



Data Driven Supply Chain in Public Procurement - A Case Study of Indian Railways

Sivalingam P. Research Scholar, Bharathiar School of Management and Entrepreneur Development, Bharathiar University

K. Malar Mathi, Professor, Bharathiar School of Management and Entrepreneur Development, Bharathiar University

Sivalingam P., Research Scholar, Bharathiar School of Management and Entrepreneur Development, Bharathiar University, Coimbatore Tamil Nadu 641 046

ABSTRACT:

With the advent of ICT initiatives in Public Procurement, e-procurement implementation by governments are mostly perceived as just compliance objective, instead of developing holistic methodology to integrate the end-to-end procurement processes. Indian Railway procurement is unique with strategic objective to ensure materials of right quantity & quality, at right place & time in the most economic and expeditious manner possible for Railways round the clock transport operation across the Indian Sub-continent. Last ten years inducted e-procurement reforms has provided rich opportunities and lessons to procurement entities and supply chain nodal centres in developing an effective supply chain by re-engineering the processes. Re-engineering necessitated an integrated system that is accessible to the procurement office, warehouse, corporate office, end user, other procurement entity in the network, vendor, finance manager, data/archives centre etc. E-procurement in Railways warranted obliterating, simplifying, adjusting, modifying, optimizing and integrating the prevailing manual processes to re-engineer new business strategy process to derive maximum benefits of e-procurement. This paper analyses as to how BPR and Data driven decision making is important for achieving the KPI of e-procurement in Indian Railways

1. Introduction

1.1 Overview

Indian Railway (IR), a government owned transport organization, procure and distribute \$550 Billion worth items every year to its transport business across the Indian sub-continent. The materials are procured centrally by the zonal Railways and distributed to the end users through the network of 268 Stores Depots spread across length and breadth of the Indian Railways. Apart from centralized public procurement (PP) the field units are delegated with powers to procure upto \$5000 per item depending upon urgency and if the item can be more conveniently procured and arranged locally. The zonal Railways can decide contracts upto \$25 million per item and above this value contracts are entered by the zonal Railways after getting sanction from the Railway Ministry. A brief profile of IR is brought out below [1].

Indian Railways Profile Fast Facts

Total outlay for the year 2012	\$58 Billions
Public procurement made in 2011	\$9 Billions
Total number of employees	1.22 millions
% of PP personnel over total staff	1%
Number of stocked items in the IR Warehouses	45,000
Inventory turnover ratio	12%

Assets population of IR				
Stations	Bridges	Locomotives	Freight Cars	Route Kms
7,321	150,746	12,147	289,185	67,415

Daily transport business turnover of IR				
No. Freight trains	No. Passenger coaches	Passengers transported	Freight Transported	Revenue
9,000	12,000	8.4 millions	1.22 billion tons	\$ 108 billions

Source: IR Year Book 2019 & IR budget

1.2 Targets and objectives of Material Management of IR

The public procurement (PP) function of the Indian Railways (IR) caters to the material requirement needs of IR' public rail transport service operation and maintenance and supports in the manufacture of assets such as rail coaches, locomotives, wagons, wheels, rail equipment, spares etc. required for the transport business. The PP requirements for operation and maintenance are more fluctuating than the asset creation material requirements. For the easy managing of the vast IR, the whole network is divided into 17 zones and for assets manufacturing 6 product specific production units (PU) are functioning. Each zone and PU is placed under a General Manager who functions as CEO with 11 different functional departmental heads under him.

The organization's Public Procurement department-chartered objective is to arrange materials at the right time, right place, at the right price at the most efficient, expeditious manner possible. The target is towards ensuring 100% availability of all items required for the Railway operations. When the item goes out of stock and if the item is readily available in the market, procurement is made immediately as otherwise lead-time is a constraint, which varies from one day to upto 24 months for some items like Rails, imported items.

1.3 Procurement Policy of IR

The entire Indian Railway procurement function is not on a single platform system and each zone duplicates procurement of same item in the year for the quantities required for each zone. The procurement is fixed period model with reviews made annually. For this the entire items are divided in such a way that, each month an equal number of items will be taken up for procurement and review. The procurement policy of IR is governed by General Financial Rules (GFR) issued by Finance Ministry, Indian Railway Standard Conditions of Contract, Indian Railway Stores Codes and the Rules and Regulations issued by Railway Board from time to time.

2. Problem Context and background

With the advent of ICT initiatives in Public Procurement, e-procurement implementation by governments are mostly perceived as just compliance objective, instead of developing holistic methodology to integrate the end to end procurement processes. Microprocessor based PCs were inducted in IR only in early 1990s mainly for simplification of PP functions office work (excepting few in-house software system developments adopted in some units) without any attempt for automation and leveraging the ICT till 2003 initially.

Last fifteen years inducted e-procurement reforms has provided rich opportunities with paradigm shift to procurement entities and supply chain nodal centres in developing an effective supply chain by re-engineering the processes. Re-engineering necessitated an integrated system that is accessible to the procurement office, warehouse, corporate office, end user, other procurement entity in the network, vendor, finance manager, data/archives centre etc. E-procurement in Railways warranted obliterating, simplifying, adjusting, modifying, optimizing and integrating the prevailing manual processes to re-engineer new business strategy processes to derive maximum benefits of e-procurement.

