CHAPTER FIVE

PUTTING VENDOR MANAGED INVENTORY IN INDIAN RAILWAYS

In this chapter, concept of Vendor Managed Inventory (VMI) is evaluated; problems of the Indian Railway's inventory management are analyzed on the basis of secondary data of inventory management retrieved from the Railway Board, Ministry of Railways. Main concepts of VMI relevant to the topic are summarized. In the next section existing process of procurement and inventory management along with linkages with various stake holders are mapped. Role of various stake holders are summarized. Then structure of sharing and utilizing information is mapped. The business process redesign leading towards VMI is suggested to address challenges of the Indian Railway's inventory management. Lastly concept of 3rdParty Logistics (3PL) is introduced and linked with VMI so as to become as a key optimizer of supply chain performance.

5.1. Vendor Managed Inventory (VMI)

The Vendor Managed Inventory aims dual objectives of higher customer service at lower inventory cost and in doing so it alters the fundamental structure of the supply chain ordering (Disney and Towill, 2002). Supplier is able to reduce his production inventory, decrease transportation cost, build a better collaboration between with purchaser, speed up the supply chain and reduce the bullwhip effect. The overall implication across the supplier-customer dyad is the transition from push based processes to a pull based processes. The issues which required due attention before implementing the VMI systems are identification the location of

- Where is the inventory located?
- How is the distribution of products or raw materials accomplished?
- How the inventory level is monitored and how visible is the customer's demand and demand history to the vendor?
- What role do information systems play in the facilitation of the Vendor Managed Inventory (VMI) system?
- Who and how makes the inventory replenishment decisions?
- Who owns the inventory?

5.1.1. Just-in-Time, MRP, and Lean Supply Chains

The environment for Just In Time (JIT) assumes stable demands and lead time, supplier involvement/partnership, streamlined and uninterrupted material flow, process flexibility and vendor involvement etc. and there is no additional transportation cost for frequent delivery and over capacity of supplier. Key requirement for successful JIT system is that supplier rate needs to match the consumption rate and supply rate is pull driven (Vrat, 2014).

5.1.2 Bullwhip Effect

When demand information flows from downstream stages to upstream stages of the supply chain it fluctuates due to local level estimation of the demand. The information gets distorted as it moves along the network and results in excess or shortage of inventory (Forrester, 1961; Kachru, 2009).

5.1.3 Gaps in the Literature

Existing literature is developed in the context of large and well managed private organizations. In the Indian context management practices in public procurement organization are entirely different and complex. In the public procurement organizations apart from Value For Money (VFM), concept of 6R‟s (right quality, right quantity, right prize, right source, right place and right time), there are other major consideration such as constitutional provision of article 14 & 19 (right of freedom and equality), transparency multiplicity of goal, public accountability towards agency such as parliament, Central Vigilance Commission (CVC), Central Bureau of Investigation (CBI), Comptroller and Auditor General of Indian (CAGI), Right To Information (RTI) etc. Traditionally there is transactional approach where each transaction is evaluated independently instead off overall integrated approach.

The available literature is not much applicable in the public procurement environment. For example in private organizations calling the bid and procuring at lowest acceptable prize from other than available bid is normal. Negotiating with other than lowest acceptable firm is permitted. The evaluation is done on overall basis and the organization can sacrifice the interest in one case in the larger interest of overall gain to the organization. Whereas in the public procurement each transaction is evaluated independently, the status of bidders on the

date of tender opening is sacrosanct. Even if the offer becomes higher afterwards on account of foreign exchange various or statutory variations.

5.2 Assessing Material Management in the Indian Railways

Material Management department of the Indian Railways is responsible for meeting the needs of raw materials and a spares for maintenance, repair and operation of rolling stock as well as the production of Loco, coaches and wagon. Select statistics related to material management is detailed in Table 5.1.

For effective supply chain management all fragments within the supply chain should have common objective which in turn facilitates collaboration, transparency and provide a visible demand pattern. Unpredictable and non-transparent demand pattern results in bullwhip effect which in turn leads to poor customer service, high inventory levels and frequent stock outs. VMI offers significant opportunities for reducing the bullwhip effect and enhancing customer satisfaction.

