Logistics Outsourcing and 3PL Challenges

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***Abstract* — Logistics has been an important part of every economy and every business entity. The worldwide trend in globalization has led to many companies outsourcing their logistics function to Third-Party Logistics (3PL) companies, so as to focus on their core competencies. This paper attempts to broadly identify and categorize the challenges faced by 3PL companies and discover potential gaps for future research. Some of the challenges will be related with the experience and information collected from interviews with two 3PL companies.**

***Index Terms* — Logistics, Outsourcing, Third-party Logistics, Challenges**

I. Introduction

LOGISTICS has been an important part of every economy and every business entity. Logistics cost average about 12% of the World's GDP [1]. In Singapore, logistics cost accounts for about 11% of its GDP [2]. The worldwide trend in globalization has led many companies to outsource their logistics function to Third Party Logistics (3PL) companies, so as to focus on their core competencies. In a recent study [3] conducted by Cap Gemini Ernst & Young US LLC, Georgia Tech and Fedex, involving 400 representatives from North America, Western Europe and Asia Pacific, it is concluded that logistics outsourcing remains a growing business globally. On a smaller scale, Bhatnagar, Sohal and Millen [4] reported that the need for logistics outsourcing is also increasing in Singapore.

The overall trend in logistics outsourcing is moving in two directions: (1) increase in the number of buyers of logistics services, and (2) increase in the extent of usage of logistics services. The extent of usage includes number of activities or business process outsourced, geographical coverage, nature and length of contract, percentage of total logistics budget allocated to 3PL companies and level of commitment [4].

In a typical 3PL arrangement (see Fig. 1), the 3PL provider sits in the middle between the manufacturers or suppliers (the buyers of the 3PL service, known as shippers) and the end customers (the consumers of the products). In this position, the 3PL provider will need to balance the dynamic pulls generated by the upstream and downstream entities, and thus faces challenges which are unique to its operations.

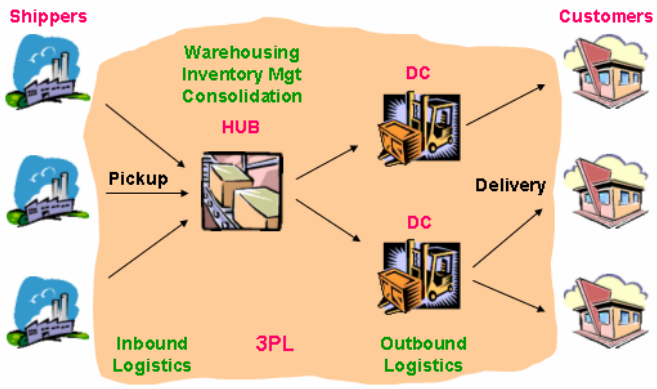

Fig. 1. Typical 3PL arrangement

With the positive outlook for the 3PL business and the immense competition which is likely to follow, it is critical that 3PL companies recognize that low price is not longer a sure-win strategy. In a study by Sink, Langley and Gibson [5], it was found that the most important selection criterion for 3PL provider was *core competencies*. Thus, the objective of this paper is to help 3PL companies identify and categorize the challenges in the business in a broad sense, and to discover potential gaps where research and development can help bridge the gap. The rest of this paper is organized as follows. In the next section, important segments of literature on logistics outsourcing are reviewed. Subsequently, the broad categorization of 3PL challenges is described, followed by detailed discussion and potential gaps identification. Some of the challenges will be related to the interviews conducted with two 3PL companies. Finally, the list of future research directions is given at the end.

II. Literature Review

There are many papers on logistics outsourcing and Razzaque and Chang [6] did a comprehensive review on

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the outsourcing of the logistics function. In general, this literature can be generally categorized according to different focus area. Some of these focus areas include logistics practices, usage of 3PL logistics services, current state and future trends, strategies and performance measurements. Interested readers can be referred to the following papers (not meant to be exhaustive) in each of the focus area,

- Logistics practices – Bardi and Tracey [7], McMullan [8], Millen and Sohal [9], Rao, Young and Novick [10]
- Usage of logistics services – Lieb [11], Lieb, Millen and Wassenhove [12], Lieb and Randall [13], Dapiran, Lieb, Millen and Sohal [14], Bhatnagar, Sohal and Millen [4]
- Current state and future trends – Kim [15], Gilmour, Driva and Hunt [16], Sheffi [17], Peters, Cooper, Lieb and Randall [18]
- Strategies – Ballou [19], Copper [20], Sum and Teo [21], LaLonde and Masters [22]
- Performance measurements – Pools van Amstel and D'Hert [23], van Hoek [24], van Heok [25], Chow, Heaver and Henriksson [26]

