CHAPTER SIX

SUPPLIER-INDIAN RAILWAYS DYAD

In this chapter the business process orientation approach is used to make procurement as a driver to the upstream supply chain of the Indian Railways. A vendor assessment system is conceptualised. Processes underlying procurement function have been analyzed to come up with redesigned procurement processes which enhance overall performance of the Indian Railways system.

6.1 Role of Procurement

Procurement contributes 60 per cent to 70 per cent of the working expenses therefore it has got importance of strategic functions to create sustainable competitive advantage. The best performing purchase organization has to move beyond their transactional role. It is further brought out that the purchasing is most important strategic function of an organization to create sustainable competitive advantage. Purchasing organization has to realize its strategic importance and should no longer remain product oriented. In the current scenario the businesses do not compete with each other on the basis of their products it is their supply chains which compete with each other. More and more businesses are oriented towards crafting their supply chain instead of just a product or a service.

Public procurement is a procurement done by government agencies. It can be defined as procurement for public, by agents of public and of the public funds i.e. taxes (Murray, 2007). The procurement process is strictly governed by constitutional provision, specific rules and procedures so as to achieve government policy objectives. The public procurement drives economy of a country and contributes to 20 per cent to 25 per cent of GDP for emerging economies like India (Gupta, 2015). It is a major policy tool for government to drive its policy objectives such as make in India, promotion of Small and Medium Enterprise (SME) Industry, and developing educated and tolerant society. The public procurement has gained attention of academia as an area of research only recently. Although the public procurement is very important but it is slow to develop because of accountability principle and lack of commercial incentive.

Political perspective in public procurement also plays an important role. Procurement professionals must understand the difference between Political interference and political mandate and many times there is a blurred line. Strategic public procurement cannot ignore the role of the politician at local and national level (Murray, 2009).Major constraint of public procurement is that it favours the supplier with lowest price and does not give importance to relationship and previous experience. The contract is written in advance by purchasing authority so there are little chances or possibility to negotiate about the contract and adjust its content in future to suit conditions. It hinders the development and building up of trust. Public procurement official are less focused on relationship and more focused on cost. Public buyers are generally risk averse. There are regulations imposing some type of constraints on how and when public buyers interact with supplier. Supplier development in public procurement is unlikely to progress if we assume equivalence between public and private procurement. Public buyers rely upon competitive tendering rather than relation contracting due to formal bid procedure. The relationship between buyers and suppliers are generally formal (McKevitt and Paul, 2014). High importance of cost criteria hinders the service qualities. Non price criteria also need to be built into the Key Performance Indicators (KPI) for public procurement (Asa, 2012).

6.2 Supply Chain Management

According to global supply chain forum Supply Chain Management (SCM) is the integration of key business process from the end user through original supplier that provide products, services and information that add value for customer and other stakeholders (Felixand Chan, 2003). SCM is a proactive relationship and the integration across all the partners of supply chain. Although the importance of integration is realized but it is quite difficult to achieve more so in the public procurement environment. Most of the problems are related to uncertainty and inability to coordinate. One of the most common problems arising out of uncertainty and asymmetry of information is Bullwhip effect. Small fluctuation in demand or inventory level of a company are propagated and magnified throughout the supply chain consequently there is knee jerk reaction and there are cases of high inventory and high sock out situation (Forrester, 1961). This problem can be reduced by seamless sharing of information and its strategic utilization. Another problem in public procurement is tendency to work in functional silos and optimize their own performance, disregarding the benefits across the supply chain. Maximizing efficiency of each activity in a chain does not necessarily leads to global optimization.

6.2.1 Level of Maturity of Supply Chain

Level 1 Ad hoc, unstructured and ill-defined, SCM cost is high.

Level 2 SCM processes are defined but activities are traditional in functional silo.

Level 3 Linked this level represent break through. Cooperation between various process holders is achieved. SCM becomes efficient and effective.

Level 4 Integrated performance measures for global optimization.

Level 5 Organizations compete through their supply chain

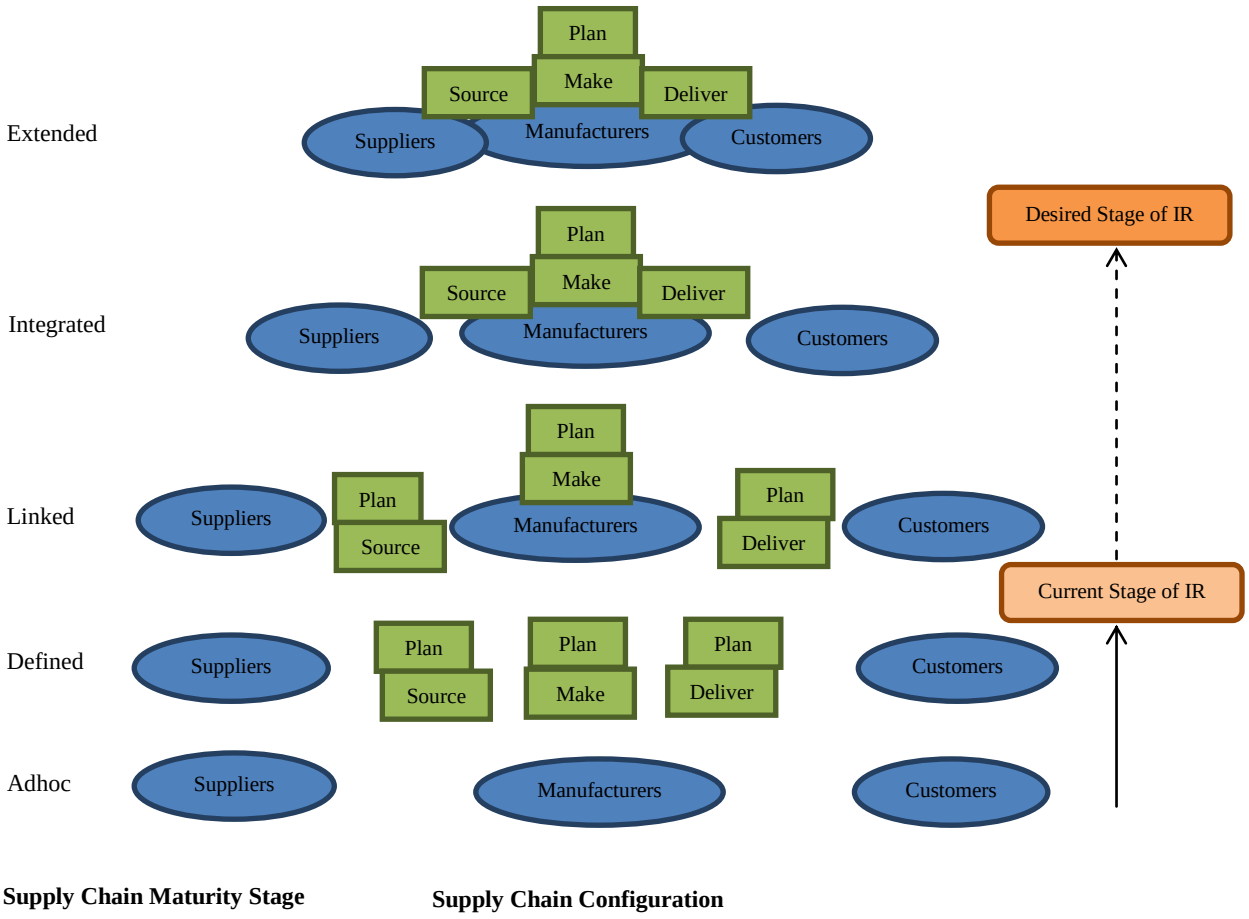


Figure 6.1 Supply Chain Maturity Model (Adapted from Lockamy and McCormack, 2004)

There are different levels or maturity of SCM such as ad-hoc, defined linked, integrated and extended. This is shown in Figure 6.1. Based on our data the researcher feels that in a public procurement environment, SCM maturity level of the Indian Railways is between level two and three and the desired level would be between four and five.

6.3 Supplier Rating System for the Indian Railways

Supplier selection on the Indian Railways is mostly based on criteria of price. No objectives or scientific system is available to evaluate the supplier on other Key Performance Indicators (KPIs) such as delivery, quality, service etc. Indian Railways being public procurement organization makes annual procurement of the all the items by issuing tenders. Bids are opened on a predefined date and time. Bids are evaluated by a committee and purchase contract is awarded to lowest acceptable and technically suitable bidder. The bid price is single most important criteria of making purchase decision. Theoretically all purchase contracts are short term and independent but the Indian Railways without formal contract is into the long-term business relationship with supplier. Number of supplier are limited over all the Indian Railways and these supplier secure the purchase orders from different Zonal Railways and Production Units by participating in annual tenders issued by these units independently. Therefore the Indian Railways suppliers are in the business of supply of item practically on long term basis but through repetitive short term contracts. The significant share of business of the supplier is contributed by Railways, but formally the supplies are arranged through annual contract. No reliable system of vendor evaluation exist which can be used for taking purchase decision in tenders.

