (Holweg and Miemczyk 2003). European Union introduced the policy of "Motorways of the Sea (MoS)" to develop and promote short-sea shipping in Europe, one of the prime objectives being to minimize environmental damage (Aperte and Baird 2013). With increasing focus on ports and rail road infrastructure improvement, automotive firms may consider better transport designs.

Road transportation in most cases occurs through collaborations with transportation companies, which own trucks or trailers. India however, is plagued with underdeveloped trucking industry and the sector has not yet matured (Raghuram and Shah 2004). OEMs maintain contracts with external suppliers offering trucking services for finished vehicles. In some cases OEMs work through long term contracts, where the transporters are evaluated on several criteria, the most important being adherence to transit times and quality of transported vehicles along with standards of driver safety, packing density, etc. Service conditions are monitored closely for a brief period of time before contracts are extended. Firms with larger scale employ advance analytics and tracking and tracing systems to evaluate performance on a regular basis. Some truckers are engaged on a short term basis based on transportation demand. Reliance on trucking industry for inland transportation is the common strategy for most automotive firms as other sources of

transportation are less developed. In some cases, the lack of scientific trucking, loading and unloading mechanisms also tend to cause delays (Holweg and Miemczyk 2003; 2011). OEMs ensure minimal level of cargo damage by utilizing fully enclosed, specially designed car carrier trucks. Finished vehicles are securely fastened to the truck body to avoid damage while transit. Cargo handlers at the intermediate points are appropriately trained to ensure damage free operations. It is imperative that for development of outbound logistics systems, various modes of transportation are leveraged in India. With increasing focus on sustainable modes of transportation and firms looking for ways to cut costs, leveraging railways and waterways could be the next way forward for outbound logistics.

In the international transport mode, our study reveals that deep-sea ocean route is mostly favored for intercontinental trade of finished vehicles. Maritime transportation reduces logistics costs and provides large transportation capacity for international distribution leading to economies of scale in intercontinental transportation of finished vehicles (Chandra et al. 2013). The OEMs collaborate with the shipping companies to transport the appropriate number of vehicles at regular intervals to overseas locations. Shipping companies operate ro–ro ships called pure car carrier/pure car and truck carrier (PCC/PCTC) to provide shipping transportation services. At locations where transportation demand is not high enough to make ro–ro service feasible or the port infrastructure does not support ro–ro operations, vehicles are transported using containers. The OEMs tend to choose the port near to their major manufacturing location that has adequate connectivity with rail and road networks, offers suitable port charges and has a favorable working environment, for exporting cargo.

Long term contracts are often the norms for overseas transportation services. In case of long-term contracts, the capacity requirements and sailing frequencies are decided between the two parties. Further, the OEMs provide yearly, 6 monthly, 3 monthly and monthly forecasts to the shipping lines for capacity adjustments. Planning modifications may be carried out from both ends on a monthly basis. In case of short-term contracts, OEMs share their projected volumes to be exported in the coming months. The OEM and shipping line negotiate the freight rates and timeframe for delivery of vehicles. Clearly, information exchange between the OEMs and overseas service providers is of prime importance in order to coordinate transport services. Long term contracts often develop trust between the negotiating parties (Ullah 2014; Sahay 2003). Further, overseas transportation services are marked by reasonably long lead times and quality services for delivery (Andersson et al. 2015). Under these circumstances, automotive firms in India prefer large, quality service providers. With increased focus on building better port infrastructures and decreasing turnaround times at ports in India, automotive firms in India stand to gain in the future (Ludwig 2015).

Another important functional area is distribution center, stockyard and inventory management. Inventory management in India has conventionally been an area of prime concern (Bhattacharya et al. 2014). Several automotive firms in India are often plagued with unwanted inventory in their supply chains and lack rigorous analytical techniques to restructure their supply chains and inventory location. Our study though reveals interesting insights around few well designed practices that firms have developed to manage inventory in the outbound logistics context.

