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Performance Evaluation Of Indian Railway Supply Chain

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Abstract :
In Governments supply chains, implementation of online systems is a challenge due to several stakeholders' involvement and their difficulties in active participation. Any supply chain system's objective is to economize the total cost ownership (TCO). To assess the outcomes of online supply systems, continuous measurement of key performance indicators is a must and to take corrective action further towards cost savings. The last 15 years implemented electronic procurement systems in Indian Railway has benefitted the organization to enhance public procurement ethics of Equity, fairness, transparency besides Value for money spent on public procurement. In this paper the issues faced in the erstwhile systems are studied and how Indian Railway implemented supply systems benefitted in improving the KPI of supply chain. The performance is measured duly by comparing old systems.

1. Introduction

1.1 Overview

Indian Railways (IR) is a state-owned 170-year-old public utility organization of the Government of India under the Ministry of Railways. As a national common carrier transporting passenger and goods over the country's length and breadth vast network, Indian Railways has always been playing a key role in India's social and economic development. It is still a cheaper and affordable means of transportation for millions of passengers compared to other modes of transport. As a carrier of bulk freight such as ores and minerals, iron and steel, fuels, cement, mineral oils, food grains and fertilizers, containerized cargo, the importance of Indian Railways for agriculture, industry and the common man is well recognized [1].

Indian Railways is headed by the Cabinet Minister for Railways. The apex body entrusted with the management of this mega enterprise is led by the Chairman Railway Board (CRB). Members of the Railway Board who represent their respective functional domains. For administrative purposes, Indian Railways is divided into 17 zones, each headed by a General Manager. Zonal Railways are further divided into smaller operating units called Divisions. There are 70 operating divisions in Indian Railways at present, each headed by Divisional Railway Manager (DRM). In addition, there are several Production Units, Training Establishments, Public Sector Enterprises and other Offices working under the control of the Railway Board.

Indian Railways (IR) is the third largest railway network in the world with 7,083 railway stations, 131,205 railway bridges, 9000 locomotives, 51,030 passenger coaches, 219,931 freight cars and 63,974 route kilometers. Today IR operates 19,000 trains each day, comprising 12,000 passenger trains and 9,000 freight trains. It transports
105 billion tons of freight traffic and 7.2 billion passengers per year. It currently has 1.36 million employees and an annual revenue base of $3 Billion as projected on March 31, 2023. Indian Railways is also home to great talent and excellent organization focused on operation, efficiency and safety [2]. Indian Railways during the year 2013 joined the select club of countries (China, Russia &USA) transporting one Billion Tons freight traffic in IR.

Over the past, IR has focused its service delivery devoting importance on social responsibility and now, there is an urgent need to enhance capacity and modernize the Indian Railways to meet country's social and economic aspirations in the 21st Century. With modernization and restoration of balance in the intermodal transport mix, IR can be a significant engine of inclusive growth and development for the country and can potentially contribute an additional 1.5% to 2% to India GDP [2]. To modernize Organization, Management, Development, Finance, Project Management, Research, Procurement, Payment functions deployment of ICT solutions are playing vital role in the recent times in IR.

The IR capital and investment put together constituting $550 Billion earned a profit of just $250 million (less than 1%) during the year 2011. Indian Railways contributed 1 per cent towards GDP of India at Factor Cost (2004-05 level of prices) during 2010-11 [1].

1.2 Indian Railway Public Procurement

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 required for its transport business. The PP requirements for operation and maintenance are more fluctuating than the asset creation material needs. Zonal Railways and Production Units (PU) run 268 stores, Stocking Depots over the railway network for the uninterrupted supply of railway materials and stores. Over 180,000 materials components of various descriptions are stocked in these depots. During 2010-11 the expenditure on materials purchases towards the requirements for operation, maintenance and production etc. (excluding cost of ballast, track related items, materials supplied by contractors for civil construction works) was $5 billion.

Over the last five years Indian Railway Electronic Procurement System (IREPS) and Material Management Information System (MMIS) have been implemented to improve efficiency and transparency in Public Procurement thus reducing the cost of material/purchase due to savings in logistics and transaction cost [1].

Unlike in other public procurement organizations, wherein the professionals are from commercial background, the IR public procurement professionals are engineers recruited through national level competitive examination. The World Bank while analyzing public procurement in India has remarked regarding IR's procurement professionals' organization as: The creation of a competitively recruited class one cadre of procurement specialists in the Railways and Department of Supply in the early fifties has contributed to comparatively higher professional standards in both organizations and needs emulation in other ministries and sectors. Creation of such cadres fosters professional growth, pride in the profession, cross-fertilization of ideas, etc. Alternatively, the professionals belonging to these services should be entrusted with the procurement activity in all ministries [3].

1.3 Evolution of ICT in Indian Railways

Management and governance within evolving network type structures is challenging and emphasizes different skill sets that were not necessarily fundamental in traditional public administration [4]. Technological advancements and the deployment of information communication technology (ICT) supposedly would make government more effective, responsive, and accountable and eventually more democratic [5].

Today we are going through an era of post-industrial society, which is basically an information society, and the economy of today's society is greatly dependent on the creation, management and distribution of information resources. Thus, in this ever-increasing changing scenario, information and information systems (ISs) are valuable organizational resources that must be properly managed for any organization to survive, succeed and grow. ISs are providing relevant, timely and accurate information so as to help organizations gain strategic advantages over their competitors. The fast development and wide usage of ISs in business have changed the way organizations are managed and thus have made many conventional management approaches obsolete [6].

Now, new organizations are information based. Recently, several approaches have attempted to shape the new information-based strategic framework-research on business process re-engineering. The importance of ISs is not only to support operational activities but also, to support strategic decisions. In other words, ISs that do not properly support an organization's strategic objectives, corporate culture, or user needs can seriously damage the organization's prospects for survival and success [7].

Indian Railway was one of the first few government departments to introduce computers in the country. Indian Railway Vision 2020 document states that Just-in-time system of material management would be adopted to reduce inventory costs and IT-based MIS, and integrated supply management would be adopted to optimize on materials life-cycle costs.

Computerization on Indian Railways started in the year 1963 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 [8]. While these systems proved to be beneficial to the Railways, they were soon found to be inadequate to cater to the increasing requirements. But it was only in the seventh five-year plan period from 1985-1990 these IBM 1401 mainframe computers were replaced with third and fourth generation micro-processor based computer systems. Consequently, computerization in the production units and the zonal railways were strengthened, and computers were introduced in the divisions, workshops and stores. Also, many new areas for computerization such as Passenger Reservation System (PRS), Freight Operations Information System (FOIS), and Material Management Information System (MMIS) etc. were initiated. These developments are now beginning to show impacts on both

the Railway system and its users. During the last five years towards computerization $200 million was allotted in Railway Budget [9].