In the above context this experience study' objective is to bring the methodologies adopted through the ICT that facilitated in improving the PP effectiveness with a reduction in TCO of the PP framework functions, better availability of materials, minimum order cycles, lesser paper work, lead time and inventory reductions, process traceability and visibility, improved response time to meet the user/ stakeholders needs, real time performance measurements etc by way of Business Processes Re-Engineering in e- Procurement.

2.1. Look back the Old System

From the receipt of estimate sheet, the procurement process starts in the procurement office through various modes of tendering and its finalization based on exigencies and value of the purchase. For each category of stores, a separate procurement section in the PP office is functioning such as Mechanical, Electrical, Consumable items etc. Different types of tenders such as open, limited, bulletin, single tenders are processed in the procurement office. From a demand to PO the maximum time is taken for open tender cases is upto 180days.

In the earlier system except using the mainframe computer as a repository to the PP information after feeding the voluminous paper data created in the day-to-day processes in the PP framework, the PP function was managed at various places through manual creation of files/records in the offices without any automation. The procurement of each item's requirement was made on yearly review (fixed p-model). For this the entire list of items for procurement were split into equal 12 batches, so that each batch comes for review every month. As the mainframe is not connected to the PP functional points and warehouse there existed back and forth paper movements among them.

2.2 Procurement processes in IR

2.2.1 Roll out of MMIS and IREPS in IR

Indian Railway was one of the first few government departments to introduce computers in the country. Computerization on Indian Railways started in the late 60s with the induction of IBM 1401s in the nine zonal railways, three production units, and the Railway Board. Many applications were computerized such as Passenger Revenue and Goods Accounting, Financial Management, Inventory operating statistics etc. While these systems proved to be beneficial to the Railways, they were soon found to be inadequate to cater to the increasing requirements [2].

While the MMIS facilitated the process automation and simplifications with enhanced PP efficiencies in the PP offices and warehouses, the PP commercial bidding process with the markets, necessitated IR to switching over to an in-house developed e-procurement system through commissioning of Indian Railway Electronic Procurement System (IREPS) in a centralized server at the national capital. It catered to the IR common PP

functions such as tender solicitation, vendor registration, and interaction with the stakeholders for PP decision making besides acting as central repository. Induction of MMIS & IREPS necessitated several modifications and adjustments in the PP functional framework in contrast to the erstwhile PP old systems. Induction of these ICT tools necessitated to PP process re-engineering adapting to the latest trends of the industry benchmarks to enhance the PP effectiveness.

2.3 Study Methodology

Each process in the e-procurement is mapped in compliance with the present process rules and purpose of the action in the manual procurement process. The process cycle in each stage of procurement is diagnosed to identify the problematic areas requiring re-engineering. Thereafter the processes warranted obliterating, simplifying, adjusting, modifying, optimizing and integrating the prevailing manual processes to re-engineer new business strategy processes to derive maximum benefits of e-procurement. Each stage of workflow of 'as is manual system' is compared and their modified processes are analyzed in section 4.

3. Literature review

Re-engineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance such as cost, quality, service and speed. Process is a structured, measured set of activities designed to produce a specified output for a particular customer or market. It implies a strong emphasis on how work is done within an organization [3].

Governments across the globe are in a fast phase of embracing ICT to deliver good governance. One of the functions of any government is conducting public procurement which not only serves the government purpose of acquiring goods, works, service, but it also triggers the economy in way the government approaches the procurement with its policies. In the course governments must think in advance about what system corrections are warranted while introducing any ICT system.

E-procurement is commonly defined as the use of ICT to automate and make more responsive and dynamic the purchasing process [5]. E-procurement should be interpreted both as a product and as a construct for human action, which interacts with institutional and rule structures to generate or enforce existing constraints on the everyday behavior and choices made by users. Within this framework, e-procurement is both a course for delivering goods and services to the consumers more efficiently, while at the same time transforming the process, including the individuals involved, by making them more effective in the discharge of their responsibilities [6].

3.1 PP Life cycle in e-procurement

The processes involved in PP are in Figure-1 starting from demand to an item to gain realization of next demand after the procured item is consumed. In order to understand the e-procurement process further, it is necessary to know the system elements and the purposes for which these modules are accessed by different stakeholders in conducting the procurement function.