The plant yard management process involves retrieval of finished vehicles from the production line, storage into the yard and final loading into trucks or rail for further transportation. Some 3PL companies have started offering logistics services to the manufacturing facilities directly. Critical to such a coordinated effort is production and demand information sharing between the OEM and LSP which our study reveals, is being increasingly adopted by firms in India. Information sharing substantially helps in inventory management (Sanjay and Ravi 2004) and increasing adoption of such practices by automotive firms in India should help reduce inventory challenges. Our study further reveals that in a stocking yard, where challenges of limited space are frequent, firms resort to integration of information regarding incoming and outgoing vehicles with yard processes. Further, the yards typically have limited manpower in terms of drivers and supervisors, hence the overall planning and execution is carried out in a way that minimizes operation time, damage rate and operational costs.

Similarly, in the case of seaports, stockyard management is closely integrated with the arrival of ships.

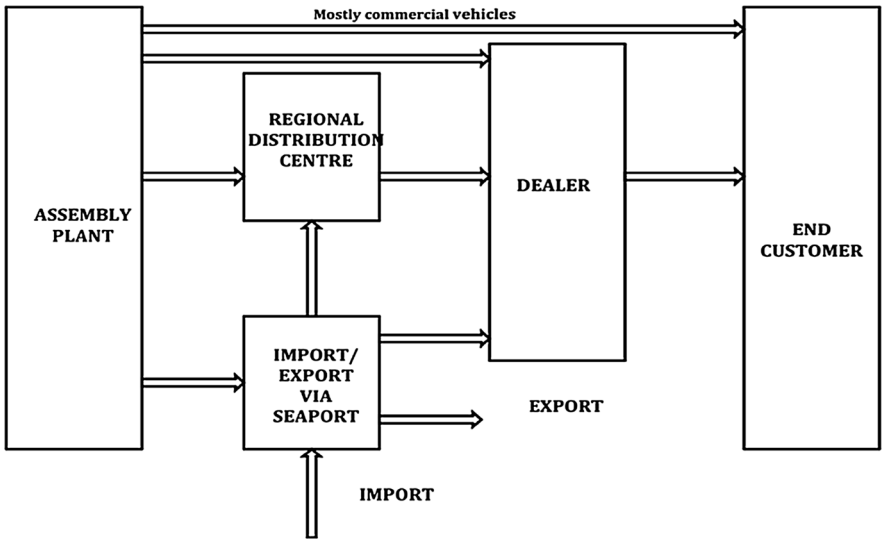

Fig. 1 Inland logistics network in India

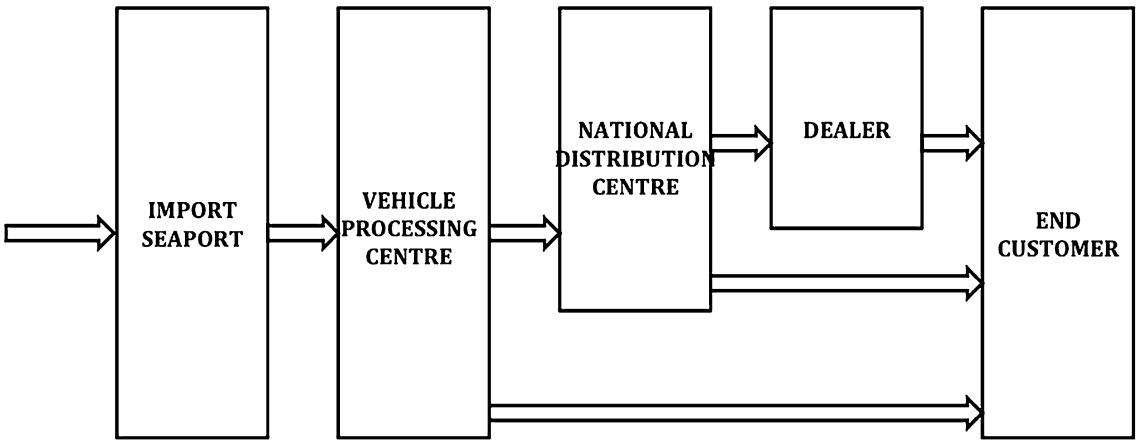

Fig. 2 Export logistics network

Additionally, logistics service providers are increasingly investing in highly skilled manpower for port operations. Skilled manpower is also leveraged to provide additional services like pre-delivery inspection (PDI) during transport activities. This interesting result points to the case of increasing adoption of information sharing techniques between OEMs and service providers. Closely knit outbound logistics operations through advanced information management techniques should reap significant benefits for logistics players and OEMs in the future.

Lastly, we discuss administrative functions. Our study reveals that several OEMs and LSPs in India have a significant focus on administrative functions. India has a complex regulatory framework (Srivastava and Chandra 2013). The export vehicles need to go through myriad of customs administrative procedures before delivery overseas. OEMs generally rely on freight forwarders for this job. International LSPs operating in India, like WWL also offer these services to the OEMs in India for export vehicles (Manoj 2009). However, inefficiencies in transactions, cost overruns and delays are a result of complex administrative procedures (Seth 2014; Manoj 2014). This partly results in OEMs and LSPs increasing their focus on administrative functions.

In the domestic front, the inter-state transit in India too involves documentary procedures with the local