1.4 Rationale of the Study

The changed scenario of globalization, liberalization and privatization has forced the organizations to pay due attention on the concept and management of ISs. Today, leading companies have started using ISs as tools for staying ahead of competitors. In the process, many organizations have already acquired either a mainframe or personal computer to computerize their ISs. Many more organizations are at the threshold of developing and acquiring these computer systems. It is indeed a healthy and positive trend but before the organizations decide to acquire larger systems, there is a need to evaluate the planning, controlling and the performance of the already computerized ISs in organizations so that the proposed huge investments in ISs could be utilized effectively and organizations will be able to use information systems as weapons of competition. In view of the importance of the subject, it is important to undertake studies to examine planning of ISs in organizations [6].

While the IR has embraced the information technology over last five decades, the proliferation of Personal Computers in last 15 years is providing rich opportunities to IR not only to automate its continuous PP (Public Procurement) functions but also act as a trigger to enable all round system improvements to obtain the value for money spend from the public exchequer. The procurement of goods, work and services contribute more than 50% of its yearly budget in IR [1]. However, there is no proper research available on the methodology of the IR's procurement process, procedures for safeguarding institutional interests or the lacunae and advantages accrued by the systems adopted. Since after commissioning various ICT projects in IR over the last 15 years, it is worthwhile analyzing the structure, processes and mechanisms and the accrued benefits which have evolved in an organization in existence in a developing country since 1853.

Towards this objective this study is focused on exploring the benefits gained by IR in its electronic procurement system and Material Management Information Systems (MMIS) commissioned in IR over the last five years.

2 E-procurement in Indian Railways

2.1 Need for e-procurement

Value for money (VFM) is the core principle governing the public procurement and is supported by the underpinning principles of efficiency and effectiveness, competition, accountability and transparency, ethics and industry development [10]. Savings from procurement have long been recognized as significant contributors to VFM and to reduce the cost of departments' operations [11].

ICT provides greater accessibility; facilitates wider multi-communication and dissemination of information; provides automatic record keeping features; and generally, enables better knowledge management and information sharing. Further, ICT in government increased productivity [12]. E-Government Procurement (E-GP) is the use of information and communication technology (especially the Internet) by governments in conducting their procurement relationships with suppliers for the acquisition of goods, works, and consultancy services required by the public sector [14].

E-Procurement is the use of electronic technologies to streamline and enable the procurement activities of an organization. It is the term used to define the set of technology solutions which are used to support and enhance purchasing processes such as e-Tendering, e-Auction or Reverse Auction, e-Catalogues, e-Marketplace and e- invoicing. There is confusion to term these e-Procurement solutions. The terms such as 'forms', 'approaches', 'modules', 'models' and 'components' have been used in the literature to refer to individual applications (tools) of a full (end-to-end) e-Procurement system [15]. Though there is some overlap, each of the e-Procurement tools concentrate on different key areas of procurement sourcing, managing, ordering and paying [16].

In India vision of Nation e-Governance Plan (NeGP), it was the necessity to speed up the implementation of the e-procurement Mission Mode Project (MMP) through rigid intervention in the form of directions from the Ministry of Finance by laying down threshold and timeliness for mandatory adoption of e-procurement system for government procurements. NeGP is working on three tiers architecture in which, Common Service Centers (CSCs) are the front end delivery point, the second tier provides common and support infrastructure in, including in it are, Sate Wide Area Networks (SWANs**)** facilitate backbone network for data, voice and video and State Data Centers (SDCs) provides secure IT infrastructure to host state level e-Government application and data. The third tier comprises of 27 Mission Mode Projects (MMPs). Out of this 27 mission mode projects e-procurement MMP is coming under integrated MMPs. The vision of the e-Procurement MMP is to create a national initiative to implement procurement reforms, using electronic Government procurement, so as to make public procurement in all sectors more transparent and efficient [17].

Indian Railway is the biggest state-owned enterprise and the largest procurer in India. It performs an important function because an efficient transport system is of vital importance to the economic development and social welfare of a country. It performs the fundamental function of stimulating the development of the national economy by transporting goods and passengers at economic/minimum cost. The rail transport industry in India is of utmost importance for the economic development of the country [17].

In IR considering the Government vision and mission in mind, E-procurement was started in the year 2003 as a pilot project and later commissioned across the entire organization. In the year 2009 the project was complete with introduction of all the modules of procurement activities of Railways. The e-procurement solutions were developed by Centre for Railway Information Systems (CRIS), an umbrella organization under Ministry of Railway. Still Railway is in the process of improving the e-procurement systems through integration of the already available systems and with the back end office systems. The sequence of development milestone of e-procurement achievement system is in Figure-1.

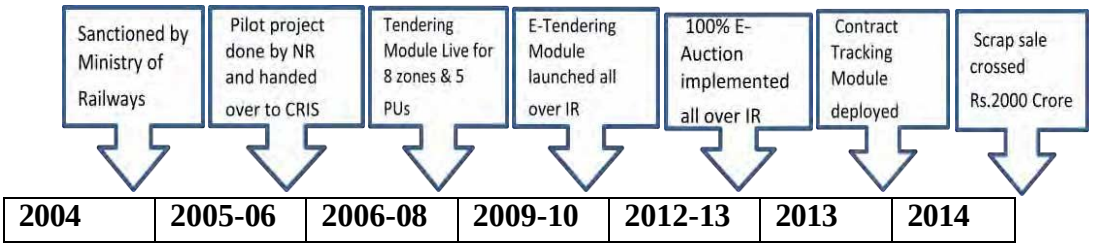

Figure-1

Milestones Achievement Timeline in IR E-procurement

Having traced the ICT evolutions and need for e-procurement in Indian railway, the rest of the paper is organized to study the latest developments in e-procurement with reference to IR, its implementation performance benefits, and the challenges faced in measuring the same. Followed by discussions in comparing such performance benefits to the benchmarks and lastly for the KPI of e-procurement identified from the literature reviews the identified benefits are measured from the collected secondary data and comparisons of benefits with reference to earlier manual system is deliberated in the findings of the empirical study.