Bureau of Indian Standards (BIS) has issued IS12040: 2001 "Guidelines for Development of Supplier Rating System". The main objective of this guideline is to assess the performance of supplier, supplier selection management policy and development of long term relationship with supplier. As per BIS standard and other literature suppliers may be rated based on any or all factors such as quality, price, delivery, service and system

Researcher carried out extensive survey of several business organization and literature review. Summary of selection methodology is summarized in Table 6.1.After extensive survey of various large organizations, literature review and repeat opinion during supply chain workshops at National Academy of Indian Railways (NAIR), Vadodara it is suggested that evaluation of the supplier to the Indian Railways could be on the criteria of quality, price, delivery and service. Criterion of system is taken care of by the source approving agency at the time of approval. it is suggested that in case of the Indian Railways the supplier ratings can be calculated in the following manner.

Table 6.1 Select Selection/Evaluation Methodology

Company	Performance Attributes	Weighted Scored (in %)	Remarks
BHEL, India	Quality, Delivery, Service	60,30,10	Score used for rating, categorized into 5 categories
ABB	Quality, Delivery, Cooperation	D – 40-60 Q – 20-40	3 categories of suppliers, evaluation both formal and informal
VOLVO	Quality Performance Measurement Level, Field Failure, Delivery Precision, Rejected Parts Per Million Level, Breakdown Failure, Unplanned Stop, Production Feedback, Warranty Claims and Safety Problem	Only target values	Scorecard used
ALCOA HOWMETT	Quality, Delivery, Service, Total Cost	Q- 55, D- 35, S- 10 Total cost not used for rating	3 categories
General Dynamics	Delivery, Quality , Financial Stability, and Compliance	D- 40, Q- 30, FS- 10, C- 20	Each category has sub-category of weights
Ordnance Factories Board (OFB), India	Quality, Delivery, Price, Service	Q- 60, D- 25, P-10, S- 5	Within each category the weights are further assigned
Rail Coach Factory (RCF), India	Delivery, Quality	D- 40, Q- 60	Warranty claim also related to Quality Rating
Coal India Limited (CIL), India	Quality, Delivery, Price	Q- 40, D- 20, P- 40	Suppliers classified into groups
SAIL, India	Quality, Delivery, Price	Q- 50, D- 35, P- 15	Vendor is scored for each order. Vendors divided into classes after getting average scores
Lockheed Martin Aeronautics Company	Pre-Install defects, Line rejections, Corrective Action Request (CAR) Quantity, CAR Responsiveness, Customer Escapes due to Supplier	Vendor Quality Rating	The elements are deducted from maximum score of 100
United Technologies Corporation	Quality, Delivery, Lean, Customer Satisfaction	N/A	Suppliers are categorized
SCHAEFFLER Technologies AG & CO. KG	Quality, Delivery	Q – 65, D - 35	Each criterion has sub criteria.
Bureau of Indian Standards, New Delhi	Quality, Delivery, Price, Service, System	Not defined	Only advisory

Adapted from Rajnish Kumar (2013) "Improving the Procurement Process of a Locomotive Manufacturer: A Quantitative Approach" unpublished PhD Thesis, Banaras Hindu University.

Table 6.2Suggested Vendor Rating Systems in Indian Railways

SN	Performance Attribute	Composition of Score	Weightage	Rationale
1	Quality rating	$\frac{Q_1 + 0.5Q_2}{Q}$	0.4	In accordance with best practice, and expert group opinion.
2	Delivery rating	$D_r = \frac{Q_t + \sum_d \left(1 - K\frac{T_d}{T}\right)}{Q}$	0.3	In accordance with best practice, and expert group opinion.
3	Price rating	$Pr = \frac{P_L}{P}$	0.2	In accordance with best practice, and expert group opinion. It will check tendency of cartel formation.
4	Service rating	Assessment by Administration on prescribed criteria.	0.1	In accordance with best practice, and expert group opinion. It will check tendency of cartel formation. It is subjective therefore low weightage.

Source: Developed by researcher

6.3.1 Quality Rating

It is the score of the supplier for consistently supplying the material of acceptable quality conforming to the specifications of the supply order. The score will be 100 percent for quantity accepted zero percent for quantity rejected and 50 percent for quantity accepted with concession or deviation. In case of 100 percent inspection of the material items in a lot, quality rating will be computed as

$Q_R = Q\frac{Q_1+0.5Q_2+0Q_3}{Q}x100$

Q = Total quantity ($Q_1 + Q_2 + Q_3$)

Q_1 = Quantity Accepted

Q_2 = Quantity Accepted with deviation

Q_3 = Quantity rejected including the rejection at pre inspection stage

Demerit factor

If rolling stock has to be taken out of service (en-route detachment) due to material failure within warranty than severe penalty is imposed and quality rating of the firm is reduce by 15 per cent for that order.

6.3.2 Price Rating

This score measures the consistency of a supplier for quoting completive rates in each and every tender. The vendor scores higher for quoting competitive rates and scores lower for quoting higher rates in a tender. The higher scores help the vendor in higher share of business. This score therefore, checks the tendency of the cartel formation and incentivize the vendor to always quote competitive rates. Mathematically it is ratio calculated in the following manner.

$$Pr = \frac{P_L}{P}$$

Where

P_L= Lowest acceptable price quoted for the product by part-I or Part-II source in the case.

P= Price quoted by supplier being rated.

6.3.3 Delivery Rating

This score measures the consistency of firm or vendor for on time supply. For quantity supplied on time a vendor gets 100% score and for quantity delayed by more than 50% of the original delivery period the vendor gets zero percent score.

$$D_r = \frac{Q_t + \sum_d \left(1 - K\frac{T_d}{T}\right)}{Q}$$

Where

Q = Quantity ordered

T= Promised delivery time

Q_1= Quantity supplied in time

Q_d= Quantity delayed

T_d= Time delay for quantity delayed

K = Constant with value as 2(Prescribed by Railway Board)

If quantity accepted is <50% within original delivery period then $D_r = 0$

In case of the vendor managed inventory system

D_r = 100 – K x (% number of days stock is less then defined level within validity of contract)

K = Constant with value as 2 (In case of at least two suppliers, 2 is chosen based on business logic of the Indian Railways)

6.3.4 Service Rating

Service rating is mostly subjective it has been recommended on the bases of following parameters. The rating will be provided by the administration.

Table 6.3 Components of Service Rating

SN	Criterion	Weightage
1	Cooperation and readiness to help in emergency	30%
2	Readiness to replace rejected material	20%
3	Providing support document on time	10%
4	Promptness in reply	10%
5	Soft issues such as ethical issue, sustainability, professional relationship, cultural fit, innovation and supplier management.	30%

Source: Developed by researcher

6.3.5 System Rating

The system rating is taken care of while granting approval to supplier by source approving agency. There is no need to further quantify.

6.3.6 Vendor Rating

For development of long term relationship with supplier author proposes following weightage to different attributes of vendor rating

Table 6.4Components of Vendor Rating

SN	Attribute	Weightage
1	Quality	40%
2	Delivery	30%
3	Price	20%
4	Service	10%

Source: Developed by researcher

Vendor rating of the firm for a supply order shall be:

$Vr = 0.4xQ_r + 0.3xD_r + 0.2xP_r + 0.1xS_r$

Vendor rating of unsuccessful bidder in a tender case will be

$$V_r = \frac{0.2P_r + 0.1S_r}{(0.2 + 0.1)}$$

Value of order will be equal to highest value of supply order placed in this case.

Average vendor rating of firm will be calculated for last three years of order as under-

$$V_r = \frac{\sum_n^1 V_{r1} x V1}{\sum_n^1 Vn}$$

Where V_{r1} is the vendor rating of firm for order 1, V1 is the value of the order one

Vendor rating are done for three years including current years and based on the score vendor can be classified into three categories. Show cause notice will be issued to C category vendor to improve the performance and business will be suspended if rating falls below 50.

Table 6.5: Aggregated Vendor Score and associated Classification

SN	Aggregated Vendor Score	Class of Vendor	Issues
1	Above 85	A	Green channel. Preferred supplier
2	75 to 84	B	Under observation
3	60 to 74	C	Show cause notice, time of six month to improve

Source: Developed by researcher

Snapshot of Material Management Information System (MMIS) of the Indian Railways is depicted in Figure 6.3 and computation of vendor rating interface of Material Management Information System (MMIS) is depicted in figure 6.4.