5.2.1 Bullwhip Effect Manifestation in the Procurement Processes of the Indian Railways

The effect of Bullwhip effect is clearly visible on the inventory management system of the Indian Railways. The psychology of the managers in the Indian Railways is that the inventory is the panacea for the problem of shortage or out of stock. Especially for critical items in case if some shortage is felt then the reaction is multifold such as enhancing the Anticipated Annual Consumption (AAC), emergency purchase etc. Total purchase is budget driven. As a result there is high inventory for some items and shortages for others. There is a gap between the money value of Anticipated Annual Consumption (AAC) of all the items and the available budget provision for consumption of these items. Anticipated Annual Consumption (AAC) value of all the items is 30-40 per cent higher than the budget available. This gap is created as a consequence of overreaction to shortage of vital items. It is reflection of Bullwhip effect. Chopra and Meindl (2014) define it as a continuous replenishment programmer where the supplier is having the responsibility of all the decision of managing customer inventory. The information which needs to be shared with supplier is inventory level, demand forecast, trend of consumption, production and delivery scheduled. In the Indian Railways the system is on the basis of annual procurement.

Table- 5.1 Material and Inventory Management Statistics in the Indian Railway

	Material Purchase		Total Issues		Inventory Balance on 31th March in Rs. Crores				Turn over Ratio		Surplus & over stock Rs. Crores	Employee	
Year	Indigenous Rs. Crore	Total Rs. Crore	Without Fuel	With Fuel	In bound (a)	Work in Progress	Misc. Advance	Total	With Fuel	Without Fuel		Officers	Total
2004-05	12621	12967	N/A	N/A	1017	333	2507	3857	N/A	N/A	N/A	737	37282
2005-06	14905	15326	N/A	N/A	1315	401	2763	4479	N/A	N/A	N/A	810	30698
2006-07	18057	18651	N/A	N/A	1669	636	2961	5266	N/A	N/A	N/A	N/A	N/A
2007-08	21352	21982	N/A	N/A	2109	764	3306	6179	N/A	N/A	N/A	N/A	N/A
2008-09	26682	27495	N/A	N/A	2757	800	3556	7113	N/A	N/A	N/A	N/A	N/A
2009-10	26726	27876	N/A	N/A	2761	906	4359	8026	N/A	N/A	N/A	831	28831
2010-11	28017	29099	16029	24188	2561	795	4874	8230	11%	13%	41	874	28224
2011-12	30176	31359	17081	26518	2755	906	4586	8247	10%	14%	55	902	28313
2012-13	33780	36027	19106	30511	2592	1094	4564	8250	9%	13%	89	883	26661
2013-14	40258	42447	20567	36847	2624	1272	4509	8405	7%	13%	62	926	26632

Source : Indian Railways Statistics, Data Compiled by researcher

The quantity of forecast is done more than one year in advance and purchase orders are placed on supplier which is having specified quantity and specified delivery period. If the supplier delays the delivery then he is liable to pay a pre-estimated damaged @ of 2% per month of the value of delayed supply.

Most of the purchases are made from the approved supplier. The list of approved supplier is common for all the 17 Zonal Railways and 8 production units. The supply order is placed on the firms by issue of annual tender. The winning bidder/bidders are placed the supply order for one year requirement. Railways does not enter into long term procurement contract with these firms. However, at the macro level these suppliers are repetitively getting order from 17 Zonal Railways and 8 production Railways. Therefore, it can be said that these firms are having long term business relationship with the Indian Railways for supply of Railways material. A significant portion of the business of these firms is contributed by Railway. Railways is therefore providing them continuous business opportunity on long term basis but not availing the advantages of long term contracts. In present system normally a supplier gets order from several consignees and he is governed by the ordered quantity and delivery period. Scheduling and dispatching of the material to the consignee is done by the suppliers as per the delivery period specified in the contract. This results into the excess stock in some places and shortages at other places. In contract with VMI system the supplier will have the information of requirements of the entire consignee and therefore can plan dispatching and scheduling optimally. This is very useful if supplier had scares production capacity. He can choose which delivery can be delayed (Kaipia et al, 2002)without causing in out of stock and loss of production. Railways on the other hand will experience benefit from decrease in administration cost. The huge man power and infrastructure of Railways is tied up and engaged to monitor the progress of the supply orders. VMI partnership results in to better availability and reduced inventory, reduced stock out by increasing inventory visibility (Angulo et al., 2004) and lower administrative cost.