So, the remainder of this paper shall deliberate seven essentials' elements. First, Section 3 reviews literature on prior research regarding development of e-procurement and discusses the performance benefits of e-procurement and the necessity to measure. Second Section 4 brings the benchmarks of Procurement performance laying a baseline to measure the e-procurement efficacy metrics. Section 5 brings the challenges that are faced by the procurement agencies in effectively measuring the e-procurement benefits. Section 6 discusses the study methodology along with data collection approach, identifying some KPI of e-procurement which are measured and compared with the present e-procurement system to the erstwhile manual system performance outcomes. Finally, Section 7 discusses the findings of the study of each of the KPI measured through the collected secondary data from the procurement archives and Section 8 concludes with the gist of benefits of e-procurement implemented in IR.

3. Literature Review

3.1Developments in ICT

Eventually how governments operate, how citizens interact with their governments, as well as what role government plays in society will change. The result is that government is expected to be more responsive, democratic, accountable and transparent [18]. As a response to the challenge of trade liberalization and globalization, the options available for conducting business electronically will continue to increase. Many developed countries such as United States, Canada and Japan are implementing e-procurement. E-procurement refers to the use of integrated information technology systems for procurement functions, including sourcing, negotiation, ordering, receipt and post-purchased review [19]. In considering the large purchasing power of governments, e-procurement applied to public procurement, presents opportunities for welfare gains that neither the private nor the public sector can afford to ignore [20].

Governments across the globe have spent significant number of resources (both human and monetary) attempting to digitalize governance (e-governance). A significant number of nations have spent more on information communication technology (ICT) over the last decade than on traditional capital investments such as roadways, airports, water purification plants and the like. Those governments investing heavily in e-governance initiatives anticipate that these efforts will transform governance [14].

One area within government that has seen significant reform efforts, as well as notable investments in ICT is procurement. Those attempting to reform the procurement process argue that the current system is broken, and unsuitable for the demands of modern governance [21]. As a result of various efforts to limit the opportunity for corruption, increase accountability, and promote transparency, procurement has witnessed tremendous pressures to change current processes. In fact, investing in ICT, primarily through e-procurement, has been an attempt to change how government procurement operates. Eventually by adopting

digital platforms, procurement would be better suited to achieve the advances of modern government.

Public sector institutions have different objectives towards the implementation of e-Procurement and those cannot be seen simply as extensions of commercial e- Procurement applications because government institutions pursue a wide variety of goals due to their different nature. Within this context the political and legislative environment in which public sector institutions operate calls for conformity to a range of requirements that have little or nothing to do with economic output [22].

Government procurement represents 18.42% of the world GDP [23]. Many countries have created specialized agencies to develop and manage business-to-government (B2G) electronic procurement (e-procurement) systems. They have done so to achieve the following objectives [24]:

- Promote the use of the Internet across different industries.
- Give signs of transparency, as the transactions between contractors and State agencies become public.
- Reduce administrative cost by improving the procurement process; and
- Reduce purchasing prices, due to a more efficient operation and to a larger number of potentials

The power of ICTs as a vehicle of communication means that citizens can be more fully involved in all aspects of government, including policymaking, thus reinforcing the creation of a culture of trust and mutual interest. It is argued that e-governance can provide a climate of honesty, integrity, trust and participation [12].

IR being a government organization has a greater role to play on the socio-economic development of India. Keeping this in view in many passenger transport sectors of IR, though the organization makes loss, it carries the social responsibility to serve the nation in providing affordable passenger transport across the country. Apart from aiming to operate the organization with profit objective, IR has the responsibility of achieving the Indian government mission of connecting every place through rail network to trigger sustained socio-economic development. For fulfilling these objectives modernizing its procurement functions become imperative so that the organization can progress in pace with the demanding expectations of transport industry.

To reduce procurement costs and improve the availability of materials for the smooth functioning of the train system, Indian Railways realized that the procurement system needed streamlining. It needed to be able to better identify the organization's needs, and to run electronic tenders for contracts to ensure those needs were met. This meant a system that would rank procurement priorities and calculate lead-times and reorder points more accurately. It would also evaluate appropriate suppliers, run tendering processes and monitor contract performance in real-time. Much greater transparency was also needed, to ensure both efficiency and integrity. Indian Railways realized ICT could deliver all this, if it could develop a tailor-made system and get staff and suppliers to embrace it [39].

3.2E-Procurement Performance Benefits

The overriding objective of a state's public procurement system is to deliver efficiency and "value for money" in the use of public funds, whilst adhering to national laws and policies. Performance measurement is about seeking to answer the fundamental question of whether the procurement system and operations ultimately deliver in accordance with the main objectives set. Measuring the performance of e-Procurement initiatives has received limited attention in government publications and academic literature [13].

Although the reported benefits and costs of digitizing procurement have been well discussed in the literature, whether proposed transformative goals have been achieved is still being evaluated. The lack of evaluation

Research is a common occurrence for most e-government initiatives and this should be far less surprising when looking specifically at e-procurement initiatives in government. Previous research suggested that simply adopting an e-procurement platform may not achieve its intended purposes [25].

The long-term benefit of the e-procurement system will come from analyzing the information collected in the system over the years of operation to better understand spending patterns, the marketplace and processes applied. Governments need to consider the information required for analytical and reporting

requirements and interaction with other systems to obtain to most value from the procurement information management system provided by e-procurement practices [13].

There are several reported benefits that are regularly associated with the implementation of e-procurement practices. Operational and cost efficiency are perceived as the primary advantage of e-procurement. Scholars assert that employing tools such as e-notice, e-auction, e-catalogue, e-dossier, e-submission and e- signatures will reduce costs and improve buyer-vendor relationships [26]. Web-based purchasing is also believed to offer the capability to develop effective long-term strategic approaches, improve process and budgetary controls, and reduce transaction costs, hence leading to more efficient supply markets [27].

It is reported that e-procurement will facilitate the documentation of the bidding process which would enhance transparency and accountability of government operations. The mechanistic formula-based e-decision making processes used during auctions and bid solicitations is posited to limit discretionary and biased selection, while also increasing transparency and accountability. A fully articulated e-procurement system would expand the bidding pool which, in turn, would eventually enhance the quality of goods or services offered to the government, and most importantly at a lower cost. Increased internal customer satisfaction is also a benefit reportedly associated with e-procurement [27].

There is a strong relationship between the perceived quality and professionalism of implemented e-procurement system, contract and process compliance. Increased use of information communication technologies in the procurement process is expected to lead to more competitive structures and generate competitive markets (expand the vendor pool) that might not have been possible within current manual structures [27].