Figure 6.3: Snapeshot of Material Management Information System (MMIS) of Indian Railways

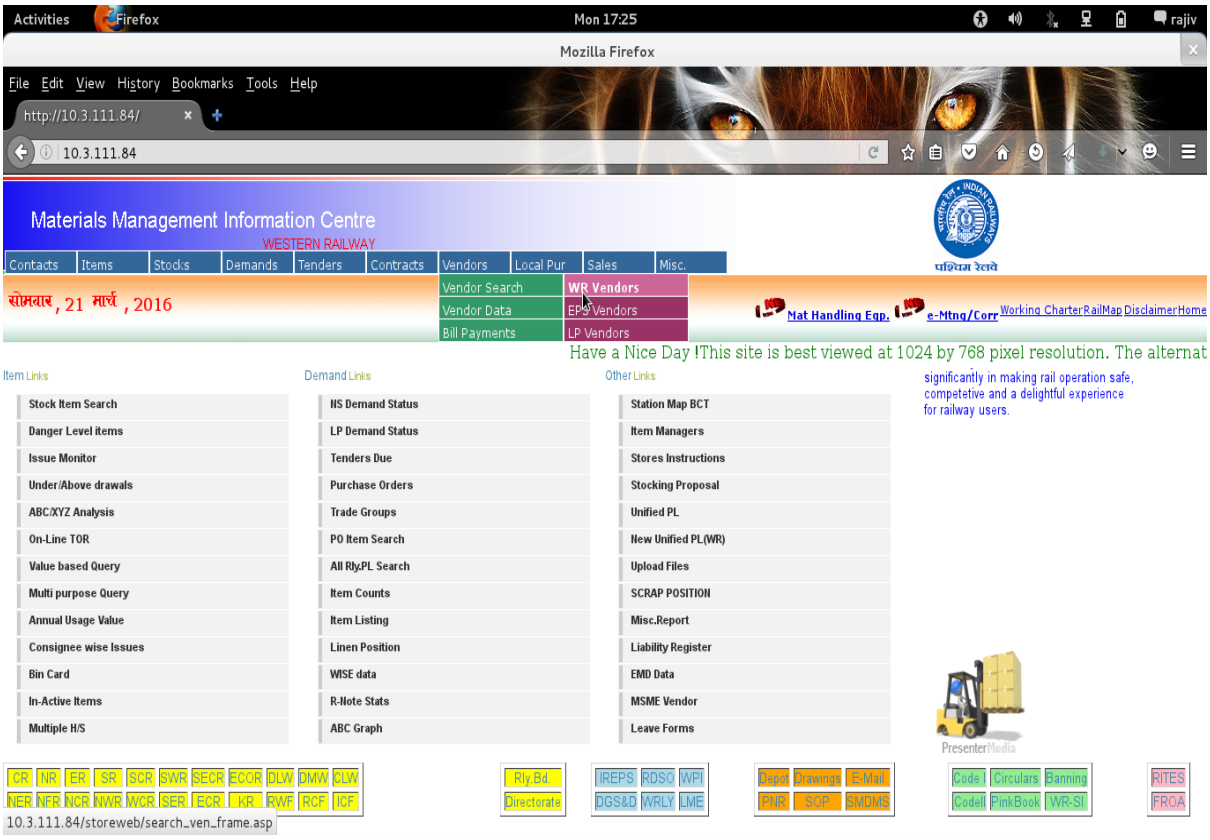
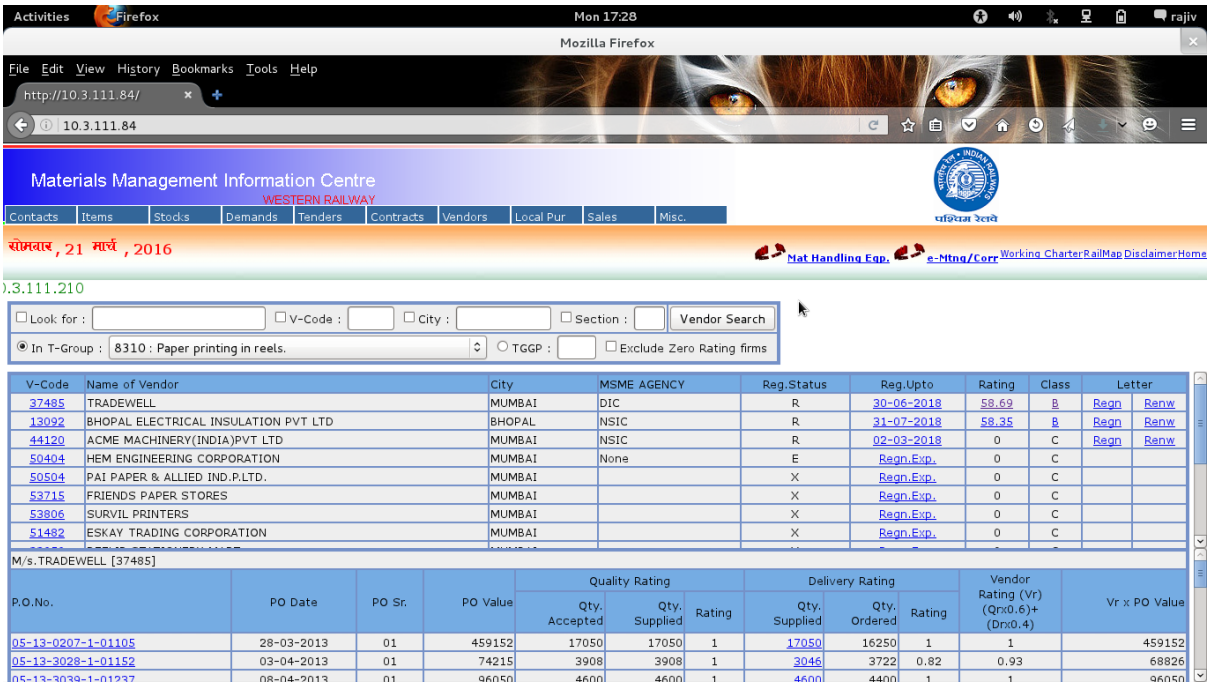


Figure 6.4: Snapeshot of Computing Vendor Rating (Scenario developed in Material Management Information System (MMIS) of Indian Railways)



6.4 Business Process Reengineering (BPR) of Procurement Processes

In the Indian Railways material management department computerization has been done in a big way. All the activities of material management from forecasting of requirement, generation of demand, calling of bids, award of contract, receipt and issue of material are mapped and carried out on Enterprise Relationship Planning (ERP) named „Material Management Information System (MMIS).

The public procurement in the Indian Railways is strictly governed by codes and manual written at the time when computerization was not very prevalent. When computerization is introduced it is generally seen that the existing process as are mapped and replicated on computer. The mere implementation of new technology without changing the business process will only realized some of the possible benefits. Strategic utilization of information and Business Process Reengineering (BPR) is necessary. The core concept of successful Supply Chain Management (SCM) is efficient information transfer sharing and complementary business processes for strategic utilization of this information (Tikmanet al., 2007).

Mapping of the business process model help us to understand the customer requirement and system capability to achieve it. It also helps us to identify areas of redundancy and inefficiency. Author suggests that the feature of customer friendly business process orientation is, any action by customer should produce desirable output. Whatever supportive process or activity required should be a part of backend process.

For continuous business improvement one should have fundamental understanding of customer requirement and process capability to achieve this. The root cause of gap between expectation and capabilities is to be realized for problem solving. The deficiency of Supply Chain (SC) can be improved by reducing number of stages, reducing lead time, working interactively rather than independently and efficient information flow (Tikman et al., 2007). Complementary information flow system; should provide opportunity and flexibility for experiment and should identify outsourcing opportunities.

In a Supply Chain approach of long-term perspective is preferred over one time negotiating the best deal. Lean working, simple tendering process, on time payment to contractor and sub-contractor is important for Supply Chain (SC) (Murray, 2009;2009a;2009b;2009c). There are several strategic advantage of long term relationship between buyer and supplier for example amortizations of fixed cost over long period of time in building up of partnership with common goal. This benefit is not realized in public procurement because of formal bid procedure and supplier is not sure of contract in future. In Railways it a seen that over long period of time the supplier are same and their significant business is contributed by Railways. So in a way the Railways is in long term business relationship with supplier but is not able to derive benefits of long term relationship (Gupta, 2015).

If all process are integrated lot of structural changes are required to strategically utilize the information available through (Material Management Information System (MMIS). The benefit of Vendor Managed Inventory (VMI), Material Requirement Planning (MRP), data mining, operation research etc. can be combined under SC. Author suggest the revised To-Be system may be adopted for strategic items as defined in Para 6.4.1 below to begin with.

6.4.1 Purchase Portfolios

On Indian Railway for all the items the purchases are made through annual contract irrespective of complexity of item. In 1983 Peter Kraljic wrote a paper in Harward Business

Review on portfolio analysis of items. The different strategy of procurement is required for different items. One size may not fit all. Kraljic classified the product on 2x2 matrix depending on supply complexity etc. and purchase importance. Supply complexity is measured by scarcity, monopoly/oligopoly, entry barrier technological complexity, and purchase importance is measured by strategic importance of purchase in terms of value added and total expenditure as per cent of Bill of Materials (BOM).

High **Purchase importance** Low	**High purchase importance and low complexity- leverage items:** Decentralize purchase, JIT, Stay in touch with market, annual purchase, target prices	**High purchase competence high complexity-strategic items:** Long term contracts, joint ventures, correct quantity forecast, backward integration, early involvement of supplier, diversify, vendor meeting, problem solving, contingency plan.
	Routine items: Product standardization, inventory optimization	**Low purchase importance low complexity bottle neck items:** Centralize purchase, buffer stock, keep low profile for price negotiations, volume insurance, search suppliers

Low **Supply Complexity** ***Hig***h

Figure 6.5 Purchasing Portfolio Analyses

In line with Kraljic the portfolio of Indian Railways purchase items are defined in the workshops of experts held at National Academy of Indian Railways, Baroda, Vadodara.