On the other hand, there are not many papers which look at the challenges faced by 3PL companies and address how they can overcome such challenges. One paper by Min [27] listed some of the challenges related to distribution but is specifically for the Japan market. Some of the listed challenges include overcoming the dominance of wholesalers, understanding the complex structure of the distribution channel and legal issues. This paper however, attempts to identify and categorize the challenges faced by 3PL companies on a higher level and in a broader sense. The challenges identified are grouped into different layers. In each layer, the associated attributes are listed and potential gaps are identified. Some of the challenges are linked to the experience and information collected from the interviews with two 3PL companies.

III. Layers of 3PL Challenges

Logistics planning attempts to make decision at three different levels, namely strategic, tactical and operational. These three levels are differentiated by their planning horizon, where strategic level is in years, tactical level in months, and operational level in weeks and days. Here, the 3PL challenges are differentiated by their level of tangibility as shown in Fig. 2. At the top level is the Logistics Network Configuration layer (most tangible), to Material Flow layer, to Information Flow layer, and finally to Relationship Management layer (least tangible).

Logistics network configuration is concerned with designing the optimal network to satisfy service requirements at the minimum cost. The optimal network consists of,

- Optimal number of warehouses and distribution centers (DCs)
- Location of these warehouses and DCs
- Service areas of each warehouse and DC
- Routings of the goods (e.g. direct shipping or via consolidation)
- Type and amount of inventory to be stored at each location
- Allocation of production plants to warehouses and DCs

The interested readers can be referred to Cooper [28], Balakrishnan, Magnanti and Wong [29], and Nozick [30] for a review of location problems.

Material flow refers to the movement of products from the upstream entities, via the 3PL provider, to the downstream entities. Major concerns in material flow include,

- Scheduling of transportation to pick up the products from the manufacturers and deliver the products to the customers.
- Warehousing of the products at the 3PL hubs and DCs
- Consolidation of products
- Monitoring the inventory levels

Some of the papers which address such issues include, Tyan, Wang and Du [31], Xu, Chen, Rajagopal and Arunapuram [32], and Yokoyama [33].

Information flow refers to the flow of information throughout the supply chain. Information flow usually accompanies the material flow, and both are tightly coupled together. Important information includes order information, inventory data, product types, origin and destination, etc. The final layer, the relationship management is concerned with the necessary terms and conditions which facilitate the partnership between the 3PL provider and its client.

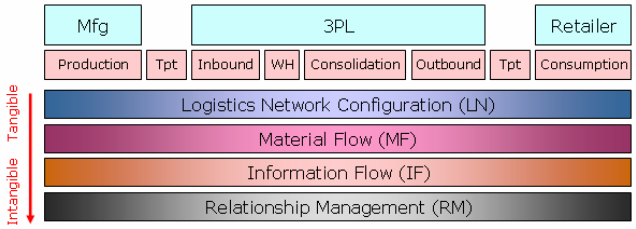

Fig. 2. Layers of challenges faced by 3PL companies

For each of these layers, some of their associated attributes are listed as shown in Fig.3.

- Logistics Network Configuration – location, links, warehouse sizing, allocation, customer points
- Material Flow – inventory, scheduling, lot sizing,

warehousing, consolidating

- Information Flow – order processing, information sharing, IT systems integration, Internet and visibility
- Relationship Management – performance measures and contract design

For the discussion in the next few sections, some of the attributes will be discussed in detail as we move from layer to layer.

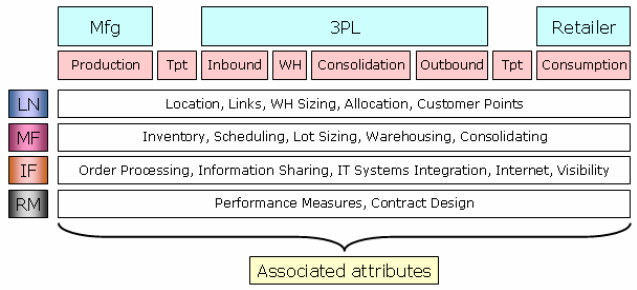

Fig. 3. Associated attributes for each layer

IV. Logistics Network Configuration

3PL companies which take over the logistics function from their clients usually have to set up a logistics network to support the flow of products from the client's manufacturing plant to the end customers. This is done by building warehouses and DCs at locations required by their clients. 3PL companies are always in need of logistics network configuration solution models to help them design the best logistics network to operate at minimum cost while satisfying service requirements.