In theory, e-procurement reduces administrative costs and bureaucracy by helping the State to avoid repeating tasks such as registration and certification of contractors, allowing for more efficient control mechanisms and reducing paperwork. It is found that the electronic reverse auctions (e-RAs) increase productivity and reduce cycle times for buyers, particularly in the case of repeated auctions [28].

Vaidya et al [15] reviewed the literature on e-Procurement performance measurement and presented a list of e-Procurement factors and measures that impact performance. Their investigation revealed Value for Money, customer/supplier satisfaction, system interoperability and integration, change management, quality and transparency of the business process, and management information as the major factors relating to the performance of e-Procurement initiatives. Use of e-Procurement systems also offers increased ability to search for products and services, automated reordering systems, and access to a wider range of service providers [13].

Use of e-procurement system enhances knowledge and confidence in using the system. Greater deployment of systems that provide the most support (i.e. more sophisticated systems with decision-making capabilities), minimize the extent of the "productivity paradox". Similarly, a high professional standard on legislation and administrative framework and a high level of training and information access on suppliers are important to improve the efficiency, competitiveness, and responsiveness of e-procurement [19].

Numerous studies have proven the potential of e-procurement. E- Procurement facilitates organizations to decentralize their operational procurement processes and centralize strategic procurement processes as a result to provide higher supply chain transparency using e-procurement system. E-procurement used for inter-organization also enhances the benefits of e-procurement within an organization. Companies using e-procurement system reported that they achieve saving up to 42% in purchasing transaction cost allied with less paperwork, which enables transaction processes to less mistake, and more efficient purchasing. Paper-based procurement process implies transaction costs range from $70 to $300 per purchase order [29].

Implementation of e-procurement initiatives and structures could improve the professionalism and outside perceptions of procurement specialists [27]. The latter would provide the context for procurement professionals to become more involved in shaping public policy. As a result, the procurement process of governments would not only be more responsive, but eventually governance could be better situated at a policy level to take advantage of innovations in the market place [27].

It can be said that the ease of use, system availability and user friendliness together can contribute to positive user satisfaction. Management information that can be extracted from the e-Procurement system improves transparency, employee accountability, compliance, monitoring and supplier performance measurement, which in turn, contribute to value for money improvement. It is obvious that e-Procurement greatly helps to improve communication with suppliers providing access to the latest information 24 hours a day, 7 days a week. Thus the maximum systems availability makes it easier for businesses to obtain tender documentation and to submit an offer. The general ease of information flow afforded by the internet can help overcome many of the problems of geographic isolation which can promote competition [13].

When e-procurement is implemented in public procurement, several benefits generated accrue to different stakeholders who are adopting the processes. The benefits to these interlinked stakeholders overall enhance the procurement performance and effectiveness of the public procurement function all round. The main stakeholders in any public procurement are the organization that embraces the customers to which the procurement entity is serving, the suppliers who perform like a partner in efficient supply chain and finally the citizen whose money is spent in public procurement. On the basis of preceding sections' deliberations, the e-procurement benefits are grouped under following four categories:-

- ✓ **Economy towards value for money (VFM)**
- ✓ **Procurement Efficiency & Effectiveness**
- ✓ **PP Ethics and Transparency**
- ✓ **Competitive Markets**

Under each of the categories, the benefits realized by each of the stakeholders are shown below in following section tables. These various benefits lay a foundation to the organization to evolve methodologies to embed a continuous procurement performance measurement mechanism in the e-procurement system to access, analyze the dynamically changing e-procurement benefits with reference to the bench marks fixed by the organization for each of the procurement activity and to take further remedial action wherever any corrections are required.

Economy towards value for money (VFM) **Table 1**

Benefit	Beneficiary			
	Organization	Supplier	Customers	Public
Administration cost savings in improving the processes	Yes		Yes	Yes
Efficient competition resulting reduction in purchase price	Yes	Yes	Yes	Yes
Optimized inventory management	Yes		Yes	
Savings in operating and inventory carrying costs	Yes		Yes	Yes
Scope for negotiated unit cost reduction	Yes	Yes	Yes	Yes
Improved knowledge and confidence among stakeholders	Yes	Yes	Yes	
Operational procurement decentralization	Yes		Yes	
Strategic procurement centralization	Yes	Yes	Yes	
Reduction in ordering costs	Yes	Yes	Yes	Yes
Efficient budget controls and expenditure monitoring	Yes		Yes	Yes
Savings in tender documents distribution	Yes	Yes		Yes
Savings in cost of receiving the bids manually	Yes	Yes		
Savings in print, copy ,collate ,postage actions	Yes	Yes	Yes	Yes
Reduction in Total cost of ownership of PP entity	Yes			Yes
Online access to tender documents	Yes	Yes		

Online payment of bid cost/security	Yes	Yes		
Elimination of reliance on postal/courier services	Yes	Yes		
Reduced total cost of procurement	Yes	Yes	Yes	Yes
Reduction in advertisement and tendering costs	Yes	Yes		Yes
Lead-time optimization	Yes	Yes	Yes	

Procurement Efficiency & Effectiveness **Table 2**

Benefit	Beneficiary			
	Organization	Supplier	Customers	Public
Elimination of tasks repetition and duplication	Yes	Yes	Yes	
Efficient contract monitoring mechanism	Yes	Yes		
Reduction in paperwork	Yes	Yes	Yes	Yes
Satisfaction among suppliers and customers		Yes	Yes	
System interoperability and integration	Yes	Yes	Yes	Yes
Decision supporting information systems	Yes		Yes	Yes
Contract compliance improvements	Yes	Yes		
Lesser mistakes in transaction processes	Yes	Yes	Yes	
Procurement specialists' improved professionalism	Yes	Yes	Yes	Yes
Evaluation tools to assist management	Yes		Yes	
Control over tender evaluation process	Yes	Yes	Yes	
Storage and archiving documentation for future use	Yes	Yes	Yes	Yes
Management of tender deadlines	Yes	Yes	Yes	
Improved audit trail	Yes	Yes	Yes	Yes
Real-time financial data availability advantages	Yes		Yes	Yes
Operational decentralization and strategic centralization of purchase	Yes	Yes	Yes	
Lead-time optimization	Yes	Yes	Yes	