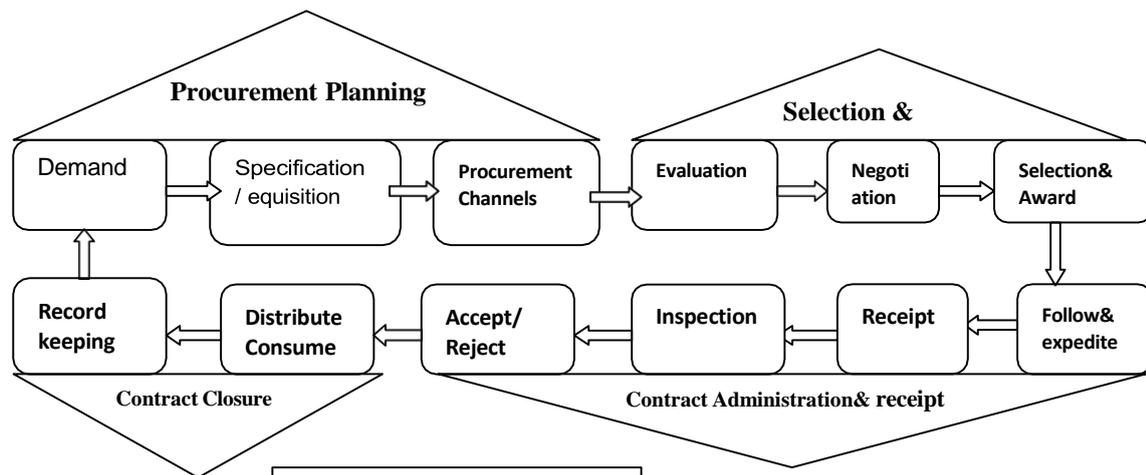


Figure 1
Procurement Life Cycle

Electronic procurement involves various stages and modules in achieving the end to end automated system. It has to conform to the framework of the public procurement policies and comply with the rules of the State. Typical E-Government Procurement (e-GP) system consists of many modules which are interlinked and that are as follows [7]

- Centralized Registration (Contractors/Suppliers/Procuring Entities and other stakeholders e-GP)
- Workflow management System
- E-Tendering (e-Publishing/e-Advertisement, e-Lodgments, e-Evaluation, e-Contract award)
- E-Contract management System
- e-Payments
- Procurement Management Information Systems
- System and Security Administration
- Handling Errors and Exceptions
- Application Usability & Help

3.1.1 Need for BPR in e-procurement

To the world and business are information system based. Strategic decision making has shifted from the intellectual regimen to relying on information. In all countries government is a substantial part of the national economy, and shifting its business activities of procurement and construction online has the potential to provide major impetus to the roll out of new technologies throughout the economy. However, the operational benefits of

technology for the governance and efficiency of these business activities is beyond question. Installing new technology can be simple, but experience has shown that extracting maximum benefit involves governance, management, organizational and behavioral changes which are almost always complex [7].

Employing ICT is not enough in achieving harmonious operation and integration. E-procurement, like most ICT dimensions, is not deterministic in character. The lack of statistical difference in historic experience with e-procurement among groups with integrated and non-integrated platforms suggests that if the integration of digital procurement is not undertaken during e-procurement's initial adoption, it is likely that it will not happen down the road [10].

The progress available through e-procurement is only realized when the system is used in an effective way. Process re-engineering is not enough as different beliefs, expectations and practices may exist. Definitive policy and strategic framework can provide clear rules and guidelines to stakeholders that can help transform the socio-technical and socio-political environments. Overall, an integrated approach between whole-of government and e-procurement initiatives can create a functionally coherent network of policies and standards; minimize competing priorities and objectives; and promote balanced benefits for all stakeholders [11].

3.2 Concerns and Challenges in e-procurement process re-engineering

Many suggest that ICT and specifically e-procurement will transform governance, but digitalized public procurement alone has not yet led to significant transformative changes. The current state of e-procurement is primarily focused on automating existing internal processes and procedures. Unsuitability of software platforms that were originally designed for private sector applications, organizational resistance to change, lack of strategic systems' integration and failure to involve public procurement professionals in the design of an e-procurement system were identified as the primary obstacles of effectively implementing e-procurement. In order to capitalize on the potentially trans-formative nature of ICT in procurement, policymakers, system designers, and procurement professionals must take an active role in the design of the software, but more importantly they must be actively engaged in the process changes that must take place to successfully implement the system. [8]

The role of the procurement professional has evolved from a transactional to a more strategic role that can directly impact the bottom line of any organization. As an end-to-end business solution, e-procurement requires a multi-functional team with members who can [15]:

- ❖ Understand public procurement policies and practices
- ❖ Benchmark and re-engineer business processes
- ❖ Build and maintain relationships with suppliers, buyers and other stakeholders
- ❖ Understand the business requirements and the technical capabilities
- ❖ Coordinate change management
- ❖ Develop training programs.

The lack of standards and evolving classification systems around catalogues, suppliers and cost codes created difficulties in achieving interoperability across and within government [15]. Information and communication technologies do not generate efficiency by themselves. To be successful, several organizational strengths (education and expertise, discipline, process effectiveness, technical infrastructure) must complement them. The adoption and continued use of e-procurement needs to be proactively managed, communicated and fostered. Change management needs to anticipate and manage the psychological, cultural and technological resistance [18].

3.3 Process Adaption in e-procurement for success

E-procurement BPR necessitates several modifications in the day to day functions of procurement and need to overcome the resistance to change exerted by different stakeholders to switch over. Unless these new processes are adapted quickly, there is not much scope in getting the fruitful benefits of e-procurement.

Aberdeen's group, while analyzing the best practices in e-procurement identified that the keys to success of e-procurement include the following [19].