Strategic Item: A category annual consumption value above Rs 25 Lakhs and critical vital; and safety item having sources of supply three or less.

Leverage Items: A category annual consumption value above Rs 25 Lakhs, low-complexity neither vital nor safety items having sources of supply more than three.

Bottleneck Items: Items having consumption value less than Rs 25 Lakhs per year, vital and safety in nature having sources of supply three or less.

Routine Items: Items having consumption value less than Rs 25 Lakhs per year, low-complexity neither vital nor safety items having sources of supply more than three.

Based on above selection criteria the portfolio categorization of purchase items of various Zonal Railways and production units is carried out. Result of such selection are given in annexure 2

On the basis of these classifications all the items of Indian Railways are categorized and results are presented in table 6.6.

Table 6.6: List of Strategic, Leverage, Bottleneck and Routine Items across the Indian Railways

SN	Railways	Number of Items			
		Strategic	Leverage	Bottleneck	Routine
1	Central Railway	79	221	287	13000
2	Eastern Railway	87	206	96	9000
3	Northern Railway	76	273	97	11000
4	North Eastern Railway	20	61	750	2500
5	North Frontier Railway	32	135	680	4000
6	Southern Railway	39	208	409	6400
7	South Central Railway	574	320	140	10000
8	South Eastern Railway	52	196	251	6600
9	Western Railway	72	281	410	10000
10	East Coast Railway	19	136	630	3600
11	North Central Railway	24	114	750	7600
12	North Western Railway	98	65	517	3160
13	South East Central Railway	17	106	168	3600
14	South Western Railway	46	45	466	1850
15	West Central Railway	58	211	382	13000

Strategic Items: In the existing system, strategic items are purchased on annual contract basis and are generally closely monitored because non-availability of these items is a critical activity. In the proposed system, it is recommended to have accurate and periodic forecast on the basis real time consumption data. In case of any deviation from the forecast the corrective action is required to be taken on the continual basis. For these items, continuous vendor meeting, early involvement of vendors, participation of vendor for problems solving and vendor development exercise should be carried out in a efficient and effective manner. Overall approach needs to enhance alignment between purchaser and the suppler and both of them should be adaptive to each other and with the environment. The indicative list of strategic items is given in Table 6.7.

Table 6.7: Indicative List of Strategic Items

SN	P.L. No	Description	No. of Sources	AAC	AAC Value
1	10330744	Nozzle Assembly to Mico Part NO.94300 33300. Cat. 22310219-1 For 16 Cylinder	2	1691	2248000
2	11123187	Equiliser Beam Long (BG) RDSO DRG.NO. SKVL 178. REF.1. ALT-5	2	105	2102000
3	11250495	Brake Shoe For Ydm4 Loco (Normal Size), to DRG. NO.D/BG-1493 ,ALT.5 RDSO specification No.M&C/MTD/101/2007	2	4000	4611000
4	17451115	Draft Gear With Yoke Assembly For EMD Locomotive To EMD Part NO 8420236 to DLW Part No17451115.	1	4	653000

5	17452417	High Friction Composition Brake Block,HHP Locomotives (Drg. No.SK-DP-3630 Alt.2 Spec No. MP.0.0100.10 Rev.03,May 07)	2	8180	5815000
6	25109443	Equaliser Spring Seat For Co-Co Bogie As Per RDSO DRG No.SKDL-3867 ALT-2 REF.1,3,4,5,7 and Modified Safety Bracket Of Equaliser Spring Seat As Per RDSO Drg No.Skel-4609,Alt 0 Additional Test Procedure During Manufacturing And Inspection As Per Annexure 1,II,III OF SMI 0225/2001 Dated 15/01/2002	1	90	950000
7	30210318	Draw Bar And Castle Nut For Draw Gear Arrangement	2	750	1365000
8	30217180	Rubber Spring For Draw Gear As Per RDSO DRG NO.SK-K 3004 ALT. NIL Conforming To RDSO Specn.C-9501 (Rev-3 of Jan-2003)	2	1075	2511000
9	31020306	M-48 Maintenance Kit for Air Dryer M/s. Knorr-Bremse make as per list attached of 50 Items.(Suitable For EMU Coach) One set consists of 50 ITEMS	1	100	2530000
10.	38106097	Side Frame Key For CTRB (For Casnub Bogies with Narrow & Wide Jaw Adapters) Narrow & Wide Jaw Adapters) to RDSO DRG. No. SK-69594 ALT. 36 ITEMS 6.	2	32100	2889000
11	38124750	Slack Adjuster Complete type IRSA-750 for BCNHL/ BOXNHL Wagon as per RDSO Drg.no.WD-93061-S-01, Alt.no.1 &conforming to STR.NO.19-ABR-07,read With All AMDTS,Latest amendment no.2 of March-2008	2	160	21357000
12	38161758	Poh Kit For Keo Type Distributor Valve Conforming To Air Brake Maintenance Manual G-97 Read With All Amdts.Latest AMDT.NO.3 Of Jan-2010 Total 48 Items as per Anex-XIII/1.	2	1411	4339000
13	38163822	Distributor Valve Type C3w Or Keo Including Adopter With Isolating Cock,& Gasket But Without Common Pipe Bracket and Control Reservoir For Air Brake System Fitted on Freight Stock. Other Technical Requirements Confirming To Str No 02-Abr-02, Read with All Amendments Latest Amend. 3 of April-2010.	3	130	237661000
14	47200017	Dry Type Power Distribution Transformer 60KVA capacity,750/415 V,3-Phase for LHB type AC coaches as per RDSO Specification No: RDSO/PE/SPEC/AC/0080 (Rev.-O)-2007 with amendment 1 and 2.	2	21	5344500

AAC: Average Annual Consumption,

Leverage Items: These are the items where the railway can leverage the power of purchase to get the best deal from the supplier. Currently these items are also purchased on annual contract basis. It is recommended to procure these items through decentralize contract, inviting open tender. The system of vendor managed inventory and arranging logistic through 3rd party logistic service provider is recommended. The indicative list of leverage items is given in table 6.8.

Table 6.8: Indicative List of Leverage Items

SN	P.L. No	Description	No. of Sources	AAC	AAC Value
1	10082785	Modified Large After Cooler Assly. With Top & Bottom Cover, As per DLW Drg. No.SKE-0970 & DLW Part No.10082785.	5	19	2805000
2	10130974	Floating Bushing For Fuel Injection Pump Lifter To Dlw Part No 10 13 0974 DRG No.32C72250-2 ALT	7	1211	829000
3	10150018	Main Bearing Shell Inter For Alco Locos To DLW DRG NO. 14B 72083-3 DRP Ref 14308B CAT. No. 21410166 DLW/DMW PT. No.10150018	6	1510	3562000
4	10244384	Exhaust Side Vavle (INCONEL) 45 Degree MW/DLW.PT.NO.1024.4384.	6	1450	4576000
5	11021251	MG Locomotive Wheels Ydm-4 to Drg.No. W/WL-4955/R.	6	175	5149000
6	23829310	Finger Contact and Flexible Shunt Assly for Reverse and CTF , To CLW DRG NO.4 TWD-101-064 ALT 6 (Sheet"0") Capacity 1500 AMPS.	7	437	2115000
7	25040753	Outer Spring (Motor Truck)As Per RDSO DRG.NO. SK.DL-3739,ALT-5 and Comparing to RDSO Spcn. No.MP-0-4900.12,REV.02 oF Nov.2012	6	676	5020000
8	25109194	Repair kit for motor suspension unit (msu) of Hitachi TM type HS-15250 A,to Hitachi drg.No. 10P-701-897 WAR00. Set consists of 7 items as per enclosed list.	5	40	9202000
9	25890013	Electro Magnetic Contactor Complete Assly., Type 291-01, 80 Amps. Rating With Auxiliary Switches 2 No. + 1 NC, As Per CLW DRG.NO.1 TWD-291-033 ALT-9 , Arrangement 'A' And To Specn. No.4tts-291-001 Alt.8 Suitable to Built Electric Locos.	8	71	1834000
10	25963004	EP Contactor Complete, TYPE TCP-3421-25-2M AS PER CLW DRG.NO.4-TWD-112-043 ALT 4, Suitable For 1500 Amps Rating. Ep Contactor Should Be Manufactured As Per CLW DRG.NO.4 TWD-112-043 ALT 4 for General Arrangement But Uprated for 1500AMPS To CLW Spcn CLW-4TES-110-001.alt-1	9	55	1919000
11	30016204	Solid Forged Wheel for Bg Coaches to Drg. No. W/WL - 1660/R Alt 12 & Confirming to RDSO Specification IRS-R-19/93, Part-II (Rev-4) of July-2012 OR Cast Steel Wheel for BG Coaches to RWF Drg.No. WAP/SK-M-343, Alt.m	7	***2922***	85559000
12	30020098	ICF BG Coching Axles TO Drg No. WTAC-3-02-303 W/WL-1661/R, Conforming to RDSO Specn.No.IRS R-16-95 with corrigendum No.3 of April,2012 or RWF DRG.NO.WAP-091.	9	***508***	26356000
13	30050716	Bolster helical spring for AC Coach to ICF DRG.No WTAC-0-5-202 ALT.r/7 &Conforming RDSO Specn No.WD-01-HLS-1994,	6	301	3474000
14	30247020	Foot Step Arrangement Complete As Per ICF DRG. NO.ICF/STD-2-4-001,Alt-n/Nil, Col-I & II.	17	1877	3070000
15	30550907	FRP Glass Shutter Assembly For Lavatory Window to RDSO DRG.no.-SK-K-0046,ALT-1.Colour-Off White, Material Confirming To RDSO SPECN.No.RDSO/2007/ CG-02 (REV.1) oF FEB.-2008.	15	6382	6363000