Logistics network configuration is usually tackled as location problem in the academic arena. Brandeau and Chiu [34] have provided a comprehensive overview of representative problems in location research. They categorized location research according to objective, decision variables and system parameters. In all, a total of 54 types of different location problems were identified.

One important thing to note in all the solution models is this – the logistics network design solutions are generated based on static information, such as,

- Customer locations and demand by product
- Potential warehouse locations, size and costs
- Available transportation links and costs
- Plant locations and capacity
- Service level requirements

However, the real world is never static. Supply chain requirements keep changing. Customer demand can change in spatial and temporal terms. Manufacturer requirements can change due to product changes. Implementing a network configuration based on today's data will become sup-optimal under tomorrow's conditions. There have been studies which looked at dynamic network configuration. They include work from Ballou [35], Sweeney and Tatham [36], Wesolowsky and Truscott [37], Van Roy and Erlenkotter [38]. All these works addressed the problem by dynamically changing the warehouse locations in response to changes in requirements, and typically trade-off the savings achieved with the costs in implementing the change.

From the interview with a large 3PL company which serves an international PC maker to distribute PCs from the manufacturing plants to the customers, such a solution based on dynamic warehouse location is not suitable. 3PL companies seek long-term relationship with their clients and usually build warehouses to exploit lower costs as compared to leasing from public warehouses. As the 3PL business grows, the number of warehouses and DCs will become saturated, and can no longer afford to build more simply to cater to changes, while leaving existing warehouses underutilized.

A more desirable solution would be to dynamically change other attributes which are not as physical as warehouses. In other words, a better solution method is required to dynamically change one, some or all of the following,

- The assignment of customer points to warehouses
- The assignment of plants to warehouses
- Transportation links and modes
- Warehouse capacity allocation

The trade-off considered can be similar to previous research works on dynamic warehouse location, that is, to trade-off savings achieved with the costs in implementing the change. In addition, since this is a dynamic model, the solution should also recommend the optimal point in time to implement the required changes.

V. Material Flow

Problems related to material flow are always faced by 3PL companies. These problems can be related to inventory policy, scheduling of fleet, routing of vehicles, consolidation and warehousing. Many of such material flow challenges can be tackled better using coordination techniques. From the interview with an internationally known 3PL company, which serves an automobile maker to distribute its automobile spare parts received mainly from US and Germany, to twenty-six countries around Asia-Pacific, coordination can be used to overcome the variability introduced by the long delivery lead time, and dynamism from upstream and downstream.

Exactly how much coordination is possible from the 3PL

provider's stand point? From Fig. 4, we can see that within the company, the 3PL provider can coordinate its inbound logistics with warehousing and also with outbound logistics. Inter-company coordination can also be possible. Examples would include,

- Coordination among 3PL companies which form alliances
- Coordination with upstream manufacturer/supplier to synchronize production schedule with inbound transportation schedule
- Coordination with downstream customers/retailers to synchronize inventory level with outbound transportation schedule

However, the biggest barrier in inter-company coordination is in information sharing and the issue of trust. Many research works have been done in information sharing (to be discussed in section VI) which shows that companies which collaborate and share information reaped tremendous amounts of benefits.

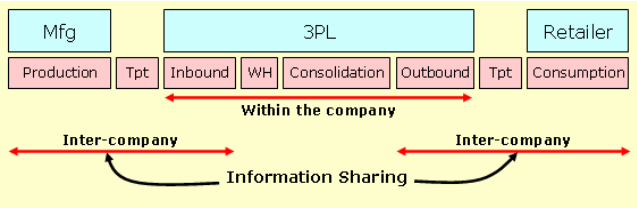

Fig. 4. Possible coordination opportunities for 3PL provider

In coordinating production with transportation schedules, research works by Maxwell and Muckstadt [39], Blumenfeld, Burns, Diltz and Daganzo [40], Blumenfeld, Burns and Daganzo [41], Hahm and Yano [42-45] and the recent work by Khouja [46], all considered such coordination from the standpoint of the supplier of the products, delivering products to end customers themselves. These works can be categorized according to the following parameters,

- Number of origins versus number of destinations
- Number of item types produced at the origins versus number of item types delivered at the destinations
- Direct shipping or via consolidation
- Synchronization possible or not possible
- Accumulation of inventory before delivery considered or not considered
- Common cycle or nested cycle
- Product cycling or economic lot sizing
- Setup cost and setup time considered or not considered
- Freight charge is per trip or per truck
- Fixed or variable production rate