- Early process of reengineering. Best performing enterprises examined and "fixed" business processes before applying automated solutions. Slapping an e-procurement solution on an inefficient process will not fix that process.
- Strong focus on user adoption. End users will resist change, especially a change that may remove some of their buying power and prevent them from doing business with their "pet" suppliers (which usually are not best-performing or lowest-price suppliers).
- Involvement of all affected stakeholders in system implementation. Getting input from all internal groups and all affected suppliers typically speeds system acceptance and minimizes implementation problems.
- Examine and "fix" existing business processes before automating them. Ensure that process development efforts are accepted by all stakeholders. Selection and deployment of technol Best Practices in E- Procurement
- System implementation can be accelerated dramatically if a company conducts an objective and critical

evaluation of existing business processes, and reengineers processes appropriately before the system is extended to end users. This approach also reduces the need for customizing solutions and lowers total cost of ownership (TCO).

4. BPR process mapping of Procurement As is process with to be process

The procurement function in IR passes through different processes from the creation of a demand for an item to consuming the same after procurement by the end user. In order to understand for re-engineering it is necessary to map the 'as-is' processes. The following table reflects the sequence of processes by each stakeholder of procurement.

Manual Processes Sequence of IR PP function from the year 1965 **Table 1**

Sl. No.	Activity for the PP	Activity agency	Purpose of the Activity
1	Demand forecast Advance intimation	Mainframe computer centre	To fill the information gaps and correct errors in the data, this print out is sent to the warehouse two months before an item is due for review for procurement
2	Updation of advance intimation & return	Warehouse Manager	Advance intimation corrected manually is returned back one month in advance to mainframe and information is updated in computer.
3	Generation of Demand Forecast	Mainframe computer centre	To assess the quantity requirement for the next 18 to 24 months based on the future forecast, current stock and quantities due in pending PO(s)
4	Collection of the Forecast and updation	Warehouse Manager	Again, updation takes place based on the latest developments, material budget projection for next year, trend of demand fluctuations, physical stock etc.
5	Submission of forecast to PP office	Warehouse manager	Consolidation of all user points demands for initiating procurement action by PP office
6	Demand Finalization and Budget provision	PP office	The total estimated demand for the item is sent to the Finance Manager, who vet the quantity that is authorized to be procured by the PP office
7	Sanctioned quantity advice to users	PP office	Communication of the quantity decided to be procured for objection or review if any.
8	Initiation and processing of Procurement actions	PP office	Deciding the vendor panel for sourcing, description/specification change, formulation of bid documents, deciding the mode of tender either public bidding or limited tender notice advertisement, sending tender enquiries to the vendors by post and opening the tender on specified date

9	Tender Finalization	PP office in collaboration with user branch	Commercial and technical evaluation of bids, quantity reviews, tender committees deliberations, acceptance of bids, placement of PO after budget clearance & negotiations if any
10	Post contract management	PP office in collaboration with warehouse manager	Supply monitoring before the PO fixed delivery dates, reminding vendors, clarifications, delivery extensions, PO modifications, material stage inspection with vendors, logistics etc.
11	Monthly transaction data update	Mainframe computer	After release of the PO manually, copies sent to mainframe and fed in the computer. Similarly each transaction document copy at warehouse sent to mainframe for feeding & updating the same in the repository which becomes archives of the item for next year review and the cycle is repeated.

Apart from the monthly updates are fed manually in the Mainframe electronic data processing centre by collecting the various papers and documents generated at PP office and warehouse, the data centre also runs specified accounting programs every month and generates various management statements, reports, outputs etc so that the status till the previous month is known to all the stakeholders. All information available in the PP office and elsewhere will be based on previous month's updated data in the mainframe computer

4.1 BPR executed in the to be process

In the procurement process cycle that was in place earlier in the past five decades, in the 'to be process' that warranted in the e-procurement environment in each stage is discussed in the following sections and tables.

Demand Forecast Planning

Table 2

Process	Executed by	Re-Engineered Process	Executed by
Fixing of Estimate due date distribution	PP office	Necessity based daily items picking for review from databases.	Automatically by Computer system
Advance intimation	EDP Centre	Obliterated	Obliterated
Review and validate pending estimates and contracts	Warehouse Manager	Done only for the items picked above and flashed in the dashboard of the warehouse manager computer	Warehouse Manager
Updation in EDP	EDP Centre	Obliterated	Obliterated
Generation of demand	EDP Centre	Generated based on priorities	Computer System

To avoid back and forth paper and information flows and updations as shown in the old system mapping table 2, instead of printing the hard copies of the advance intimation in the mainframe/server for the batch of items due for procurement after two months, a soft copy of the data is accessible through customized menu driven program for user point to take a print out (if required) and update the discrepancies if any noticed online on real time basis. The mainframe computer is isolated from the PP networks except running the monthly programs and generation of management reports for progress monitoring and records.

Elimination of hard copy print outs in the mainframe/central server, sending it to the satellite user points spread across the national networks, manual updating by the users, re-submission back to the server, manual feeding and its errors etc address the problems of back and forth paper flow, human errors, delays etc cutting the time required arriving the forecast from three months to 15 days.