PP Ethics and Transparency **Table 3**

Benefit	Beneficiary			
	Organization	Supplier	Customers	Public
Ethics of transparency fair play visibility	Yes	Yes		
Clear visibility of customer demand throughout	Yes	Yes	Yes	Yes
Online information exchange among stakeholders	Yes	Yes		Yes
Market transparency	Yes	Yes	Yes	
Control over discretionary and biased contract award	Yes	Yes		Yes
Customer satisfaction		Yes	Yes	
Round the Clock access to information	Yes	Yes	Yes	Yes
Employee accountability	Yes		Yes	Yes
Accountability for each activity	Yes		Yes	Yes
Online information exchange among stakeholders	Yes	Yes		Yes
Speed and ease of response to supplier's queries	Yes	Yes		
Reduction in complaints/challenges/suspended process	Yes	Yes	Yes	Yes
Lead-time optimization	Yes	Yes	Yes	

Competitive Markets **Table 4**

Benefit	Beneficiary			
	Organization	Supplier	Customers	Public
Access to broader vendor base for better procurement	Yes	Yes		
Meaningful buyer-supplier relationships	Yes	Yes		
Efficient supply base and markets	Yes	Yes	Yes	
Enhanced quality and services of broader vendor base	Yes	Yes	Yes	Yes
Buyer supplier interaction and feedback	Yes	Yes		
Development of new suppliers	Yes	Yes		

Procurement Cycle Time **Table 5**

Benefit	Beneficiary			
	Organization	Supplier	Customers	Public
Reduction in procurement cycle times to buyer	Yes	Yes	Yes	
Automated reordering systems	Yes	Yes	Yes	
Standardization of procurement processes	Yes	Yes	Yes	Yes
Reduction in order fulfillment time	Yes	Yes	Yes	
Reduction in bid validity from vendor due to faster contract awards	Yes	Yes	Yes	
Lead-time optimization	Yes	Yes	Yes	

4. Benchmarks in Procurement Performance

Public sector e-procurement is a complex socio-technical system embedded in multiple layers of government. It has the capacity to become a meaningful agent of transformation in procurement practices through the joint actions of different layers of government and cooperation across diverse agencies [30]

ISs of any worth must be adequately planned for. The planning activity must be undertaken on a regular basis. ISs must be made a part of the organizational plan so that a proper match between the business and ISs plan can be achieved. A supportive attitude of the department management and of the department staff in IS project planning can contribute only in the presence of strong leadership. Hence, it is the collaborative role of all the heads as well as of the staff, which should be strived for [6].

The rationale of procurement benchmarking is to research and identify best practices that have proven to be successful in particular areas and which have the potential for improving other similar practices and or performances. Benchmarking VFM can often be very difficult. VFM is a very broad concept encompassing a range of factors, and it is very important to understand the implications it has for the public sector. Although VFM criteria often seem self-explanatory, benchmarking VFM can be difficult where the subject matter is technically complex, requiring sophisticated understanding and there is no universally accepted methodology to follow [31].

Benchmarking and performance measurement are the main techniques that have been used by many leading researchers and practitioners on improving both private and public sector organizations [31]. As a practice within the public sector, benchmarking implies a systematic measurement and comparison of the activities of individuals and organizations with a view to improving their efficiency and quality. Benchmarking may be distinguished from other traditional forms of evaluation by its attempt to visualize best practice through normalizing comparison and by urging public entities to ask themselves what they can do to promote best practices [32]. The rationale of procurement benchmarking therefore will be to research and identify best practices that have proven to be successful in particular areas and which have the potential for improving other similar practices and or performances [31].

Public sector procurement is more regulated than private sector procurement, and there are more rules to comply with, more policy considerations to implement. Government agencies are very bureaucratic in nature and are extremely reluctant to change their current habits and practices. Even those public bodies that genuinely wish to change are restricted by standing orders, public accountability, and probity constraints. It is argued that public sector agencies need to incorporate most of the modern management tools and technologies to cope with the procurement industry, to remain competitive and make maximum use of scare resources [33].

Benchmarking enables and motivates one to determine how well one's current practices compare to other practices, experience best practices in action, locate performance gaps, prioritize opportunities and areas for improvement, and improve current levels to world class standards. Benchmarking is not the same as benchmarks; benchmarks are performance measures [33]. The service and public sectors are also keen to embrace performance measurements. The importance of benchmarking in the achievement of better results in public procurement and in overall business performance has been widely asserted in literature. We do not need to measure everything that matters; we only need to measure the things that matter [31].

The need to benchmark and measure performance in public sector organizations is becoming more intense. Procurement benchmarking therefore is the effort to measure performance of a supplier of goods or services based on quality price and timely delivery. Another benchmark in the public sector is customer-supplier satisfaction as measured by the number of complaints received [34].

We cannot simply adopt a best practice and implement it in the organization but that one may have to look at the way things are being done, such as the prevailing culture and human resources employed to do the job before one can adopt a benchmarking practice [35]. Process benchmarking and internal benchmarking would be both important when a comparison of techniques is undertaken. Process benchmarking is when methods and processes are compared to improve the processes in one's own organization. Internal benchmarking is when comparisons are made between departments or divisions of the same organization. Internal assessment contributed to the attainment of benefits of benchmarking by focusing on the culture, training and internal communication within the organization. Thus, in the last ten years, different types of benchmarking have been used as a common management practice in purchasing departments, in both developed and developing countries [31].

Benchmarking that involves comparative study or analyses of successful procurement systems of all or a number of contracting authorities can be an excellent method of assisting with the definition of performance targets. Benchmarking data may also be made available nationally to ensure the use of a uniform performance measurement system throughout the country, which may also facilitate comparisons at a national level. Benchmarking is also a method by which a contracting authority may compare its own operations in various aspects with comparable external undertakings, such as a similar contracting authority known for its excellence. Benchmarking can also be used for various other comparisons, such as prices or service levels [31].

Benchmarks fixed for each procurement activity by IR (manual bidding) Table 6

Progress Chart of coverage of requisition for procurement of items through open bidding					
Activity	Target (in days)	Actual Dates From - To	Days Taken	Deviation (+/-)	Reason for excess time
Registration of demand and advising demand No.	**2**				
Indent scrutiny and consolidation of all demands	**10**				
Quantity Approval by the Procurement Authority	**5**				
Vetting of procurable quantity by Finance	**7**				
Procurement proposal and approval of bidding	**7**				
Bid schedule preparation with samples/drawings	**10**				
Release of notice inviting bids	**10**				
Bid opening period after issue of bid	**45**				

notice					
Making commercial tabulation after bid open	**5**				
Checking & vetting tabulation by Finance officer	**3**				
Technical evaluation by the technical authority	**10**				
Finalization of tender by the Evaluation committee	**25**				
Contract award acceptance by the Authority	**2**				
Issue of letter of acceptance and counter offers	**10**				
Draft contract award preparation for concurrence	**3**				
Contract award concurrence by finance branch	**8**				
Purchase Order numbering and dispatching to all	**5**				
Contingency buffer time allowed	**5**				
TOTAL	**172 days**				

Source: Southern Railway intranet site https://10.5.2.32

While measuring the procurement performance, it is necessary to rely on some base indicators for comparisons and to attempt improvement continuously. Government has fixed targets or milestones in each of its procurement functions to measure efficiency. IR in the procurement cycle from the demand generation to the post contract compliance activities like refund of bid security back to the supplier, compilation of contract completion and performance details etc., the organization has fixed benchmarks, and IR analyzes them continuously for effective monitoring to achieve the targets.