Working towards VMI is a company wide effort to stream line business process with supporting technology. For its success all the fragments of supply chain should have common objective. Normally the agreement with VMI partner shall include parameters such as maximum and minimum inventory level, minimum delivery quantity and transport schedules. Information sharing arrangements, consumption pattern, demand pattern and forecast accuracy. A positive attitude among all the persons involved is a perquisite. It is important

that the Railways should have trust in a supplier and allow him to schedule the deliveries. There is a fear that vendor will take advantage of urgency situation and supply materials to reduced standard. Low volume products have a larger potential for improvement then for high volume products. Because operation of high volume products are already well polished. Further. VMI is most effective for product with stable demand pattern(Federgruen and Yang, 2011).

5.2.2Key performance indicator (KPI) in case of Vendor Managed Inventory (VMI)

Traditionally performance measurements are conceptualized in terms of standalone performance measure themes. However, in supply chain context various performance measure themes have cascading effects. The interactive effects of performance measures are depicted in figure 5.2. Therefore, system level view is required for development of true performance measures.

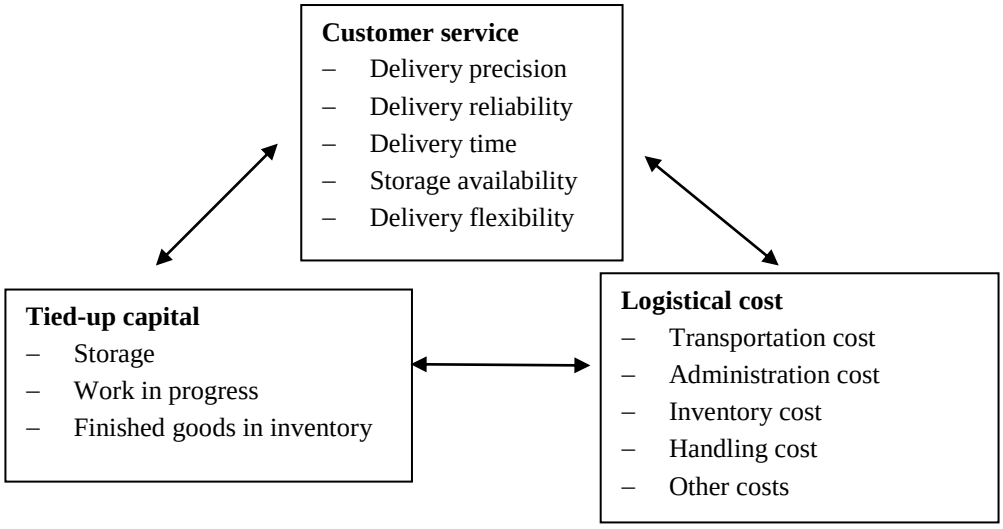


Figure 5.2 Key Performance Indicator (Adapted from Lumsden & Mirzabeiki, 2008)

At the National Academy of Indian Railways a five day workshop was conducted. It was attended by procurement experts and policy makers of the Indian Railways. This workshop discussed Key Performance Indicators (KPIs), their measurement systems and associated impacts on the underlying supply chain. Issues which emerged during the discussion are elaborated in Table 5.2.