Bottleneck Items: These items are purchased through annual contract basis. These items are difficult because sources of supply are limited and value of purchase is small. Here the suppliers are more in commanding position. It is recommended to go for centralized purchase and pool requirements in order to create desired volume; moreover, maintaining safety stock would help. For vendor development, continuous search of supplier and approach of value engineering will help. The indicative list of bottleneck items is given in Table 6.9

Table 6.9: Indicative List of Bottleneck Items

SN	P.L. No	Description	No. of Sources	AAC	AAC Value
1	10140920	Lifter For Fuel Pump Cross Head DLW DRG.NO.32 B 72247 - 1 DMW/DLW Part No.10.14.0920 ALT-C	2	220	1119000
2	10160115	Spring Air and Exhaust Valve to DLW DRG Spring Air and Exhaust Valve to DLW DRG No 46D72023 ALT 'K'.DMW/DLW PART NO. 10160115 MATL Spec IS: 4454 (Part Grade 2D or Super clean Version of DIN 172250 T-70SC) RDSO MP.IB.EN.04.23.08 from DLW sources only.	2	1225	238000
3	10210477	Lock Spring Seat for Air And Exhaust Valves to DRG. NO.23D71170-1 DMW/DLW.PT.NO. 10.21.0477. ALT. l.	2	2650	1568000
4.	10210775	Shaft For Air And Exhaust Valve Lever tO DRG.NO. 24 C 72078 ALT d DMW/DLW PART NO. 10.21.0775.	1	368	676000
5	10211123	Thrust Ball Lever Seat. As Per Drawing no.24 D 72031 ALT.e TO. DLW/DMW .PART NO. 10.21.1123	2	1183	765000
6	23869379	Master controller for Electric loco as per CLW Drg.No 1 TWD-241-115 Alt 11	2	38	14364000
7	23890060	C-118 Contactor Complete. CLW Specification no. CLW/ES/SK-3/C-15/C.	2	8	521000
8	25518562	Stainless Steel Corrugated Flexible Hose Assly. for Main Compress0r, to DRG.NO.WR-CCG-EL/4-CX-011 ALT-1, REF.1 TO 5.	1	515	451000
9	25519130	3 Pieces Design Connecting Rod And Crank Shaft Assembly. Complete With Bearing For ELGI Make Main Compressor To ELGI PT.NO.A-070069(New).	1	28	9908000
10	25718150	AOH Replacement Kit For Single Bottle VCB of M/s. Schneider Electric Infrastructure Ltd. Type 22CB As Per Annexure A.	1	42	495000
11	30050042	POH KIT NO.S-955001,B1 FOR Gabriel Shock Absorber Consisting of 19 ITEMS AS PER LIST ATTACHED.	1	416	707000
12	30236071	Bent Coupling Link with Trunion NUT to RDSO Drg. no.SK-99001 Alt-4(or latest), Item no.2, Fitted with Item no.6(In assembled condition)	2	290	729000
13	30358814	Spare Parts Kit Set For C3w Distributor Valve Required for Coaching Stock Consisting Of 42 Items As Per List Attached.	2	210	504000
14	31027064	Axle Box Housing Finish Machined As PER ICF DRG.	2	54	601000
15	31500006	Desiccant kit (4 Kg/ Vessel) to Knorr-Bremse part no. 503329.	1	175	628000

Routine Item: Around 70 per cent items are routine items in nature. Currently these items are purchased on annual contract basis. These Items require product standardization, variety reduction and inventory management. Indicative list is given in Table 6.10.

Table 6.10: Indicative List of Routine Items

SN	P.L. No	Description	No. of Sources	AAC	AAC Value
1	10050243	Fuel Injection Tube Assembly to RDSO DRG NO. SKDP-3925 ALT-a DLW PART.10 05 1703.	9	561	1486650
2	10050760	Fulcrum Pin For Fuel Pump Cross Head Lifter for Fuel Efficient LOCOS	5	630	850500
3	10051727	Large Fuel Primary Filter Element (Low Mean Pore Size) As Per DRG.NO.SKDP 3901.	5	298	805303.28
4	10121158	Main Casing For 350c Turbo Super Charger As Per Drg. No. 26AA71750 ALT. h	5	5	539632.45
5	10124639	Valve Guide (Air & Exhaust) For 251+ Cycle Head (Standard Size) to DLW PT NO.10124639 , TO DLW DRG NO.23C 71081-1. Alt.C.	6	4600	1044936
6	23251979	Guide Profile And Key For Safety Glass On Side Wall to DRG.NO.WR/CCG/EL/4-GK-033 ALT-4 REF 1 & 3 & CLW Ref no. 01/3/44/52" & specification no.IRS-R-57-75 CL-10 as advised in case no. 22.15.1123	13	1142	568567.54
7	23569384	Connecting Terminal Complete For Tap Changer To Bombardier PT NO S-1225 DRG NO AG-546099 R1 OR AAL PT NO G-1225 DRG NO 9980383472801	5	90	296612.1
8	23569918	Control Lever Complete For Tap Changer M/S BT PT NO A 4540,DRG No HAGT-225320-R1.	4	10	1109335.5
9	23799160	ICAR Capacitor 0.47 Micro Farad +/-10% Rated Ac Voltage 600V-URMS,Periodic Peak Voltage UMAX - 1050 V, Rated Insulation Voltage U -600 V, Model CCR 25E1, CAPACITOR Cylindrical Shaped With 8 MM DIA X 10MM Long, Fixed Stud At The Bottom, Diagram of Capacitor -34 MM +/- 1 MM Length 55 +/- 2 MM, Excluding STUD at The Terminal of GE USA Model; A2,BE 5668.or Sunny Brand Capacitor Manufactured By M/S Yash Capacitor Pvt Ltd, Nasik Type YRC-4,0.47MFD 660V for Earthing Circuit "	6	818	892405.28
10	25971487	Capacitor Suitable For Rc Damping Network Type ICAR/ITALY MSR 25-D-22-50 (22 MFD 550 V) or Advance Mysore ASPR 15 (25 MFD 660 V) OR YE-001 (25 MFD 660 V) Manufactured By To IS 13648-1993 (Damping Purpose MSR Type)	9	880	1963500
11	33500022	Ball Joint Roll Link to Drg.no.C53.973 REB BRED 8416 Rev.3R (FF no.1560095.4)to be read with T.S. 17.531.100 03,T.S.17.617.100 02 & MDTS 148 Rev.01.	11	900	4329000
12	33500046	Lateral Bump Stop to Fiat rg.no.C53.973.REB BRED 8374 Rev.02 (Firm's no.PIRELLI/ 98.2.00010B) to be read with T.S.17.531.100.03, T.S.17.617 100.02 and MDTS 148 Rev.01. & MDTS-122 Rev.03.	9	456	1258035.6
13	33501002	Primary Vertical Damper to RCF DRG.NO. LW-05102, Alt-A Confirming to. Specification No. T.S. 17 560 100 03.	9	970	4753000
14	35016449	Coller For Axle Box Roller Bearing Arrangement to	8	696	501774.24

		ICF DRG.NO. EMU/M-0-2-005 ALTN/NIL.			
15	36440012	Roof Ventilator Assembly (TRA TYPE) with Fixing Arrangement As Per ICF DRG No.	7	430	467302.5

6.5 Case I: Re-Engineering Material Management Processes in the Indian Railway

Case study of Indian Railways is considered to underline the theoretical findings and also to show how the performance of supply chain can be improved by business process reengineering. It will show the benefit of process of supply chain by using the reengineered combination of business process, modelling and simulation.

Indian Railways Material Management department caters to need of uninterrupted flow of material and spares and maintenance and production of rolling stock and maintenance of assets such as station buildings, tracks, hospital suppliers etc. Zonal Railways and production unit run 260 depots over the Indian Railways network for uninterrupted supply of material and stores. Over 1.8 lakhs material components of various descriptions are stoked in these warehouse annual value of procurement on Indian Railway is more than Rs. 40000 crores (Indian Railways year book 2014-15).Controller of Stores is the head of Material Management function on a Railways. This office is responsible for all the aspects of Material Management function such as assessment of the need forecast the requirement invitation of tender award of contract receiving the material and logistics in Zonal Railways (ZR) or Production Units (PU), Controller of stores in Zonal Railways or Production Units deal with roughly 15 to 20 thousands of unique item. These items are distributed to various purchase sections. The purchase sections are classified on the basis of end use of the item for example spares of diesel locos, electric locos, carriage and wagon, general items etc. Annual procurement system is followed for all the stock items.