In the public open bidding process IR has fixed benchmarks in the year 2003 at a time when ICT were fully functional for its Decision Supporting systems (DSS) of procurement. The objectives were to achieve visibility, accountability and observe and analyze the reasons for ineffectiveness to take remedial action besides continuously improving efficiency. The Table 6 above shows the details of benchmarks fixed by IR for each of its activity in procurement. For easy facilitation of recording the progress of each activity the table was printed on one side of procurement file, so that after dealing by the stakeholders, the time taken by them are recorded. After the contract award, cases which have deviation in excess of 5% tolerance are reviewed by the Procurement auditing to identify the problems.

5. Challenges in Performance measurement

Developing and implementing an e-procurement system can be difficult and complex. An effective and efficient system incorporates appropriate tools and procedures that support technical, business and work practice requirements. It also integrates with buyer agency systems (i.e., FMIS / ERP) and supplier systems. This integration will ensure all participants have access to the data required to complete the transaction. In many examples, the diverse technical requirements of different agencies were underestimated, and technical delays eroded the value proposition to those buyers. The technology used in public e-procurement systems needs to be aligned with industry standards. This can be difficult with the lack of agreed standards in the industry. The lack of standards and evolving classification systems around catalogues, suppliers and cost codes created difficulties in achieving interoperability across and within government [30].

Increasing the effectiveness, efficiency and transparency of public procurement systems has become an ongoing concern of governments and of the international development community. Performance measurement is viewed as a warning, diagnosis and control system, that is used to keep track of economy (looking back), efficiency (current organizational process), effectiveness (output in the short term) and efficacy (output in the long term)[13].

There are several barriers in implementing e-procurement successfully and the organizations faces challenges in measuring its performance metrics. While it is easy to measure the reduction in procurement cycle time in e-procurement scenario, it is a difficult task to measure the level of confidence built among the stakeholder or the change in supplier/customer relationships/satisfaction.

The implementation of e-procurement can often be costly, especially in cases when systems based on incompatible platforms are attempted to be incorporated later. The more diverse the technical platforms the more prohibitive it becomes. Fulfilling the legislative requirements for transparency and timely provision of information increases by notable margins the operational cost of e-procurement [27].

The management and monitoring of e-procurement systems will emphasize different skill sets and relationship constructs that have not been witnessed in traditional public procurement practices. It could be argued that e-procurement might stymie the development of trust within the relationships between procurement specialists and vendors. While information communication technology can limit human-induced biases it can also strip the public sector of the benefit of reduced administrative costs that result from trust-based working relationships among members of networks [26].

The complexities and risks involved in e-procurement activities are frequently misunderstood and the seeds of failure often shown with the presumption that technology per se rather than management and culture are the key. In this situation security and trustworthiness are the paramount active concerns preventing the wider adoption of e-procurement strategies. Fears over security are no less significant amongst those companies that already have substantial experience of e-procurement. Indeed, the more companies know about e-procurement, the more scared they are about security. All these e-procurement systems need to be introduced in organization effectively to obtain all round benefits [38].

Challenges faced in e-Procurement Performance Measurement Table 7

Measuring benefit	Challenge faced
Annual Cashable savings	For fixed specification/price items arriving savings in comparison to previous Period
Individual price analysis	Under frequent fluctuations calculating the change by indexing inflations/price Indices
Savings in procurement due to efficiencies	Savings during a period in terms of resources, benefits calculation through input output analysis
Procurement function and Procedures quality	Measuring target metrics such as time to complete an activity, cost, % of restricted/negotiated tenders/prices
Contract implementation efficiency	Cost savings, achieving implementation deadlines, milestones, Return on investment on capital
Internal and external collaborations/relations	Supplier and internal customers/clients' satisfaction levels towards collaboration and service levels respectively
E-procurement as a competing priority	Maintaining e-procurement among other priorities of the organization/ Government
All stakeholder adoption of system	Supporting internal customers and suppliers to facilitate in adoption / training till full implementation
Conflict with already working information systems	Integrating with other Management information systems in the organization like ERP, MMIS
Developing skilled resources	Building multifunctional teams to address end to end solutions
Managing Authenticity and security	Creating and maintaining an effective information security process/policy in the silo type government set-up
Top level Management support	Vision and mandate of the top-level management to achieve the milestones till full implementation
Budget constraints	Organization priority to allot sufficient funds for time bound implementation
Resistance to change	Adaptation of new procedures by the stakeholders
Re-engineering the old processes	Obliterating, modifying, and introducing new processes for adaptation by stake holders
Consistent policy goals and objectives	Are critical as inconsistent systems are meaningless acting as constraint to maximize economic efficiency
Accurate and reliable	Collection of good quality, relevant and appropriate data in a

statistical information	robust and consistent manner for practical use.
Defining and measuring efficiency	Difficulty in defining efficiency, measuring it and applying across consistently
Adopting performance driven culture in organization	Regulatory and institutional mechanisms offer rare incentives to strive for improved efficiency
Setting performance targets relevant to achieve	Well defined, timely, reliable, comparable and verifiable targets in day to day working

However, the challenge of measuring the performance of e-Procurement initiatives has received limited attention in government publications and academic literature. An organization's e-Procurement objectives and performance measures are grouped into four perspectives: Financial, Customer, Internal Business Process and Learning-and-Growth [13].

In order to address the challenges in measuring performance, it is worth to analyze them first, so that whether the deployed performance measurement systems delivers effective results can be checked. Some of the challenges analyzed are in Table 7 [30].