Table: KPI and Associated Performance Measures

SN	Issues	Performance Measure	Impacts on Supply Chains
1	High lead time	Cycle time in days	Bullwhip effect, In correct forces, Anxiety to customer
2	High Inventory	Inventory terms	Locked up capital, Inventory carrying cost, Lack of agility, Obsolescence, Surplus
3	Stock out	Per cent stock out	Stock out cost, Loss of out turn, Knee jerk reaction, Loss of confidence
4	Responsiveness	Time taken to respond to change in environment or requirement	Inventory built up, Lack of agility, Redundancy in system

5.2.3 Logistics cost

Transportation Costs

Transportation cost is single largest component of logistic cost (Gunasekaran, 2007). High fill rate shall require regular and frequent transport. It does not necessarily mean higher transportation cost because supplier will experience smoother demand signal. Supplier is allowed to coordinate the replenishment and efficient route planning instead of responding to customer orders on point to point basis.

Administration Costs

This includes the cost of personnel involved in monitoring receipt and acceptance of material. The administration cost comes down substantially as supplier will ensure the timely availability of material.

Inventory Cost

Handling Cost and Other Costs Cost associated with capital block, surplus and obsolesce constitute inventory cost which comes down heavily through VMI initiatives. Cost associated with handling of inventory is handling cost which goes down as inventory goes down. Other costs include cost such as material requirement planning and consumption. Transparency and visibility achieved through VMI results in efficient product scheduling which in turn lowers cost. Vendor is having advantage of assigning the product and product mix, better react to dynamic changes in requirement and minimize Bullwhip effect.

5.2.4 Customer service

The certain level of customer service involves a specific cost. Normally it is felt that increasing level of service will result in to higher service cost. However, in VMI system the supplier will be able to optimize the delivery scheduled to different consignee within his production capacity, it is expected that there will be lesser occurrence of supplies after scheduled delivery and therefore the cost will come down. Customer service can be broken into delivery precision, delivery reliability, delivery time, storage availability and delivery flexibility. All these factors will have positive impact because of more predictability, visibility of inventory consumption and demand. The level of customer service goes up and cost comes down as shown in Figure 5.3.

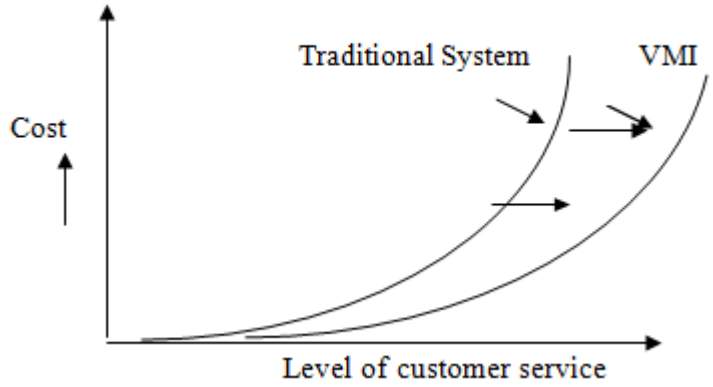


Figure 5.3 Typical Costs and Customer Service Relationship

Tied up capital also reduces because of Vendor Managed Inventory (VMI) system the inbound inventory, working in progress inventory and finished good inventory is expected to come down because of predictability, visibility and flexibility of delivery.

5.5. Theoretical Framework for implementation of Vendor Managed Inventory (VMI) in the Indian Railways

5.5.1 Assessing Existing System

Indian Railways is having a very complex and disintegrated system of procurement and material management. The entire Indian Railways is divided in to Zonal Railways, Production units, workshops and field units. Entire planning process commence with preparation of budget. In the month of November budget estimate is prepared for following financial year. In this budget activity are planned targets are finalized and the resources are allocated which include separate allocation for consumption of material.

From this budget purchase grant is derived. Controller of Stores (COS) who is the head of the material management department forecast the Annual Anticipated Consumption (AAC) of various stock items in consultations with consuming and finance department. While forecasting the Annual Anticipated Consumption (AAC) the past trend of consumption and targets are kept in mind. The procurement of stock item is made on annual procurement basis. For uniform distribution of work load throughout the year of procurement calendar of all the stock items is decided and it is generally fixed. Trend of inventory availability and over stock position can be seen from the Table 5.3.The theoretical frame work of the existing procurement process is given in Figure 5.4