Demand Forecast generation

Table 3

Process	Executed by	Re-Engineered Process	Executed by
Estimation of Quantity by Depot	Warehouse Manager	System formulas for each type of item decide the quantities for review	Computer System
Consumption trend analysis	Warehouse Manager	System scientifically calculated based on weightages, safety stock required	Computer System
Budget Matching	Warehouse Manager	Balancing more funds for extra demands by cutting lesser demands	Computer System
Calculate quantity required for the year	Warehouse Manager	Arrived based on ABC category, lead-time, safety levels, risks	Computer System
Forwarding the demand for vetting	Warehouse Manager	Send online – information exchange	Computer System
Finance vetting of demand	Finance Manager	Online verification and vetting clearance and returning	Finance Manager
Transmit vetted demand to procure	Warehouse Manager	Submitted online through digital signing	Warehouse manager

The demand forecast generation processes are exhibited in table 3. The finalized forecast in the server is placed online for viewing by the user's warehouse managers, who consults, checks the budgets, reconciles the planned demand for the ensuing year in consultation with the end users of the item, fills any gaps or corrects errors that may be found in the recoupment proposals generated. The controlling officer (of several end user and sub- users) who decides the total requirements required for the ensuing period are also provided with all the details of consumption of their users, so that a comparison is made for the quantity projected during the earlier procurement cycle and actual consumption of the item. After analyzing the reason, it is also possible to revise the requirement for next cycle with necessary justification for the revised budget demand from the Finance manager. In the earlier manual system this was not possible, and it warranted getting cumbersome process details down the line to analyze the realistic demand of each item that led to delays, process duplications, voluminous paper work etc.

The updated recoupment forecast is sent thereafter online to the Finance manager in case it exceeds certain value threshold

limits in terms of value of procurement, quantity to be procured etc. for exercising budget control. Small value items below the threshold value are directly sent to the PP officer for procurement. After finance vetting of the proposed demand for procurement with modification, if any the warehouse manager complies with the observation of the Finance manager and forwards it online to the Procurement manager

Planning in PP office

Table 4

Process	Executed by	Re-Engineered Process	Executed by
Registration of demand	PP office staff	System automatically registers based on valid vetted demand received	Computer System
Checking demand matching budgets	PP Manager	System matches and flashes message about shortfall or excess	Computer System
Consolidation of all warehouses demands	PP office staff	Automatically done by the system	Computer System
Providing Quantity for each warehouse	PP Manager	Computer suggestions to PP manager based on data and calculations	PP Manager
Vetting of Procurable Quantity	Finance Manager	Send online and cleared online for further procurement action	Finance Manager
Communicate procurement Quantity	PP Manager	Computer sends message to users only when demanded quantity vary	Computer System

The procurement planning in the PP office is depicted in Table 4. Instead of manual calculations to arrive the demanded quantity for procurement, the Decision Supporting Software systems in the computer automatically calculates based on the previous trend of consumption, lead-time involved in procurement based on previous history of lead times involved in contract finalization, risks such as supply failure, stock out situations, safety/buffer stocks required for each nature of the item. For this ABC categorization based on annual usage value, safety/vital/essential/desirable items etc. This entire process eliminates paper work duplication, enhances the

visibility and traceability of each case showing pending status and its monitoring. In comparisons to the manual old process taking two-month time this work gets completed within a fortnight cutting across delays.

Priority processes				Table 5
Status of items at the start of day in the PP Office	For stock out items Priority #	For<1month stock items Priority #	For<3months stock items Priority #	Action
Items without any PO dues at all	1	5	9	Generate adhoc demand and make emergency purchase
With uncovered dues i.e. no PO available but tender under finalisation	2	6	10	Expedite contract Finalisation for early PO release
Live PO with valid delivery period exists	3	7	11	Review & take alternate action on the defaulted contract
PO with Valid delivery period available	4	8	12	Contact vendor for supply status and take action in case of delay in supply

The normal course of action by the procurement office in line with the old system will be to consolidate all user demand and clubbing to arrive the quantity to be procured for that item for the next year. As this is item specific, fixed period review every year, irrespective of whether stock available or otherwise, a review is conducted by taking print outs, which wastes time and resources. This methodology doesn't facilitate to take cognizance of the other items which may require review due to precarious stock situation as result of fluctuating demands, rejections, and trade failure against the last PO etc. With a view to overcome this problem and to place the PP functions on priority basis the following Table 5 process priority is assigned for the day-to-day functions of PP office.

By adoption of the above process of monthly review is obliterated and instead the above priority wise processes are in the daily schedule work of the PP office and warehouse manager. Since identifying the above priorities manually is a tedious process due to dynamic material inflow and outflows at the user points, the ICT tools in the MMIS software brings the above priority work schedules to the PP manager on daily basis. As the very purpose of the procurement manager is to support the agency's operation by ensuring availability of materials, the above become first priority on every day to address the stock out situation problems. After focusing attention and taking necessary action for the above the PP manager can take up the other regular work. The priority also signals the correct/remedial actions to be taken at the user points. This also reflects prospect of regular availability of materials for operation, maintenance and production in the ensuing days facilitating the PP office top management to initiate alternate emergent action to improve the material availability wherever warranted.