The demand is generated as per annual calendar. Anticipated Annual Consumption (AAC) is estimated on the basis of history of consumption and future projection. Lead time for procurement i.e. Interim Period (IP) is generally 10 months and procurement is made for 1 year requirement called Contract Period (CP).

The executive department carryout the activity planning and target fixing as a part of budgeting exercise. In this the funds are allocated for consumption of material. This information from various departments is utilized for projecting the purchase funds called

purchase grant. This exercise is done as a part of budgeting process. The budget is approved by the parliament.

Total purchasing by a Zonal Railways or a Production unit is limited by the availability of purchase grant. Under efficient working conditions as a best practice the total purchase grant should match with Anticipated Annual Consumption (AAC) value of all the items need to be procured in a year. On account of Bullwhip effect and dynamic conditions it is generally seen that there is a wide variation between purchase grant and Anticipated Annual Consumption (AAC) value. This variation creates distortion such as over procurement of some items and under procurement of others. On some Railways like Central Railways the effort is made to match the purchase grant with Anticipated Annual Consumption (AAC) value.

As a part of procurement process the demand for each item is generated by Material Management Information System (MMIS) as per pre-defined annual calendar. The consolidation of demand is done and quantity required up to Contract Period (CP) is worked out on the basis of stock on hand and dues in pipeline. Tender notification is issued. Open tender is the normal mode of tendering. Bulk of the procurement is made from sources which are approved by centralized agencies such as Research Design Standard Organization (RDSO), Diesel Locomotive Works (DLW), or Chittaranjan Locomotive Works (CLW) etc.

The study of lead time of procurement on Western Railways is done as shown in Table 6.11. It is noted that lead time of procurement in year 2009-10 was 342 days which has come down to 285 days in year 2014-15. Lead time reduction is main benefit of Material Management Information System (MMIS) and e-procurement system implemented on Indian Railways.

Table 6.11 Lead Time of Procurement

Year	Total No of Purchase Orders	Demand generate to TOD (days)	TOD to PO (days)	Days (PO to Material Received)	Total Lead Time (days)
2009-10	4306	127	38	177	342
2010-11	3762	106	39	179	324
2011-12	2846	115	48	162	325
2012-13	3445	111	40	170	321
2013-14	3328	113	45	156	314
2014-15	3893	109	42	134	285

PO- Purchase Order, TOD: Tender Opening date

Source: Data Compiled by researcher

Flow chart of purchase done by Controller of Stores (COS) is shown in Figure 6.6. Date of generating of demand is day zero (D-0). Bids are tabulated after opening. For high value tenders above Rs. 15 lakh, these bids are evaluated by a tender committee comprising of the officer from Material Management, Executive and Finance Department. Contract is awarded mostly to lowest technically suitable bidder. The contract is issued after the scrutiny and approval of finance department. This contract contains the specification of item, quantity required, inspecting agency and delivery period. Based on the process described above an AS-IS model is developed. The process maps are used for visualization of complexity. This developed model is validated by employee of all the departments concerned.

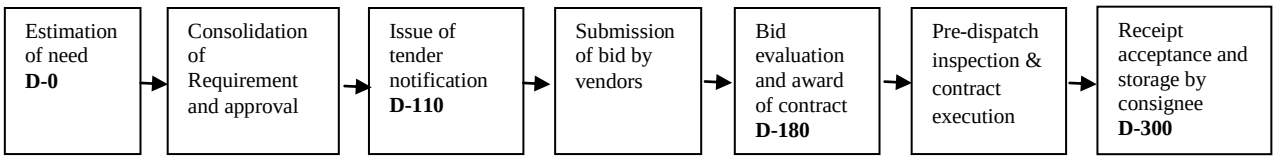


Figure 6.6 Typical Lead Time Associated with Procurement
Source: conceptualized by researcher

6.5.1 As Is system

The existing procurement processes of the Indian Railways are depicted in figure 6.7.

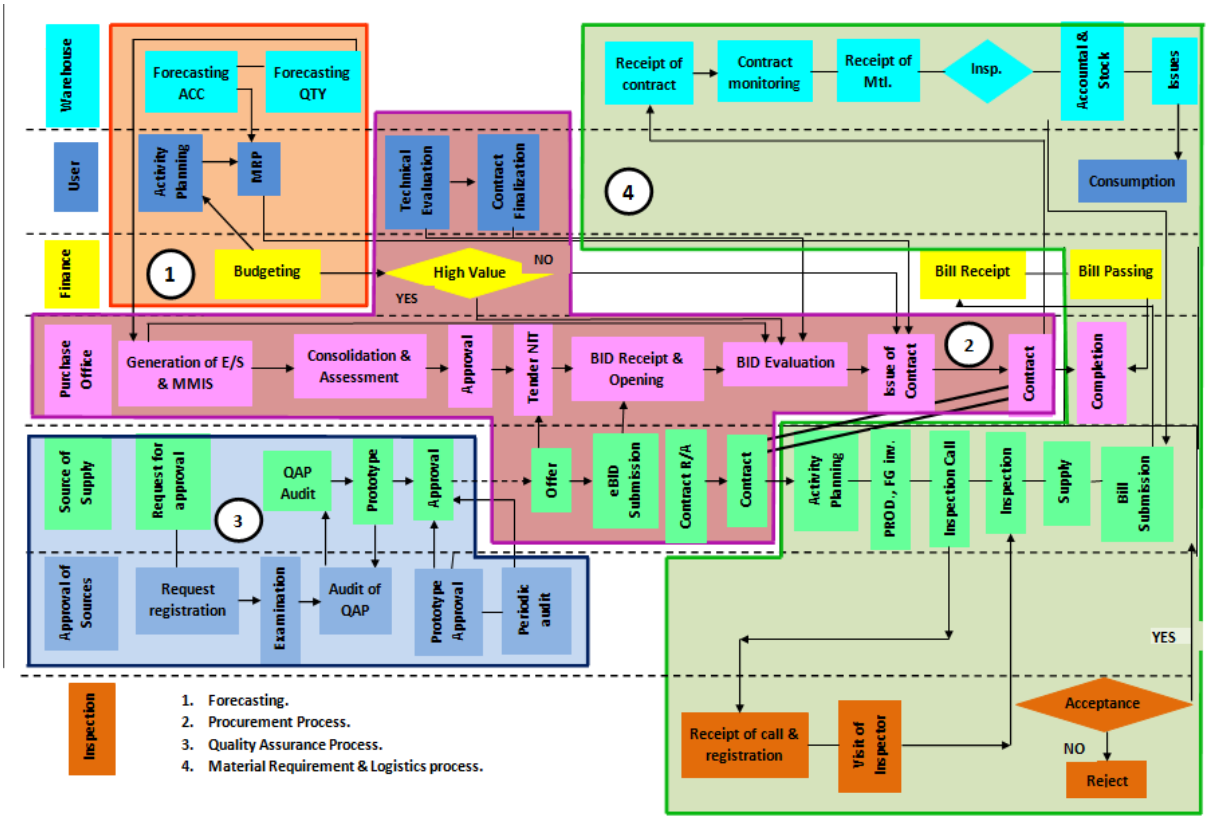


Figure 6.7 Processes Mapping of Procurement of the Indian Railway
Source: developed by researcher

The analysis helps us to understand the current problem and make them more visible to all decision makers. The problems identified are:

- High lead time- the total lead time from demand generation to receipt of material is 300 days. This high lead time also results into higher response time and customer anxiety.
- Gap between the purchase grant and Anticipated Annual Consumption (AAC) value- This leads to over procurement for some items and under procurement and stock out situation for others.
- Source approving agency approves the source as part I supplier or Part II supplier. Part I supplier are eligible for bulk quantity order from 75 to 85% whereas part II suppliers are eligible for trial quantity of 15 to 25%. Part II supplier can be upgraded to Part I supplier after establishing their performance.
- The contract is awarded on the basis of lowest technically accepted bid. The relationship and previous record of performance does not play very significant role. Supplier is governed by the conditions of contract. There is little incentive for reacting to the emergency situation. The same supplier may get order from different Zonal Railways and Production Units. The supply is governed by the condition of contract rather than the need of the buyer. So there can be cases of oversupply on one railway and shortage on other.
- The contractor is governed by condition of contract. There is little incentive to go beyond the scope of contract even though there could be mutual benefit.
- There is high inventory and high stock out situation- lot of staff and other resources are put to use for chasing and monitoring supply.
- The credential of firm, past performance is only used as screening criteria for approval of source. The cases of banning of firm on the basis of past performance mostly become court cases.
- Procurement on annual basis does not allow building up of long term partnership.
- There is little incentive on the part of the supplier to improve the design. The system is not conducive for innovation and value engineering. The cost of purchase and cost on purchase is high, supplier performance is not rewarded and there are cases of cartel formation.