Furthermore, good measurement systems with appropriate benchmarks are important components of any reform program to identify potential areas for enhancement. Most measures are lagging indicators (outcomes oriented) rather than leading indicators (outputs oriented). While measuring only the financial approach may be suitable for the private sector as profit is, arguably, the predominant goal, the same single-focused approach cannot be applied as the only measure for the public sector. A more balanced measure of the benefits and progress of an e- Procurement initiative is necessary. This will enable a public sector organization to ensure that e- procurement strategy implementation objectives are being fulfilled and support the broader objectives of government agencies in terms of their requirements for transparency, accountability and probity [37]. The reform solutions within government procurement systems must include measures that address issues of accountability, transparency, value for money, a professional work force and ethics [31].

6. Study Methodology

6.1 Data Collection Approach

IR has been benefitting on several fronts in e-procurement implementation that has been enumerated in the preceding literature survey. However, considering the challenges in measuring all the performance benefits due to non-availability of structured secondary data in the archives, only some KPI, which covers few of the major aspects of effectiveness were identified and taken up for comparative measurement between manual procurement and the later e-procurement performances.

Over the last 20 years IR after introduction of Personal computing systems has been capturing procurement data and in the last five years on introduction of e-procurement and MMIS, the data is archived. Since the IR is not adopting a continuous performance measurement program in respect of its ICT outcome, the data captured was voluminous and not structured to reflect/analyze the benefits/ comparisons of e-procurement over the first five years and later five years. Hence the captured data is voluminous and must be structured to study the performance factors identified for measurement.

Though there are 17 zonal railways and 6 production units carrying procurement, only half of these procurement authorities have been deploying information systems prior to e-procurement implementation. So the sample data collected and analyzed in this exploratory research pertains to authorities which have been using the information systems in different platforms for over 15years internally.

6.2 Study Objective

The study question/objectives are: - What are the benefits of e-procurement in IR? How can it be measured? How many benefits with reference to manual procurement systems?

The data available can answer the above questions and has relevance to the organization, time and are measurable. The collected data was structured, verified and formatted to meet the research objective of measuring the identified performance indicators. Among 180,000 different items available in IR only items used specifically by IR were selected, which constitutes a monopolistic market. Among such 1000 items, random samples of 150 items were selected for study. As the sample of 150 items can meet the statistical requirements of study, the data was compiled comparing the metrics pertaining to manual procurement vis-à-vis the e-procurement over a period of 10 years.

The items selected are procured by most of the PP agencies across many zonal railways and hence inter-se comparisons are feasible. For the selected 150 items, the data was compiled comparing the metrics pertaining to manual procurement vis-a -vis the e-procurement for the KPI to be studied. For 150 items the total number open tender procurement analyzed under three different zonal railways is 1200 over 10-year period which is a considerable sample size. From the collected data the outliers like proprietary contract procurement, restricted emergency procurement was removed (the time required is less and methodology followed in this bidding method is different), so that the data represents homogeneous open contracting tenders only. The data was coded and formatted according to the KPI to be studied, checked for validity and reliability. The whole of the data was retrieved through an organization intranet. For parameters which are not captured in the database like number of pages in the procurement office file, advertisement cost etc. individual documents, files, archives were accessed from the organization for study and the data collected.

In the process of IR public procurement function, the organization continues to study each activity effort and time required to be taken through work studies. After work study, IR has fixed targets for each of the activity from generation of purchase demand to disbursement of payment to the supplier. The PP office was a decade back when e-procurement systems were not in place has introduced benchmarks for each of the procurement activity and have been recording the time and effort taken continuously in the procurement file. Where there were deviations the reasons for the same were also captured for analyzing and taking remedial action if any is required. So these act as benchmarks on which both the erstwhile system performance can be measured and also e-procurement performance metrics.

7. Empirical Results and Analysis

To limit the performance metrics only to the extent of KPI of procurement efficacy and effectiveness among the benefits identified on e-procurement, only some of the KPI were taken up for study from the secondary

data collected. The KPI measured is in the reduction in times from each of procurement activity with reference to the benchmark time fixed by IR. The extent of savings in paperwork, back and forth file movements, tasks duplication, economic factors like savings in bidding advertisement cost, reduction in rates. Further the efficiency indicators like availability of items for IR operations, inventory turnover ratios etc. were measured and compared with the present e-procurement regime to earlier manual procurement adopted period. It is obvious that apart from these benefits IR has also benefits in most of the e-procurement benefits due to being achieved through ICT. However, to measure all the benefits the archived data is not structured and further the time taken to measure all the e- procurement benefits is enormous.

The KPI identified for measurement are grouped into the following categories of benefits and discussed below.

- Procurement Cycle time
- Economy towards Value for money
- Procurement Efficiency and Effectiveness
- Competitive Markets

7.1 Re-engineered procurement planning time

The warehouse on receipt of this advance intimation, two months prior to the demand generation date, checks its office records to verify and validate each of the printed information in the intimation and submits back to the EDP center in next 30 days. Thereafter in the EDP centre on updation of the demand information in computer, generate a final draft demand for the next procurement period. After the introduction of e-procurement and MMIS systems, these 60 days procurement planning time is eliminated. As the entire information is real-time online, for any validation, the warehouse accesses it and completes it

online. For this the procurement office, warehouse, finance branch, EDP centre is integrated though internet and intranet. The efficacy metrics in time saved of these activities is brought out in the following table 8

Procurement Processes Cycle time comparisons in e- procurement (Year 2021) Table 8

Manual Procurement system *				Electronic Procurement System		
Activity	Carried by	Benchmark Time	Time taken in days	Modified activity in e-procurement	Average measured time	Savings in paper (A4 size)
Draft demand advance intimation	EDP Centre	30 days	25 to 40 days	Online daily alerts to warehouse for validation and verification if any for modification	3 days	12 pages
Demand scrutiny and budget vetting	Warehouse	30 days	30 to 35 days			
Procurable Quantity Calculation	PP office	15 days	30 days	Error checks, forward to Finance and budget clearance	7 days	18 pages
Demand approval for Procurement	PP officer	5 days	7 days	Demand examination with sanctioned quantity already available in the system and deciding the quantity procurable	15 days	16 pages
Description/ Specification updation	End user	7 days	15 days			
Bid invitation, Advertisement, bid open date fix	PP office	25 days	30 days	Online updation of description and specification by user with email/SMS alerts	3days	6 pages
Bid open time after bid documents kept ready	PP Office	75 days	60 days	Online bid documents uploading and email and SMS alerts to probable bidders	30days	250 pages
				*Source: Southern Railway intranet site https://10.5.2.32		

In addition to the 60 days saved in planning, the demand is generated online and after budget clearance the documents flow manually to the procurement office within a week time instead of normal 30 days in the erstwhile systems. On getting a valid demand for the item in older days, a trend analysis of items was made in procurement office by comparing the past consumption, change in activities, justification for the demanded quantity etc. This process is eliminated by way of computer intelligent decision supporting systems suggesting the time and quantity to be procured for the next demand cycle period. The paper files moving at different levels are modified to online interactions and approvals, thereby another 30 days' time is saved.