authorities as India has multiple taxation structures in different states in addition to inter-state taxation (Srivastava and Chandra 2013). Our study reveals that due to this inefficient regulatory framework, automotive sector in India has not been able to develop an integrated logistics framework across the country. The study illustrates the need for a simplified regulatory framework which would enable OEMs and LSPs to develop a closely knit logistics framework. The result is in contrast to state of logistics in developed economies where OEMs work with uniform regulations and efficient logistics systems.

Discussions

Several key findings can be derived from this study. The role of LSPs in Indian automotive outbound logistics is still limited in its scope and has significant potential for integration of activities. The lack of several LSPs in the outbound logistics sector and infrastructure issues have led OEMs to act as logistics integrators for their products' distribution chains. A 3PL company is termed as logistics integrator when it takes over a major portion of the management of logistics operations from its customer. This involves high level of integration with the customers while sharing risks and rewards associated with logistics management (Hertz and Alfredsson 2003). The outbound logistics distribution network is inefficient due to poor infrastructure and restrictive regulatory framework having multiple taxation schemes across different regions. The transit points like ports and stockyards have high turnaround time due to inefficient operations and poor planning. The usage of efficient transportation modes like railways and coastal waterways for long hauls is limited. Information technology systems and decision support systems are used in fragmented way across different functions in the distribution chain. However, it has increasingly started playing an important role in integrating various players in the outbound logistics systems. Information integration and management has significant role to play in the improvement of Indian automotive outbound logistics systems.

Based on the understanding of the logistics systems practiced in India through expert interviews and literature review, the key issues outlined previously could be classified under three categories (also refer Fig. 3). We believe that these issues raise several interesting research questions which hold potential for researchers and practitioners in the automotive outbound logistics area in an emerging economy context. The insights from this study are fairly distinct from similar attempts in the past which are based on developed economies.

Logistics organization: role of third party logistics service providers

The export and import of automobile distribution channels has gradually witnessed the rise of 3PL service providers in India. The overseas shipping and customs requirements make part of this logistics chain very complex for OEMs to manage alone. The ability of a LSP to provide integrated logistics services to OEMs is one of the key factors in resolving issues in Indian automotive outbound logistics service. It can be hypothesized that increased role of third party logistics service providers should improve performance of automotive firm's outbound logistics in terms of reduced costs and lower delivery times.