- While implementing Material Management Information System (MMIS), age old procedure prescribed in the code and manual is replicated. The process renovation has not been done. The lots of information is available but is not being utilized strategically.
- The projection of future demand Anticipated Annual Consumption (AAC) is affected by Bullwhip effect. There is a wide gap between purchase grant and total Anticipated Annual Consumption (AAC) value.
- Each member in the chain is trying for local optimization instead of global optimization. Consequently stock levels, stock out situation, transportation cost is higher.

6.5.2 To BE SYSTEM of Procurement Process of Indian Railways

Based on above problem several improvements were proposed. The process at all the Departments of Railways and supplier are integrated. To be system is depicted in figure 6.8.

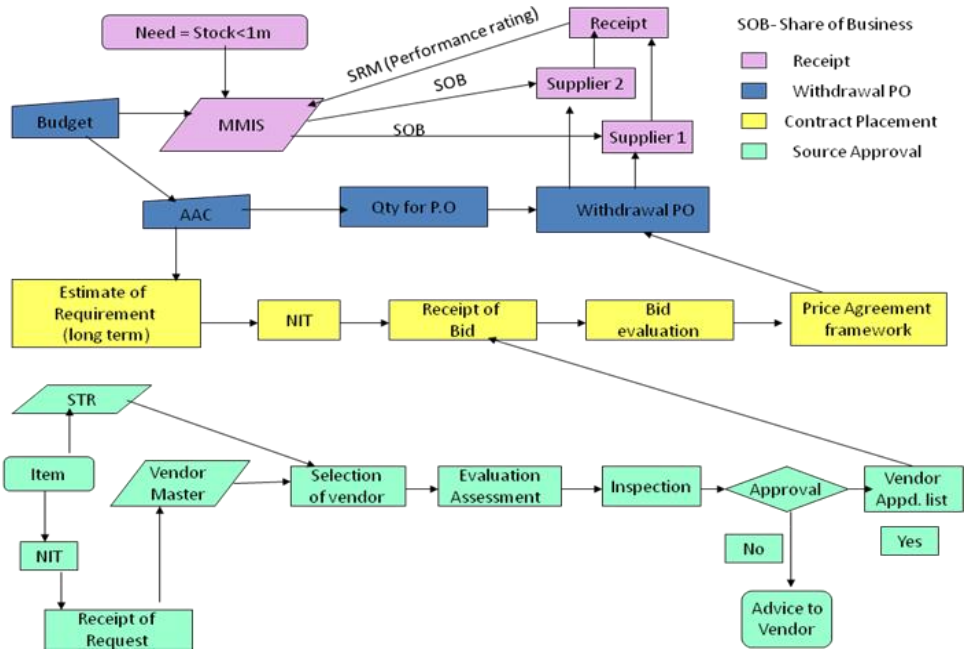


Figure 6.8 Business Process Renovation-Renovated Business Model
Source: Developed by researcher

- Vendor approval process will be done separately by Research Design and Standards Organisation (RDSO) as being now. This aspect of vendor approval is not studied in this thesis as such no change is suggested except the process is to be made more transparent.
- Purchase contract and price agreement contract will be finalized on the pattern of running contract. These contracts will remain valid for entire contract period. For each item there will be two/three running contract. Contract agreement will be entered into for these items

in advance. For entering into long term contract the Request for Quotation (RFQ) shall be modified suitably as per Annexure 4. It shall contain the breakup of material cost, conversion cost, over heads and profit elements. The target of long term agreement can be annual price reduction in Bill of Materials (BOM) of 3 to 4%.

The Share of Business (SOB) between two or more supplier shall be distributed according to following formula

$$SOB_1 = \frac{SOB\ Tender\ x\ V_{r1}}{\sum SOB\ Tender\ x\ V_{r1}}\ \%$$

Where Share of Business (SOB) tender is distribution of quantity among supplier as per merit of the firms in tender. Vr1= average vendor rating of the firm for last three year (Max). For new firms last Vr of available records.

Supplier can access the Material Management Information System (MMIS) through internet. As per the redefined purchase order supplier is required to maintain the stock at predefined level. The share of business between two suppliers is adjusted dynamically on real time basis as per the formula given above.

Status of the firm whether part I or part II shall be reckoned on real time basis. This means if a part II becomes part I during the course of supply the firm shall be eligible for bulk order. It is seen that the cartel formation tendency is there in part I sources. Dominant strategy of part II sources is quoting competitive rates. This system along with long term contract and evaluation of supplier on price rating will solve the problem of cartel formation. The delivery condition in the contract is redefined. Instead of giving the terminal date of delivery period, supplier is required to maintain stock within minimum and max limit say 15 days to 3 months inventory at all its consignee depot throughout contract period, limited by total quantity on order. Inventory limit can be set on case to case basis to optimize transportation cost. This will also help the supplier to optimally distribute the quantity to different consignee on the basis of stock availability and urgency. Contract will be valid up to end of contract-period so quantity option clause can be more effectively utilized.

In the revised system the vendor is responsible for maintaining the inventory. The information of stock available and consumption pattern is available to vendor on real time basis. Supplier has to take the decision of supply on the basis of this information. With the

passage of time more confidence will be built up on the system and there will be minimum Bullwhip effect. The future demand projected using the model will be more accurate. This will reduce the imbalance between Anticipated Annual Consumption (AAC) value and purchase grant. This minimizes Bullwhip effect. In future delivery from supplier can be arranged on the basis of Third Party Logistics (3PL) to optimise on transport cost and smooth supply chain.

The contracts will be placed on two suppliers. The Share of Business (SOB) between the suppliers will get automatically adjusted in a transparent manner on a real time basis to reward the good performance. Vendor performance will be measured on criteria of, Delivery, Quality, Price and service. This will incentivize supplier for always maintaining consistent good performance. Railways can reserve the rights to allot unsupplied quantity of one suppler to other in the case of default.

6.5.3 Potential implementation problem

1. A new way of thinking and human related issues
2. Different organizations and culture shall have to unite and transform to support Supply Chain .
3. Loss of control in the environment of long term contracts and automatic adjustment of SOB the employee may have feeling of loss of authority.
4. Sharing of information require high level of trust.

6.6 Supplier Service Quality

It is felt that prime source of dissatisfaction for a customer is gap between service quality expectation and perception. To enhance the satisfaction level the gap between expectation and perception need to be understood and minimized. This gap can be reduced by increased information flow and bringing in transparency across all levels of supply chain. With this objective, the parameters of service quality were identified using literature and expert views. The questionnaire to measure service quality was designed (Prakash 2011). First the purpose of the survey was explained to the groups of Senior Scale and Junior Administrative Grade Officers of Indian Railways. The respondents were participants of Management Development Programme (MDP) and Advance Management Programme (AMP) courses held at National Academy of Indian Railways, Baroda, Vadodara. The responses were measured

on 5 point Likert scale. The survey questionnaire was given to 354 participants, 184 of them submitted the response. The data was then analyzed.

6.6.1 Measurement of Service Quality Offered by Supplier

The items of the scale along with their underlying factors which are used to measure service quality are taken from Prakash (2011). However, we have performed assessment of the scale in the context of this study. The assessment of the scale measuring service quality is conducted through sequence of steps. For this purpose, we have performed reliability analysis, Principle Component Analysis (PCA) and Confirmatory Factor Analysis (CFA)

Reliability Analysis

Reliability represents the consistency among the scales in their measurement of a construct (Hair et al., 2005). We analysed the reliability of the perception of supplier using Cronbach alpha coefficients. Cronbach alpha coefficient is defined as the proportion of the total variance of a scale that is attributable to a common source. In this analysis reliability is assessed by internal consistency method which reflects equivalence, homogeneity and inter-correlation of the items used in a measure. The reliability results are depicted in table 6.12.

Table 6.12: Results of the Test for Reliability Analysis

Service Quality Component	Cronbach's Alpha	Interpretation
Perception about suppler	0.869	Acceptable measure

Factor Analysis

Exploratory factor analysis of the data is carried out through a sequence of steps. First, the appropriateness of factor analysis is assessed. This is performed by analysing correlation matrix of the data. Bartlett test of sphericity reflects the statistical probability that the correlation matrix has significant correlations among at least some variables (Hair, 2005). The score of Bartlett test of sphericity is provided by SPSS v21 and is depicted in table 6.13. The results are significant, thus, providing clear indication of suitability of factor analysis. Assessment of sampling adequacy is judged by Kaiser-Meyer-Olkin (KMO) statistics which ranges from 0 to1. The KMO value of above .6 is considered significant and gives clear indication for the suitability of factor analysis. In the present case the KMO value of 0.785 is considered meritorious and hence acceptable for factor analysis (Hair, 2005).