At the other end of the supply chain, the 3PL provider can also coordinate the transportation schedule of its outbound logistics with the inventory levels at the retailers. This is similar to Vendor Managed Inventory (VMI) or Continuous Replenishment Program (CRP), except that the 3PL provider acts on behalf of the supplier. Again, the main success factor in VMI is in sharing of information, including sharing of point-of-sales data and inventory level information. Papers on VMI include Raghunathan and Yeh [47] which studied the impact of information sharing on CRP and factors that affect the value of CRP, and also quantified the value of CRP and determined the optimal number of retailers a manufacturer should work with; K.L. Cheung and H.L. Lee [48] which focused on using information to coordinate shipment to achieve economies of scale and to use information for stock rebalancing, and also compares the benefits derived from both; Cetinkaya and Lee [49] which presented an analytical model to approximate the optimum replenishment quantity and dispatch frequency simultaneously; Axsater [50] in response to [49] provided a simple procedure to compute exactly and illustrated that the errors when using the model in [49] can be very large for certain problem types.

To achieve a total coordination of upstream and downstream entities, a 3PL provider can attempt to merge the solution methods from synchronization of production and transportation schedules and VMI. The main benefit would come from the 3PL provider's ability to risk pool inventory at its hub, and schedule pick up and delivery according to dynamic changes upstream and downstream.

VI. Information Flow

Information is one of the most important elements in logistics management. Previous research works on information sharing include (1) works that look at the value of information sharing, (2) works that look at collaborative forecasting and (3) works that develop replenishment policies based on information sharing,. For the last case, it has been discussed as VMI in the earlier section.

For the first case, works include, Lee, So and Tang [51] which developed an analytical model fore one retailer and one manufacturer, to quantify the benefit of information sharing and found that the benefit is very high especially for demands that are significantly correlated over time and when demand variance is high and also for the case of long lead times; Cachon and Fisher [52] compared the reduction in supply chain costs between a supply chain that does not share information with one that shares full information, for a model with one supplier and N identical retailers with stationary stochastic demand. The result from the numerical study showed a 2.2% lower on the average and a maximum of 12.1%; Gavirneni, Kapuscinski and Tayur [53] studied the role of information under three settings:

(1) supplier has no information except past data, (2) supplier knows the demand distribution and that the retailer uses (s,S) policy and (3) supplier has full information, for a two-stage capacitated supply chain. They showed the optimality of order-up-to policies for finite and infinite horizon, and through computational analysis, quantified the savings obtained;

For the second case on sharing information for collaborative forecasting, known as collaborative planning, forecasting and replenishment (CPRF), usually involves two parties, the manufacturer and the retailer. The collaborating parties would jointly generate a forecast and plan for that forecast. The desired effect would be to make the supply chain more efficient since the forecast is coordinated and carried more information. Yossi [54] studied a two-stage supply chain involving a supplier and a retailer. He created two models, (1) a decentralized structure where each member performs local forecasting and integrates adjusted forecasts into his replenishment process and (2) a centralized structure where the two members jointly forecast and update, and compared the two models with a benchmark model where forecasts are not integrated with the replenishment process. In the following year, Yossi [55] studied the case of auto-correlated demand on the same two-stage supply chain. He created three models, (1) retailer and supplier coordinate their policy parameters but do not share observations, (2) supplier manages the supply chain's inventory without information of retailer's observations, and (3) full sharing of observations with collaborative forecasting. The insight derived was, VMI and CPRF becomes more important as the demand process is more correlated across time, and as company's ability to explain the demand uncertainty through early demand information improves.

From 3PL provider's standpoint, having early demand information and be part of the collaborative forecasting effort, will definitely help in planning the transportation capacity, inventory levels, and scheduling. Consider the business conditions of the 3PL company which serves the automobile maker. Automobile spare parts are shipped to service centers as regular parts required during regular service schedules and as emergency parts due to car accidents. These spare parts are usually very expensive which suggests low inventory and when needed in emergency must be shipped by air. The company faces the difficulty in managing the inventory of the spare parts to cater for both regular orders and emergency requests which must be satisfied immediately. Having constantly updated demand information and forecast, the company will be able to handle the inventory and transportation planning and scheduling more efficiently.