In India and across the globe, many companies like NYK and WWL are now offering outbound logistics services for export vehicles (2008). In India their services are currently limited to maritime logistics with few attempts to manage a part of the inland chain. These firms were gradually evolving to emerge as one-stop solution for logistics management of export vehicles (Semeijn and Vellenga 1995), although currently most of these firms offer integrated services in partnership mode with other LSPs (2008; Special 2014). In this case a single 3PL company manages the entire logistics of finished vehicles, from the factory to the dealer. The role of 3PL firms in domestic distribution of vehicles in developing countries like India is still very limited. They mostly act as transportation providers or provide warehousing facilities. It can be argued that the advantage of 3PL companies can be attained only when they are able to co-ordinate the logistics of several OEMs together to achieve economies of scale in operations (Bhattacharya et al. 2014). This is not realized presently due to infrastructure issues, mistrust among the firms, complex regulatory frameworks and varying taxation schemes across the country. These provide various challenges to logistics planners to carry out integrated planning in an efficient way.

Logistics function: outbound logistics integration through information management

To minimize uncertainty in lead-times and consequently, buffer stocks at each point, proper visibility of cargo at each point of logistics chain is very important. Holweg (2003) suggests that reduction in lead times can only be achieved by better integration of logistics operators along with common access to reliable planning information. A number of advanced information technology solutions are available for outbound automotive logistics. There are systems for transportation management, which help in decision support for planning car-carrier loading, optimize delivery routes, and help in tracking vehicles through installed GPS systems. All these systems may be integrated with the overall ERP systems for integrated control (MacLeod 2011).

It can be hypothesized that the general shortcomings in integrated logistics that have been identified in the Indian scenario can be overcome through information management and integration. In a country like India where vehicle distribution largely remains unorganized, these methods may yield the expected benefits vis-à-vis the costs incurred, for many of the OEMs. This would include data sharing for better planning and co-operation for capacity adjustments, supplier contracting, etc. It is expected that the logistics integrators would develop systems and processes for integrated logistics planning from manufacturing plants on one end to dealers and customers at the other end. Advanced decision support systems often provide various solutions for synchronous planning between different firms. It can be hypothesized that such an implementation would resolve several shortcomings in the current state of outbound automotive logistics systems. These automatic systems for data exchange ensure timely exchange of reliable data. OEMs would be able to share demand forecasts with the 3PL providers, who in-turn would be able to carry out capacity adjustments promptly.

Logistics network: network redesign

It is hypothesized that with the enhanced role of LSPs as able logistics integrators in form of 3PL parties along with advanced IT systems in place, firms can develop optimal strategies for logistics network design. Models developed and practiced in developed economies like hub and spoke model, efficient stocking systems, etc. if implemented in emerging economy context can provide significant time and cost savings. This should enable OEMs, LSPs and automotive dealers to increase focus on customer service rather than stocking and transfers (Kiff 1997). Network redesign can further enable consolidation of cargo and make the use of cheap transportation means like railways and coastal shipping for long hauls more lucrative (Vasiliauskas et al. 2010). However the development of efficient networks can only be successful through intermediation by Government and public institutions in terms of improved infrastructure and supportive regulatory framework across the country in terms of standard taxation scheme, easy transit across borders, etc. Government's role in development of outbound logistics sector, specifically, logistics network is critical to the future success of automotive outbound logistics practices in an emerging economy like India (refer Fig. 3).

Conclusions

Outbound logistics management of finished vehicles in an emerging economy such as India is garnering new attention due to the changing business landscape. The sector provides increasing opportunities for improvement in terms of minimization of cost and lead-time to improve customer satisfaction. Literature on automotive supply chains has focussed mainly on developed markets with a major impetus given to customer responsiveness and cost reduction through adoption of BTO strategy. The structure of outbound logistics of finished vehicles follows a centralized distribution system in the developed markets and also emerging markets like China. The studies suggest a strong presence of integrated LSPs managing multi-brand products for distribution to final dealers and consumers.