4.2 Re-engineered Re-order points

Once a demand hits the PP office server online, on real time basis the system activates the review not only for the items for which demand has been received for the day, but also for the demand that has to be procured when quantity reaches below re-order level. In the conventional supply chain the re-order points are arrived when the stock reaches below certain level. This is based

on lead time assumptions for each item. But in a public procurement process wherein creation of competition is the watch word by ensuring public procurement ethics, the lead time changes from time to time, item to item due several market conditions such as the present supplier offering better delivery than previous vendor, production capacity of the vendor base, economic batch quantities, change in technology, readiness to pay higher rates for earlier delivery, supplier readiness to adjust their production schedules according to the purchase demand etc. So, it is required to calculate the lead-time scientifically in cognizance of dynamic market conditions over a period. For this though the PP manager cannot evaluate the future market dynamics of the item, it is possible to make logical conclusions from the past lead time data over a period of about five years.

For approximate calculation of the lead-time requirement of the item in the next procurement cycle the following factors can help. After consumption of the item at the user points across the network that are captured online, the change in stock to a lower level triggers the system to run and filter the item that has reached the re-order point. The re-order point is through analysis of data from several databases which may be cumbersome process if done manually. Hence it was not possible during the manual process regimes. Those factors are listed below.

- In the last five procurement cycles, what was the average time take to cover the demand with a PO
- The average delivery materialization time taken in the last five PO i.e. time taken from release of PO to receipt and acceptance of the item in the warehouse.
- The average time of total period of delivery time extension given for last five years POs for arriving safety stock i.e say for instance in the last five years POs a total delivery period of extension of 15 months was given in five PO, then the safety stock required is 3month stock (15/5 months). This time includes from the date of PO to the PO cancellation date also in case a vendor fails to supply that led to cancellation of contract.
- The overall vendor rating performance average of all the vendors who have supplied that item in the last 5 years to arrive the uncertainty risk factor of the vendors for the item. The IR adopts separate formulae for calculating vendor performance evaluation ratings that include delivery, quality and service rating of the vendor for each successful contract or defaulting. This address the difficulties in getting the item based on the quality of vendor base for the item and the risks involved in the contract failure.

If the stock available in the warehouse and live dues (through which supply may materialize) quantity reaches re-order level taking into the above factors the system signals to take next procurement cycle action on emergent basis i.e

The Quantity required for the total of Periods = $[(a+b+c)/d] \times \text{[Monthly quantity required]}$

If the available balance (Stock + live PO quantity) is less than this total quantity the system triggers an alert to initiate procurement action for next period.

The PP office once completes the actions for that item in that day the next item are taken. The receipt of the fresh quantity in warehouse and consumption by user makes the system dynamic and real-time and priorities for each day is prompted for each procurement manager once logs on the system on first time of day. The prompts PP manager specific in the system is based on procurement value powers delegated to different procurement managers in hierarchy and also based on the group of items meant for each procurement manager. The processes involved in deciding the sources to whom bid solicitation is to be resorted to is in Table 6.

Effective sourcing methodology in Procurement

Table 6

Manual Process	Executed by	Re-Engineered Process	Executed by
Deciding tender mode	PP Manager	Based on value & exigencies decided	Computer System
Floating restricted bid invitations	PP Office	e-tendering authorizing access only to decided panel of bidders	Computer System
Deciding the bidders panel for bidding	PP Manager	System brings all successful suppliers & registered sources along with their credentials/performance	Computer system
Issuing printed bid bulletins to sources	PP office	E-bid bulletins are placed on weekly basis to access by registered vendors	Computer System
Open bid invitation draft preparation	PP office	System gathers all information and makes draft bid invitation	Computer system
Collect files of past procurement history	PP office	All relevant information is flashed and accessible in the system itself	Computer System
Call bid attention to prospective bidders	PP Officer	Automatically system collects from the past contract/bid databases for email	Computer System
Collect sufficient drawing copies	PP office	Request send online to user Branch and softcopy uploaded for bidders	User Branch
Finalise description and item specification	User Branch	Online updation by users all the latest specifications of the item	User Branch
Bid invitation approval	PP Manager	Through Digital signature online approvals by PP manager	PP Manager
Draft Tender Approval	PP Manager	System generated draft is verified and approved by the PP Manager	PP Manager
Deciding Delivery Schedules	PP Office	System fixed delivery schedules based on lead time and stock etc	Computer System
Inclusion of special conditions of contract	PP Manager	Picks from the past conditions and suggest to the PP Manager	Computer system

Preparing bidding Enquiries	PP office	Generated by system, they duly suggest prospective vendors for bidding	Computer System
Typing the enquires and bid open date fix	PP office	System generates and suggests bid opening date from the calendar	Computer system
Posting/ mailing bid invitations to vendors	PP office	Uploaded in the e-procurement site for access to the respective vendor	Computer system
Draft bidding documents approval	PP Office	Generated online and approved by PP Manager online	PP Manager
Preparation of Notice inviting bidding	PP office	Generated automatically by computer with information available	Computer System
Sending bid notice for publication	PP office	Send online through mail to Public relation Branch	Computer system
Bid notice publication in news paper	Public relation unit	Send to publication online to the respective publishers	Public Relations
Checking bid notice correctness	PP office	Bid notice send by publishes and checked online for corrigendum	PP office
Collecting publication for reference	PP Office	Forwarded by mail by publishers and kept as soft copy for future	PP office
Clarifying queries and protests of bidding	PP Manager	Received online to PP managers and clarified online	PP Manager