Other than sharing information for coordination (as discussed in section VI) and forecasting, the other vital benefit for a 3PL provider is achieving visibility. In a recent report [56] submitted by Cap Gemini Ernst and Young, Georgia Southern University and the University of Tennessee, it was reported that visibility in the supply chain should be the first of the six drivers (including connectivity, execution, optimization, collaboration and speed) to be implemented. From this report, it is concluded that visibility can result in the following benefits,

- Creating an adaptive supply chain that is effective and efficient
- Increasing the ability to do demand-driven replenishment (as in VMI)
- Lowering inventory levels
- Reducing cycle times
- Improving the use of more cost-effective transportation

3PL companies usually share order tracking information over the Internet to allow their clients to have visibility of their products within the supply chain. However, there has been very little research work which focuses on how the 3PL companies can participate more actively in information sharing, what other types of information can be shared, using what kind of technologies, the subsequent impacts, as well as assessing the value the 3PL company achieve through information sharing.

In logistics management, information systems are part-and-parcel of the business. Some of the information systems used are Logistics Information System (LIS), Warehouse Management System (WMS) and Transportation Management System (TMS). In a recent paper by Mason, Ribera, Farris and Kirk [57], they claimed that "Companies are not suitably equipped to make informed, effective decisions based on the data collected separately by … WMS… and TMS…", and "Today's supply chain management systems must not only be able to provide real-time data but also to integrate data across the supply chain and to support real-time decision making in response to changing conditions." They addressed some of the open questions pertaining to the integration of WMS and TMS, and highlighted the potential benefits of the integration. Also, simulation analysis was used to examine the benefits gained. To benefit the 3PL companies, more research work can be done in this area to address the challenges which are unique being the middle man in the supply chain.

VII. Relationship Management

3PL companies usually seek long-term relationship with their clients and thus are very concerned with maintaining good relationship through good performance. Performance measures are used to gauge whether the 3PL provider has provided its services up to, above or below the expected

level. Some of the performance measures given in [8] are,

- Inventory accuracy
- On-time shipments
- Customer complaints
- Backorders
- Warehouse cycle time
- Number of kilos/unit shipped
- Number of dollars shipped

For large 3PL partnerships, performance measures are usually linked to the legal contract between the 3PL provider and its client, to determine the performance incentives and non-performance penalties. In any of such contracts, it is important that the associated penalties and incentives stated are fair for both parties involved. In the paper by Lim [58], he proposed a game-theoretical model to find an optimal contract, which includes penalty and gain-sharing incentives, which will be accepted by the 3PL provider and induce the 3PL provider to truthfully reveal his capability. However, from the list of performance measures given above, it is obvious that the performance measures are rather numeric in nature and does not directly relate to the true bottom line, dollars and cents. How then can the penalties and incentives be valued if the performance measures are not measured in dollars and cents?

Again, consider the 3PL company which serves the automobile maker. Part shortages sometimes occur at the service centers, resulting in car owners unable to have the faulty part replaced in the car on time. This sometimes lead to car owners replacing the faulty part using alternative or non-genuine parts which may affect the overall performance of the car, which in turn affects the overall image of the car brand. In other situation, the unsatisfied car owner may just change the car to another brand, thus the car maker ends up losing an existing customer. This discussion may seem hypothetical but in fact is very real. By quantifying the actual money loss accrued due to a unit of a particular non-performing indicator, it will allow the 3PL provider to prioritize its operations towards fulfilling the more high-valued ones. Also, the penalties and incentives can then be related to a parameter of the same units.

VIII. Future Research

The objective of this paper is to provide a broad categorization of the challenges of 3PL companies and identifying the potential gaps. The potential gaps in each of the layers are summarized in the table below,

	Layer	Potential Gaps
1	Logistics Network Configuration	Dynamic logistics network configuration with changes in transportation links and modes, assignment of warehouses to demand points, assignment of plants to warehouses, allocation of warehouse capacity, while keeping the location and size of existing warehouses fixed.
2	Material Flow	• Coordination with upstream to coordinate production and inbound transportation • Coordination with downstream retailers to coordinate inventory level with outbound transportation • Full coordination with upstream and downstream
3	Information Flow	• Study information sharing for collaborative forecasting from 3PL provider's standpoint. • Explore ways for 3PL companies to share information, address the types of information to be shared, types of technology to use, assess the impact and value in sharing information. • Integration of LIS, WMS and TMS.
4	Relationship Management	Quantifying the actual money loss accrued due to a unit of non-performing indicator.

This list of potential gaps is useful for academic practitioners to perform future research to develop solution methods to answer the needs of 3PL companies.

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