Table 5.2 Availability of Stock Item, Inventory Balance and Over Stock

Safety Stock Level				**Overall Level**			**Value of Inventory Balance Crs.**	**Surplus & over stock Rs.Crs**
Year	**No. of Items available**	**No. of Items Total**	**% availability**	**No. of Items available**	**No. of Items Total**	**% availability**	**In bound (a)**	
2003-04	7155	7517	95.18	106695	114974	92.80		N/A
2004-05	5406	5706	94.74	69254	73183	94.63	1017	N/A
2005-06	5318	5548	95.85	66100	70361	93.94	1315	N/A
2006-07	5337	5510	96.86	82326	86277	95.42	1669	N/A
2007-08	9587	9780	98.03	103214	108325	95.28	2109	N/A
2008-09	8898	9018	98.67	101212	104681	96.69	2757	N/A
2009-10	8499	8573	99.14	102764	106286	96.69	2761	49
2010-11	8208	8303	98.78	99164	102693	96.56	2561	41
2011-12	7983	8167	97.75	100817	104943	96.07	2755	55
2012-13	9617	9707	99.07	102817	107493	95.65	2592	89
2013-14	9768	9838	99.29	99977	104750	95.44	2624	62
2014-15	9663	9737	99.24	98119	103142	95.13	N/A	N/A

Source: data compiled by researcher from Indian Railways Operations Statistics Handbook from 2004 to 2015

The theoretical frame work of the existing procurement process is given in figure 5.4