Table 6.13: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.785
Bartlett's Test of Sphericity	Approx. Chi-Square	1126.642
	Df	271
	Sig.	.000

Exploratory factor analysis is conducted using the Principle Component Analysis (PCA) with Kaiser Normalisation (Eigen values greater than 1) and varimax rotation procedure to examine whether the items produce the proposed factors and whether the individual items load on appropriate factors as intended. These factor loadings are reasonably consistent with the suggested factor structure of the scale. Output of exploratory factor analysis is provided by SPSS v21 and is depicted in Table 6.14

Table 6.14: Communalities, Factor Structure and Loadings for Items of Service Quality

Factors and Associated Items of the External Service Quality Scale	Commu-nalities	Factor Structure and Factor-Item Loadings						
		F1	F2	F3	F4	F5	F6	F7
Agility (F1)								
Shares transaction related information	.763	.682						
Collaborative relationships	.692	.661						
Contingency plans	.813	.693						
IT infrastructure	.821	.715						
Relationship (F2)								
Joint improvement activities	.814		.528					
Upgrade technical capabilities	.867		.564					
Understand your organization's works	.834		.537					
Adaptability (F3)								
Monitors external environment	.757			.567				
Flexible product design	.723			.582				
Alignment (F4)								
Exchanges information and knowledge	.843				.595			
Defines clear roles and responsibilities	.736				.618			
Shares risk, costs and profits	.757				.624			
Service Reliability (F5)								
Products have reliable design	.751					.642		
Value confidentiality in operations	.778					.721		
Best quality at right time	.851					.688		
Knowledge, expertise and skills	.749					.672		
Service Competence (F6)								
Understands requirements	.781						.651	
Maintains consistency in quality	.791						.681	
Competent employees	.761						.721	
Possesses right tools and equipment	.843						.685	
Credibility (F7)								
Maintains honesty in its dealings	.863							.589
Market reputation	.761							.612
Innovative and strives for improvement	.813							.563
Your supplier has financial strength	.753							.635

The commonalities express the proportion of the variance of the 24 items extracted by seven factors of the scale. All the items have significant communalities (not less than 0.50) (Hair,2005). The factor-item loadings represent the correlations between each item with their underlying factors. All the items have significant factor loading (not less than 0.52). Internal reliability of items of various factors of the scale is examined using the Cronbach alpha coefficients. In this analysis internal reliability of items is assessed through split half method and internal consistency method. In split halves method, the items of a measure are subdivided into two subsets and the answers obtained are statistically correlated. The internal consistency method assesses the equivalence, homogeneity and inter-correlation of the items used in a measure. Output of this analysis is provided by SPSS v21 and is depicted in table 6.15. The results indicate that the scale to supplier service quality is a reliable instrument returning an overall Cronbach alpha of ~ 0.7 (Hair, 2005).

Table 6.15: Results of the Test for Reliability Analysis

Factors underlying the External Service Quality Scale	**Cronbach's Alpha**	
	Split Half Method (Part 1, Part 2)	**Internal Consistency Method**
Agility (Four items)	.861 and .779	.907
Relationship (Three items)	.881 and .865	.908
Adaptability (Two items)	.828 and 1.000	.904
Alignment (Three items)	.820 and .822	.790
Reliability (Four items)	.786 and 8.32	.790
Competence (Four items)	.914 and .861	.946
Credibility (Four items)	.855 and .872	.888

These factors of the scale may be used as a diagnostic tool or metric to measure what level of service quality is offered by the suppliers and what level is expected by the purchaser i.e. Indian Railways. The comparison of supplier service quality perception vs. expectation scores of various factors and overall supplier service quality are depicted in Table 6.16.

Table 6.16: Comparison of Service Quality Offered by Supplier Perception vs. Expectation Scores (Measured on 5-point Likert Scale)

Factors of Service Quality Offered by Supplier	Rating of Supplier Service Quality																			
	0-1				1-2				2-3				3-4				4-5			
	Poor				Moderate				Average				Good				Excellent			
Agility																				
Relationship																				
Adaptability																				
Alignment																				
Reliability																				
Competence																				
Credibility																				
Overall service quality																				
Legend Perception				Expectation																

6.7 Interpretation of Gaps in Service Quality

Measurement of Service Quality Offered by Supplier - Question wise analysis.

Agility

Agility describes the supplier's ability to respond to sudden changes in demand and external disruptions in a cost-efficient manner (Lee, 2004), and involves timely and prompt service towards the manufacturer (Mersha and Adlakha, 1992). It also involves responsiveness which reflects willingness to help its manufacturer and provide prompt service to them (Parasuraman et al., 1985, 1988). In the Indian Railways the suppliers are governed by the condition of the contract which does not provide much incentive to the supplier to respond out of the way for sudden change in the requirements. However, on personal relation basis some suppler can be said as more agile as compared to others but there is formal incentive attached to it.

Relationship

Relationship is described in terms of attitude and communication which reflects the ability to share and fulfil information needs (Ghobadian et al., 1994); Haywood and Farmer, 1988; Parasuraman et al., 1985). It also involves accessibility which reflects the ability to share relevant information (Grönroos 1982, 1984,1990). In the Indian Railways the relationship between the buyer and supplier is on the arm's length basis strictly governed by condition of contract. The contract conditions are predefined keeping in mind the future scenario and it is

quite difficult to change the conditions in future even if there is a genuine need to do so. The public procurement is evaluated from transaction to transaction basis there are formal and informal guidelines with respect to relationship with the suppler which ultimately results in arm's length the relationship.

Adaptability

Adaptability reflects supplier's ability to evolve with dynamic environment and needs of purchaser (Lee, 2004). In the Indian Railways there is a poor incentive on the part of the supplier to carry out any change in the specifications even if the situation warrants and it is in the interest of the Indian Railways. For example the Indian Railways used to buy the wagon component made out of copper bearing during years up to year 2002. The copper bearings have corrosion resistant property. Later on technology improved and better corrosion resistant properties were available in steel without copper bearing. However, Indian Railways did not revise the specifications. This has forced the supplier to use the obsolete specifications which was inferior and costly. Some of the supplier who has quoted for the improved specifications were disqualified as not matching as per the tender specification. As such there is a disincentive on the part of the supplier to remain adaptive to changes in environment such as the technological up gradation.

Alignment

Alignment involves developing business interests with their manufacturer (Lee, 2004; Kumar, 1996). Alignment also reflects supplier's ability to respond to sudden changes in supply, demand and external disruptions in a cost-efficient manner and sharing information with their manufacturers. This also involves involving the supplier in joint product development. In the Indian Railways there is no formal system for joint product development for mutual benefit. Many times supplier with vested interest introduces a product which has got certain advantages. The Indian Railways is required to make the procurement through open tender giving equal opportunity to all. Therefore there is poor incentive on the part of the supplier to do product innovation. The contract is governed by the conditions of the

contract so the alignment if any is restricted within the boundaries of the terms and conditions of contract.

Reliability

Reliability refers to supplier's ability to perform the promised service dependably and accurately (Berry, 2009; Parasuraman et al., 1988). It also involves trustworthiness which refers to the ability to show trust and confidence (Grönroos 1982, 1984,1990). In Indian Railways the suppliers are required to abide by the terms and conditions of the contact. There are penalty clauses if conditions are not met. So to the extent of adhering to the terms and conditions there is a formal system for ensuring the reliability. Practically in around fifteen percent of the cases supplier fails to supply the material within the stipulated delivery period. In around two percent of the cases the material supplied by the supplier is rejected for not confirming to specifications and the terms and conditions of contract.

Competence

Competence reflects professional capability and ability to provide honest, dependable service to the manufacturer (Ghobadian et al., 1994; Grönroos 1982, 1984, 1990; Parasuraman et al., 1985). There is a well laid out system of prior approval of sources for supply of critical components. The value wise ninety percent of the purchase is made through pre-qualified approved sources. The approval of the source is done by Railways Design and Standard Organization (RDSO) and Production Units such as Diesel Locomotive Works, Varanasi (DLW), Integral Coach Factory, Chennai (ICF). There is a 100 percent inspection to ensure the quality. The quality assurance through process capability and Six Sigma is yet to be adopted.

Credibility

Credibility reflects ability to perform service as per the need of the manufacturer (Ghobadian et al., 1994) and also reflect the ability to prepare accurate invoices and other correct technical details. There is a formal system of evaluating the supplies confirming to the specifications and terms and conditions of the contract. However, there are reported incidences of corruption which allows the substandard material to enter into the IR system.

6.8 Conclusions

The core idea is to have business process orientation to take benefit of Information Technology and e-procurement and converting the push processes of procurement into pull process. In the renovated business model, supplier takes the whole responsibility for managing the minimum and maximum inventory for all of its consignee. Fundamental structural changes are required to fully utilize the potential benefit. Role of Information Technology and its strategic utilization is very crucial. An automatic system of measurement of performance of firms and communication of score along with adjusted share of business may be implemented. This prepares the platform for global optimization instead of local optimization. Electronic exchange of data between railway and supplier involved in the process shall reduce the lead time, manpower required for chasing the order, inventory and imbalance between Anticipated Annual Consumption (AAC) value and purchase grant. This model will integrate various departments involved as well as suppliers for supply chain integration. The supplier becomes a strategic partner is the main idea of process improvement. By this process Railways will be able to achieve fourth level of integration of supply chain maturity. In order to achieve fifth level of maturity further joint efforts will be required for continuous improvement, innovation and value engineering.The portfolio analysis helps to identify area of opportunity and vulnerability. This supply chain strategy can bring up to 10 per cent reduction in bill of material. Money saved through process streamlining directly adds to the profit. Progress towards effective supply chain management may slow and gradual will have lot of surmountable difficulties but the rewards are tremendous.

6.9 References

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