The mode of tender is decided based on total value of the item to be procured either to resort to open public advertised tendering or to issue tender to the limited prospective sources. However, in case the item has to be procured from a sole single source only or the stock situation warrant for emergent tendering in a faster way than the normal, the same is decided accordingly. Once the quantity to be procured is finalized, on seeking the MMIS system to generate a tender solicitation proposal it furnishes the following information for the item

- (i) List of all successful sources that supplied the item in the past with vendor performance rating >40%
- (ii) Past sources whose vendor rating is less than 40% for the item
- (iii) Other than the (i) & (ii) above, the other approved/registered sources with Railway for the item, but not supplied the item in the past, wherein their overall vendor ratings based on all other items supplied to Railway is >40%. (40% is the minimum qualifying performance rating for supplier that entitles to consider their bids)
- (iv) Delivery requirements for the item based on available stock and live PO, say for instance a stock of 3 months quantity (excluding safety stock) is available in March '14, then the first installment of 3 months quantity should be deliverable in the next contract during the month of June '14, so that before the item is exhausted, fresh quantity is sought for.
- (v) If the item is out of stock or the lead-time is such that before the next supply is expected the available quantity may gets exhausted, out of the total quantity of demand three months quantity can be procured through emergency purchase through limited tender or sole sourcing from the ready stock sources which is also prompted in the system.

In case of limited tenders, all sources in (i) above is included and the sources (ii) & (iii) is decided by procurement manager in a discretionary manner depending upon the nature of the item, value of procurement, sources capacity cum capability, number of sources in (i) that can be suffice to create competition, delivery requirements etc. Thereby MMIS system assists the PP manager in identifying the effective sources and decides the speed at which the item could be made available to avoid stock out situation. Once the sources and bidding mode is decided, the bidding process is managed as per Table 7.

When the contractor supplies the item to consignee, the item is received in the warehouse, where it is verified for its quantity and quality and accounted in the books of warehouse. The processes is in Table 12

Supplies Receipt and Acceptance

Table 12

Process	Executed by	Re-Engineered Process	Executed by
Dispatch of stores by contractor	Contractor	Physical activity by the supplier	Contractor
Sending of dispatch documents	Contractor	Negotiable documents sent physically and posted in mail	Contractor and E-portal
Receiving dispatch documents	Warehouse	Scanned copies received online	e-portal
Receiving supplies, checking for quality and quantity	Warehouse	Physical activity done as is	Warehouse
Certifying documents for payment	Warehouse	Entered in the portal and invoices are certified for payment	Warehouse and e-portal
Acceptance and accountal by consignee	Warehouse Manager	Acceptance entered and accountal online	Warehouse and e-portal
Submission of payment documents	Contractor	Submits physically and sends online	Contractor
Receiving bills by Accounts branch	Finance manager	Received both physically and online submissions	Finance Manager
Bills scrutiny and verification	Finance Manager	Carried out online	Finance Manager and e-portal

Passing of bills	Finance Manager	Carried out online	Finance Manager and e-portal
Preparation of Bankers Cheques	Finance Manager	Obliterated	e-portal
Sending Cheques to contractor	Finance Branch	Obliterated	e-portal
Remitting in bank for clearance	Contractor	Obliterated	e-portal
Realizing payments	Contractor	Receiving through EFT for bills	e-portal

5 Conclusion

This paper discussed the issues in e-procurement and how in public supply like IR e-procurement can be benefitted through business process re-engineering of each of the procurement activity within the policy and rules framework.

In the old PP systems in the absence of priorities the PP manager in most time was doing crisis management in making available the items that become out of stock. Whereas in the present system it is possible for the PP manager and the warehouse manager to know at once the item reaches re-order point based on several factors. This facilitates preventing actions in the PP office for all the time availability of items. Further as most day to day functions are carried out in the MMIS and e-procurement portals, the TCO of the PP is reduced besides ICT tools improving the effectiveness of the PP functional framework.

Even though it is possible to have better than the proposed to be process, to comply with the PP rules, policies and ethics the process improvement is attempted within the available resources and implementation scope

as otherwise it is possible to obliterate the entire process for more effectiveness with the following measure which could be done in the future when government brings new legislation to improve efficiencies of PP further.

From annual P-model to daily review models: - The present system was developed 40years back when no computers were available in the procurement office. Once the entire process in online no annual reviews is required and it is possible to do procurement work on daily priority basis based on the categories and urgency of requirement. At present there will be items without contracts, but the office will be placing another contract for the requirement of next year when the same item is in stock. This is against priority working without paying immediate attention to an item which is stock-out. The following model is proposed to do priority work.