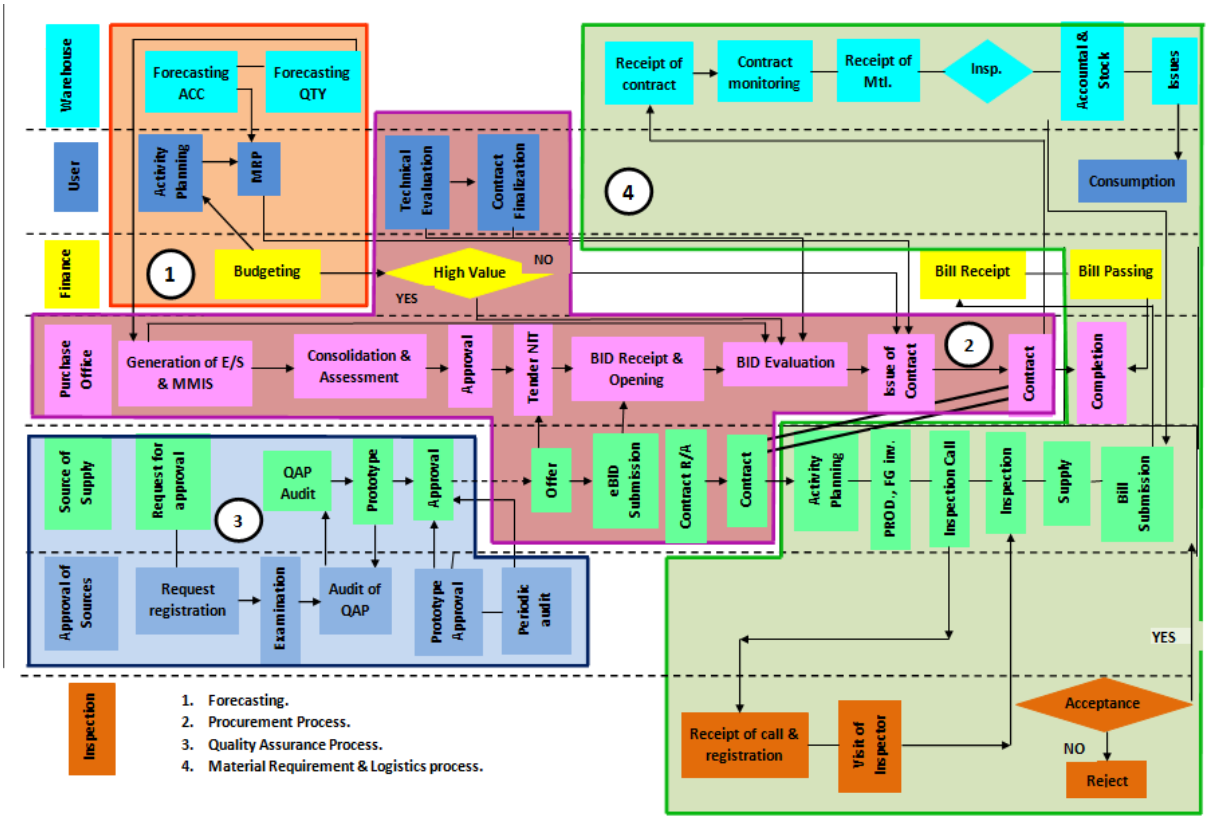


Figure 5.4 Framework for Procurement Indian Railway (As Is SYSTEM)
Source: Developed by researcher

Normally the budget allocated for the procurement of material should match with the value of Annual Anticipated Consumption (AAC) of all the stock items. It is seen that in actual case the Annual Anticipated Consumption (AAC) value of all the stock items put together in nearly 30 to 40 per cent higher than the budget provision for the procurement of these items. This distortion is the net result of Bullwhip effect. This anomaly creates operational difficulty in maintaining the supply chain. This creates situation of over stock of some items and out of stock situation of some other items. From this table it can be seen that on one hand there is high stock out situation and on the other hand there are many items which are surplus and overstock. The average physical inventory is three month across the year. Controller of stores is responsible for material planning, procurement, inventory management and logistics. The bulk of the procurement to the extent of 90 per cent of the value is made through approved sources on annual procurement basis by issuing tender once in a year by all Zonal Railways and eight production units independently. The approval of vendor is done by centralized agency normally Research Design & Standard Organisation (RDSO), Lucknow. This approved list is common for all the Zonal Railways and production units to the large extent.

These approved sources are required to offer their bid in the tender issued by Controller of Stores (COS). The tenders are having a specified due date of tender opening.

The entire procurement process is performed through e-procurement system. The high value tenders are evaluated by tender committee which comprises of the officers from Material Management department, Consuming and Finance department. Contract is awarded to winning bidder/bidders. In the similar manner the procurement is finalized by all the 17 Zonal Railways and eight Production Units. The supplier is governed by the condition of the contract which includes the quantity delivery scheduled, pre-inspection of the consignment at the site of the supplier by pre-inspecting agency prior to dispatch. Payment terms are related with inspection and dispatch. In case firm is not able to supply up to the terminal date of delivery specified in the contract, there is heavy penalty @2 per cent per month or part their-of the value of delayed supply. The supplier therefore is governed by the contract. He has to complete delivery before terminal delivery date. This leads to a situation of sudden delivery of consignment at fag end of delivery period in some case and shortage of material in other case.

5.5.2 Redesign of Procurement System for the Indian Railways

Deficiency in the Existing System

High cycle time: It is seen that average cycle time from the date of generation of indent of an item to the placement of supply order is 280 days. Delivery commences after two to three months. The total cycle time therefore is around 365 days in this annual procurement system. This high cycle time leads to forecasting error and enhanced Bullwhip effect, poor responsiveness in meeting changes in the demand pattern.

High Inventory in the System: The supplier makes a production planning as per the individual order and arranges third party inspection for individual consignee. The call of inspection is given to inspecting agency after the consignment is ready. This results in high level of finished goods inventory in the system.