In contrast, outbound logistics in an emerging context has received limited attention in the past. The present work combines understanding of previous works and semi-structured interviews with management executives directly involved in the outbound logistics management in India. Synthesizing these, we propose a framework with testable hypotheses for

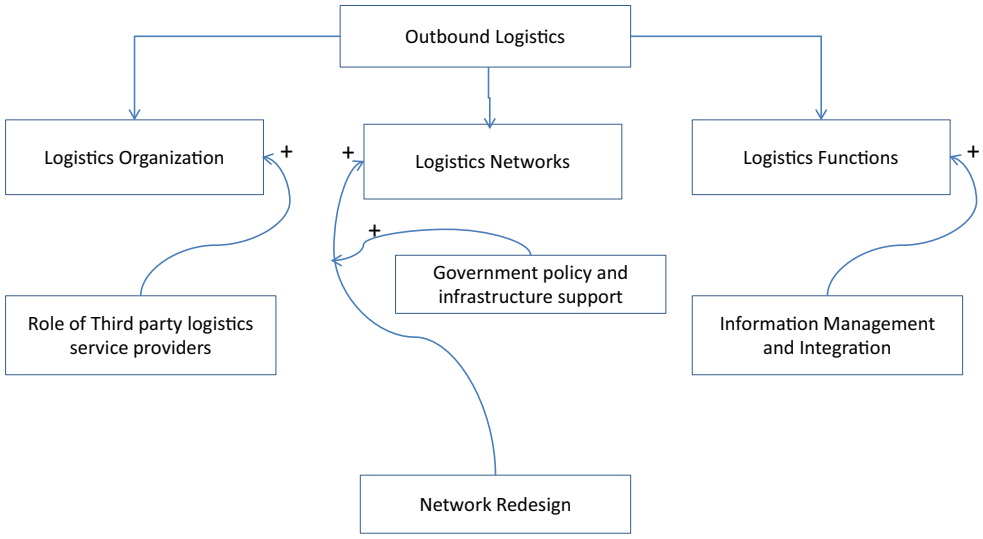

Fig. 3 Strategic framework for outbound automotive logistics development in India

development of outbound logistics in the Indian automotive industry.

Our exploratory study reveals that the industry practices lack technological sophistication in India as compared to advanced logistics systems in developed economies. The logistics management process is fragmented across the distribution chain. There is a need for integrated logistics management across the complete distribution chain. Integrated logistics can be developed through certain primary tools namely, the emergence of able, integrative LSPs in this sector offering complete end-to-end logistics services to different OEMs. As an enabling mechanism OEMs need to focus on collaborative partnerships with LSPs and also competing OEMs to create a suitable environment. Integration of logistics functions through the development of advanced ICT systems and mutual relationships through partners needs to be addressed to reach the desired level of efficiency and responsiveness in the automotive supply chain. Given that the poor level of infrastructure, regulatory policies and taxation structure in India are major factors in constraining development of the automotive distribution process, the Government needs to take an active, developmental approach to formulate business friendly policies and develop an enabling infrastructure. Without state support the OEMs and LSPs would find it very difficult to reengineer and redesign their outbound supply chains for achieving efficiency and responsiveness of international standards.

This study being exploratory in nature has certain limitations. A limited sample size and geographical focus may limit the generalizability of some of the findings. There is significant scope for empirical analysis to understand the relationship between OEMs and LSPs in the outbound logistics sector in an emerging economy context. Future studies can also focus on outbound logistics management practices of markets like China and Brazil and draw a comparative analysis of various logistics management practices deployed. Additionally, a detailed survey of IT and communications based tools and implementation strategies of various firms can be carried out to enhance understanding in this field.

Acknowledgments The authors sincerely thank the industry respondents for their valuable responses. Suggestions received from the Editors also helped significantly improve the paper.

Appendix

See Table 2.