As most of the key personnel are provided with Digital signatures, online working, and authorization/approvals is not a problem. At present in the as is process every month the monitoring is done by taking printouts/management reports of all the cases pending, which is time consuming process. In the re-engineered process these metrics and performance parameters are proposed to be captured online and reflected in the map. The main problem in the as is process is visibility of each case and its traceability. Another problem is at each stage how many cases are pending could not be found in real time. To overcome this in the to be process two metrics of KPI, viz, (a) how much work has been done at each process (b) how much is pending with the stage and how much is not done within the target is captured. This will facilitate analyzing the process performance to identify process bottlenecks, problems etc. for addressing the same with improvement in the processes now and then. The re-engineered processes will have benefits as below, with simplification, automation, integration & re-engineered processes

- ❖ Forecast & Demand decision data is kept online (no printouts) & updated online duly transferring to Mainframe via intranet for demand finalisation.
- ❖ LT/BT through e-tender, eliminating paperwork, online offers, manipulations in tenders avoided
- ❖ E-mail/sms alerts every stakeholder with pop-up screens while log-in every time.
- ❖ Online retrieval of vendor database & performance details of Registered sources for tendering decisions.
- ❖ Integration of Stores & Mainframe server via intranet for real-time information visibility across organization
- ❖ Online description/Requirement revision by consumer
- ❖ E-mail/SMS alert instead of Call attention advice to vendor
- ❖ Clarification for the queries answered online for the tender
- ❖ Visibility of process, its metrics measurement, performance monitoring.
- ❖ Identification of KPI for all main processes to know the reasons.
- ❖ Demand to PO time will get reduced
- ❖ Manual commercial evaluation is reduced with e-tender tabulation of offers
- ❖ Visibility and performance metrics is easy to measure and monitor
- ❖ Quick tender finalization and PO release is possible due to less process time

From a policy perspective, it becomes readily apparent that the success of any attempt to transform government, whether in terms of governance or administration, must not only account for the idiosyncratic nature of individual environments, but must also account for all existing processes within systems and how best to transform them collectively. Technology on most occasions is simply a tool that must have a defined set of circumstances to properly achieve its potential, like a set of agreed upon criteria to implement any policy process change. In addition to recognizing the limitations of structurally unsupported technology, there is a significant amount of research in the policy implementation literature which finds that to avoid potential problems during implementation, political, institutional and behavioral issues must be fully assessed prior to adopting new initiatives [17].

REFERENCES

- [1] Railway Board (2011): Indian Railways Year Book 2011. URL: http://www.indianrailways.gov.in/railwayboard/uploads/directorate/stat_econ/yearbook10-11/Year_book_10-11_eng.pdf
- [2] J.M.Ovasdi (1990): Railway Administration and Management pp.294-295, Deep and Deep Publications, New Delhi.
- [3] Sotiris Zigiariis (2000): Business Process Re-engineering. Report produced for the EC funded project INNOREGIO: Dissemination Of Innovation And Knowledge Management Techniques.
- [4] R.D.Gurmeet Singh, Pathak and Rafia Naz (2010): E-governance for improved public sector service delivery in India, Ethiopia and Fiji. International Journal of Public Sector, Management Vol. 23 No. 3, 2010 pp. 254-275, Emerald Group Publishing Limited.
- [5] D.Coulthard, D. & T.Castleman (2001): Electronic procurement in government: More complicated than just good business: The 9th European Conference on Information Systems (pp. 999-1009).
- [6] Clifford McCue and Alexandru V. Roman (2012): E-Procurement- Myth or Reality Journal Of Public Procurement, Volume 12, ISSUE 2, 212-238.
- [7] Shakeel Ahmed Ibne Mahmood (2012): Public Procurement System And E-Government Implementation In Bangladesh: The Role Of Public Administration.
- [8] Flávio Perazzo Barbosa Mota and José Rodrigues Filho (2011): Public E-Procurement And The Duality Of Technology: A Comparative Study In the Context of Brazil and The State Of Paraíba. Journal Of Information Systems And Technology Management Vol. 8, No. 2, 2011, P. 315-330.
- [9] R.Somasundaram & J.Damsgaard (2005): Policy recommendations for electronic public procurement. The Electronic Journal of e-Government, 3(3), 147-156.
- [10] F. P. B.Mota & J.Rodrigues Filho (2010): E-procurement público Brasileiro: Nem só de lances se faz um pregão. XXXIV EnAnpad. Rio de Janeiro: Anpad.
- [11] Simon R. Croom and Alistair Brandon-Jones (2005): Key Issues In E-Procurement: Procurement Implementation and Operation in the Public Sector. Journal Of Public Procurement, Volume 5, Issue 3, 367-387.
- [12] H.H. Chang & H.K.Wong (2010): Adoption of E-procurement and Participation of E-marketplace on Firm Performance: Trust as a Moderator." Information & Management, 47: 262-270.
- [13] Wan Sallha Yusoff *et al* (2011) :Electronic Government Procurement Adoption Behavior amongst Malaysian SMEs.
- [14] Francesco Bof and Pietro Prevital (2011): National models of public (e)-procurement in Europe International Business Research Vol. 4, No. 1; January 2011
- [15] Department of Finance and Administration, Australian Government (2005): Case Studies on E-procurement implementations, Commonwealth of Australia.
- [16] K.Cornelia Sabiiti, Edwin Muhumuza and C Benon Basheka (2011): Developing Public Procurement Performance Measurement Systems In Developing Countries: The Uganda Experience.
- [17] Government of India (2011): Guidelines for compliance to Quality requirements of e-Procurement Systems. Ministry of Communications & Information Technology. Department of Information Technology.
- [18] Marcos Singer (2009): Does E-Procurement Save The State Money? Journal of Public Procurement, Volume 9, ISSUE 1, 58-78.
- [19] Aberdeen group (2005): Best practice in e-procurement. Aberdeen Group of Researchers.