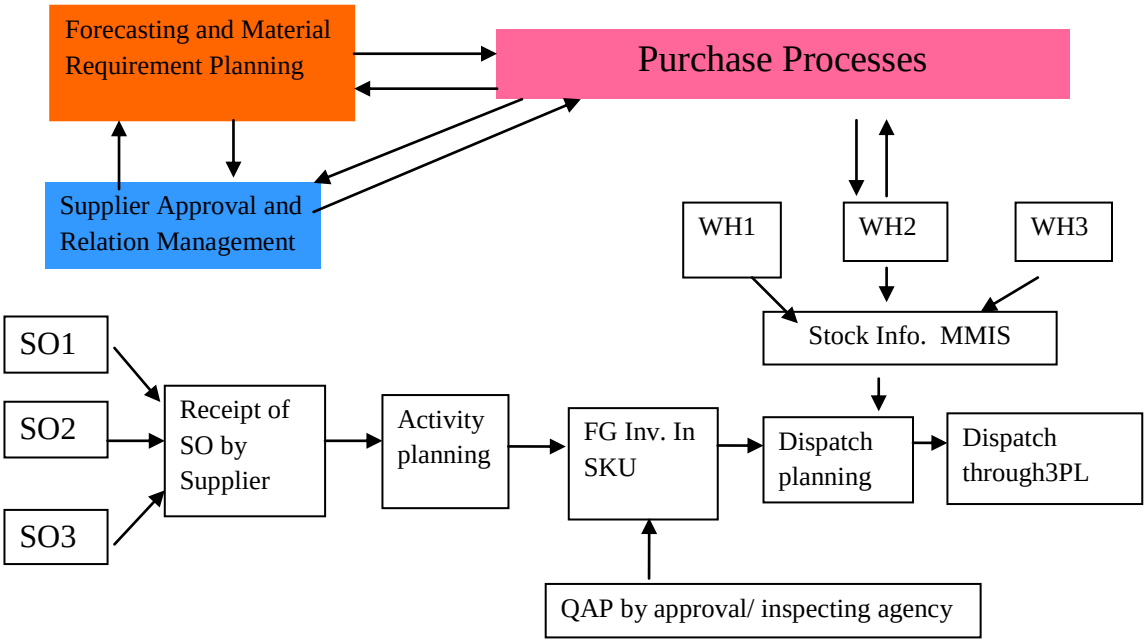
The supplier makes the supply to the various consignees as per delivery period specified in the contract. The urgency at different consignee is not the main criteria of dispatch scheduling. Supplier is more guided by the delivery period which results in to unbalance supply, high inventory and high stock out situation.

5.5.3 Proposed System and Implementation Plan

The entire material management function in the Indian Railways is carried out on Enterprise Resource Planning (ERP) called Material Management Information System (MMIS). This Material Management Information System (MMIS) is web based. If firm fail to deliver the material within the specified time and request for delivery period extension then Railways administration on the merit of the request can grant delivery period extension with pre-estimated damage and not by penalty termed as liquidity damage @2 per cent per month of part thereof. This system can be modified the supplier can be allowed to have access of Material Management Information System (MMIS) system of the Indian Railways so that they can view the availability of stock and trend of consumption on real time basis. The supplier will be required to maintain within minimum and maximum specified inventory to all it consignee. The liquidity damages clause shall apply only when the stock level falls below the specified level. Provision will be made to safeguard the interest of both partners in case there is sudden surge in demand.

For ensuring flexibility in delivery scheduling for each item Stock Keeping Unit (SKU) shall be specified. This SKU will be granted a unique ID code by supplier. Third party inspecting agency shall carry out the inspection of the item and issue inspection certificate mentioning the SKUs unique number. This will help the supplier, flexibility in production and dispatch scheduling. This basically amounts to delayed differentiation. Another big advantage of this revised system is operation of quantity option clause. The Railways contracts are having ± 30 per cent quantity option clause which can be operated within the original delivery period of the contract. In revised system of VMI the contract validity period in contrast to annual procurement system normally will be one year therefore window for operation of 30 per cent quaintly option clause shall also enhance to one year. This system will help in ensuring the availability of valid contract always at all times. Currently there are many cases where stock is not available and there is no valid contract. This is undesirable situation and will be taken care of effectively by revised system. System of VMI will become very effective if the third party pre-dispatch inspection is avoided and it is replaced by manufactures Warranty Test Certificate (WTC). The schematic diagram of the revised system shown in Figure5.5

Vendor Managed Inventory System



Legend:
SO: Supply Order
WH: Ware House
FG: Finished Goods Inventory
QAP: Quality Assurance Plan
SKU: Stock Keeping Unit
MMIS: Materials Management Information System
3PL:3rd Party Logistics