Table 2 Summary of data sources and analysis

Outbound logistics components	Point discussed	Data sources	Key insights
Logistics organization	Contracts with Logistics Services Providers (LSP)	Interviews with OEM's managers	Lack of complete logistics solution providers in India
			Long term contracts
		Interviews with LSP's managers	Mostly applicable to export logistics
		Industry publications	
	Development of LSP capabilities	Interviews with OEM's managers	LSPs in India mostly consist of independent transportation and warehousing services
		Interviews with LSP's managers	Small scale of operations and asset bases
			Contract terms mandate standard practices in terms of safety and efficiency
			Focus on in-house coordination; lack of joint efforts to develop strong LSPs
			Complaints about timely information sharing
	In-house capabilities for outbound logistics	Interviews with OEM's managers	Complete planning, coordination and execution of outbound logistics functions
	Monitoring of LSP performance	Interviews with OEM's managers	Key Performance Indicators (KPI) are personnel safety, vehicle safety, logistics cost, transit time, etc.
			KPIs measured and evaluated for LSPs
	Contracts with truckers and warehousing facilities	Interviews with OEM's managers	A mix of long-term and short term contracts.
			Contracts terms renegotiated periodically
	Administration of outbound logistics	Observations on personal visit to OEM's offices; in-factory and main offices.	Separate outbound logistics division; head office and in-plant
			Managers associated with the division continuously interact with sales, production, & external service providers
		Interviews with OEM's managers	
Logistics network	Current taxation structures and resulting implications	Government reports	Lack of centralized taxation
		Interviews with OEM's managers	Inter-state taxes result in regional distribution planning in every state
		Industry publications	A number of toll booths and collection units at state borders leads to large transit time and logistics cost
	Government's role in domestic and export market support	Government report	Law enforcement to ensure safe and timely transit of vehicles through roads
		Interviews with OEM's managers	Infrastructure development
			Lengthy customs inspection and clearance processes for export/import vehicles
			In-factory customs documentation for export vehicles
			Proposed GST (Goods and Services Tax) bill expected to improve scenario
	Restructuring supply chains for cost effectiveness	Interviews with OEM's managers	Centralized taxation structure may lead to national level planning
			Increased usage of cheaper modes of transportation like rail, coastal and inland waterways.
	Process innovations	Interviews with OEM's managers	Improvements in alterative shipping routes
			Development of rail infrastructure
		Industry publications	Development of waterways, ports and vessels

Table 2 continued

Outbound logistics components	Point discussed	Data sources	Key insights
Logistics functions	Outbound transportation and administration	Interviews with OEM's managers	Increased focus on administrative functions due to complex regulatory framework
		Interviews with LSP's managers	Lack of integrated logistics framework across the country
			Separate planning for domestic and export vehicles
			Market segmentation for distribution
			Roadways are the primary mode of transportation
			Underdeveloped trucking industry in India
			Fully enclosed car- carriers used for shipping finished vehicles
			Commercial vehicles mostly transported directly
			Potential for leveraging railways and waterways to cut costs
			Maintaining transit times challenging
			Long term collaborations with established ro–ro shipping companies for export shipments
	Warehousing and inventory management	Interviews with OEM's managers	Excess inventory and delays common, esp. during high selling seasons
		Interviews with LSP's managers	Lack of scientific inventory management
		Industry publications	
	Port and yard management	Interviews with OEM's managers	Integration of yard planning with incoming and outgoing transportation flows
		Interviews with LSP's managers	
		Industry publications	
	Information flow and order management	Interviews with OEM's managers	A combination of POS data and demand forecasts used for planning order management
			Usage of advanced information systems dependent of scale of operations
	Coordination between OEMs and LSPs	Interviews with OEM's managers	Timely information exchange about asset availability and transportation demand
		Interviews with LSP's managers	
	Communications between OEMs and LSPs	Interviews with OEM's managers	Mostly dependent on personnel communication, lack of advanced, real-time information exchange
		Interviews with LSP's managers	
	Documentation requirement	Interviews with OEM's managers	Customs documentation for export vehicles
			Documentary procedure for inter-state transit
	Process monitoring and control	Interviews with OEM's managers	Advanced tracking systems based on GPS employed by most OEMs; extent of tracking is dependent on scale of operations
			Direct telephonic conversation with drivers widely practiced for transit management

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