Figure 5.5 Proposed Vendor Managed Inventory based To Be System for Procurement in the Indian Railways
Source: Developed by researcher

5.5.4 Arranging Transport on Third Party Logistics (3PL) System

At present the Indian Railways purchases materials worth more than Rs.40, 000 Crores. The transport cost element in this volume of purchase is approximately 5 per cent i.e. Rs. 2000 Crores which supplier arranges through a small piecemeal transport contract on originating point to destination point basis. The Indian Railways also arranges inter-depot transfer and the distribution of material by engaging road transport on originating point to destination point basis. However, in general the end user is not getting timely supply of the materials due to poor integration of procurement processes. The transport resource is sub optimally utilized. In the present system the supplier is entrusted to manufacture and supply of the material. Supplier therefore engage small piece meal contract on case to case basis.

If we engage a 3PL service provider who will have an interface with the existing Material Management Information System (MMIS), the contract will be placed on Ex-Works basis with the condition that when material is ready for dispatch, the supplier will be required to login in 3PL portal through a secured channel and enter the transport requirements which shall contain information such as description of material, quantity, originating station and destinations. Similarly other internal users can also enter their transport requirements of inter depot transfer and distribution in the same portal. In this manner the entire snapshot of the transport requirements of the Indian Railways shall be available to 3PL service provider who can optimally (type of vehicle, route planning and back haulage etc.) do the load and route planning. This portal will serve as a aggregator and some of the traffic lost can come back to Railways. This portal can also serve to provide end-to-end connectivity to the Railways freight customers.

Arranging this logistic on 3PL basis shall gel well with VMI system for ensuring flexibility and delivery scheduling. It will also result in saving of transport cost to the extent of 30 per cent due to better route planning and scheduling, economy of scale and aggregation. The 3PL service providers will be required to aggregate the transport requirement by use of a dedicated and secured website. This will also allow the facility of SMS alert for tracking of consignment. The enhanced visibility across supply chain will help in reducing Bullwhip effect. The schematic diagram of 3PLsystem is given in Figure 5.6.

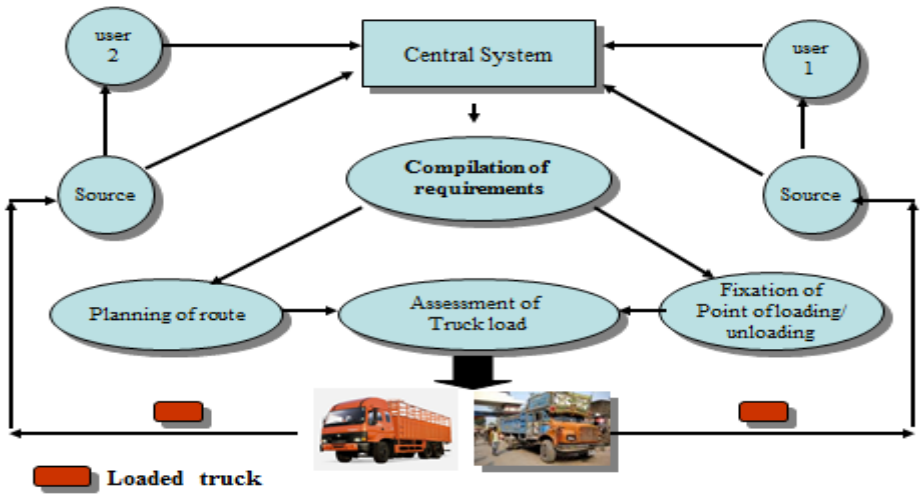


Figure 5.6 Implementing 3PL Systems in IR
Source: Developed by researcher

5.6Summary

Normally it is felt the public procurement environment each activity is evaluated independently and therefore required to be handled on individual transaction basis. Whereas, for effective supply chain management the integration of all the fragments of supply chain is a pre-requisite. The proposed system can be integrated in public procurement environment with minor changes in the contract condition. The system shall have positive impact on reduction of inventory level, improving the customer service and reducing the Bullwhip effect to a large extent. It is very cost effective solutions which can be implanted in Public Procurement Environment.

5.6 References

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