As an item specification could be modified continuously, access is given to the end user, who updates the latest description/specifications including uploading the specifications and drawings softcopies for bid invitation purpose. All put together saved IR 10 months' time of procurement cycle time from the earlier 18 months cycle time. Once the integration of back-end office systems is implemented the efficacy could be improved further.

7.2 Bid Invitation

In the conventional system once the mode of tender, either restricted or open contracting tender is decided, an NIT (Notice Inviting Tender) is sent to Public Relations department, wherefrom the matter is sent for various publications for a wider publicity among the vendor fraternity. To maintain the PP ethics and rules compliance only a monthly update of tenders are uploaded in the e-procurement portal, are sent to publication, thereby reducing the time to the extent 30 days (maximum). The system, apart from saving the documentation and paperwork also generates email/SMS alerts automatically for the interested vendors who are either registered for these items in Railway or participated earlier in the tender floated for the items. The whole process of initiating of NIT to fixing the bid opening dates took 90 days earlier has been reduced

to 30 days now.

7.3 Bid Opening

To comply with the transparency ethics, on the date of bid opening, an elaborate arrangement have to be made to open the bid, verify, document, sort-out item wise and read them in presence of vendors who have participated in the bid invitation. This activity took atleast 30-60 minutes for each item depending upon the nature of the item and number of vendors participated in the tender. Now on elimination of this process, after bids are electronically opened at the specified time, all the vendors, who have participated in the tender, can access a comparative commercial tabulation statement to compare with other bidders offers. In the manual bid opening many times bids were received late after bid opening time. These bids are treated as late bids and are not included in the evaluation. In the e-procurement tender opening the concept of late bids are eliminated as the bidder cannot submit any offer after bidding time closure.

7.4 Contract award

In the old manual system, a laborious process of tabulating all the offers manually and writing them in a printed form had to be completed, a methodology besides fraught with errors warranting checking mechanisms, involved 5-7 days. As commercial tabulation is made automatic in e-procurement portal after opening of the e- tender through procurement office authorized person's digital signature and encryption keys all the stakeholders of the tender can access the bid details at once including the Technical and Commercial evaluation committees. These improvements make the contract award within a month in comparison to 90 days earlier.

On bid opening in the erstwhile methods, as all the bid papers submitted by the vendor is kept as received condition in the file. The evaluation and contract awarding authorities had to search for several commercial and technical details from every bid paper submitted, which not only laborious but lead to errors and disputes later. Due to this the bid finalization for evaluation to the authorities took extra 15 days. In case of capital equipment procurement tenders, the bidders are specifically asked to commit a bid validity period of 120 days in comparison to other open contracting tender's validity of 90 days. But now the technical parameters matrix is uploaded in the e- portal asking compliance remarks of each of the parameter from the bidders during the online bidding, thereby compilation of such technical evaluation after tender opening is not required.

7.5 Delivery period and lead-time

An analysis of the collected date reveals that the delivery time i.e. the time lag between contract award date to actual delivery of the item at the warehouse improved atleast by 50% in each case on an average as the time period of communication by postal/courier is eliminated. Once the contract award is signed digitally by the contracting officer, the same at once reaches the successful bidder by mail. By introduction of payment gateways, payments from the bidders like bid fee, earnest money, security deposits etc. are paid through payment gateways online. Even after contract award, post contract documents like road permits, contract modifications, octroi

Exemptions, entry tax etc are dealt with online. All these system corrections led the vendors to offer less delivery period.

Earlier it was a mandatory condition that each bidder has to agree for a bid validity of atleast 90days after bids are opened, due to the reason that the contract award finalization took atleast 90 days. Due to this it was common for the bidders to load a risk cost of escalation that may arise during this 90days bid validity period. As now tenders are finalized within a month, the bidders confidence is enhanced thereby a margin reduction in the offered rates is possible with better competition. Another reason that could be attributed to savings in rates is faster acceptance of supplies by consignees and online electronic payment. For each month delay the supplier loses at least 1% of contract value by way of interest on their locked-up money which is now passed on to the purchaser.

7.6 Payment Time

In the course of procurement processes, while the bidder is involved in payment procedures like paying bid documents cost, Drawings/specification costs, Earnest money deposit, contract securities and performance guarantees, the purchaser has to refund the bid fee if bidding is cancelled, return the EMD to

all un-successful bidders, refund the security deposit after contract completion and return the bank performance guarantee after the warranty/guaranty periods besides paying for supplies made by the vendor.

In earlier days, the bidder, to purchase bid documents, must visit the procurement office to pay the cost or has to send the payment through mail/courier. Taking into consideration several delays, the bid opening is fixed either for a longer period or postponed sometimes due to process delays/complaints. In the initial stage of e- procurement, IR was allowing the bidders to download the bid documents online with the condition that the bid cost has to be paid by the bidder by sending the bank draft before the bid opening. This again resulted in difficulties in watching every bidder payment. Later IR collaborated with the government bankers and opened the payment gateway for electronic fund transfers by bidder to IR bank account. This facility of online payment gateway is also extended to earnest money payment by bidders. As security deposit and performance guarantee payment is meant for only the successful bidders before the contract award, still IR receives the same manually but it is included in the integration of its back office systems to deal like other payments.

In the revised process both bidder and purchaser save time and resources. In PP the time lag between goods delivery to payment receipt by the supplier is an input for the bidder to decide the final bidding cost as the supplier has to factor- in the interest amount involved on their locked-up capital with the purchaser for the delays in payment disbursement. This in turn affects purchaser-supplier relationships resulting in disputes as well sometimes.

Earlier in the manual systems, the supplier after delivery of goods to the consignee must wait atleast one month for release of their goods acceptance document to lodge their bills with the IR Finance branch. During this period in the warehouse, the items is accounted, inspected in the labs and finally taken into the books duly releasing the goods receipt note to the supplier. Even after submitting the bills by the supplier, about 15 days' time is involved in passing their bills, preparation of cheques and dispatching them to supplier and then remitting them in the back for clearance. This takes another 15 days' time and virtually the supplier gets the money only after 2 months.

In the present scenario after the introduction of certain system corrections, the payment process is expedited. First the inspection process after receipt of goods is eliminated except the quantity checks and visual checks, by introducing the inspection process in the supplier premises itself before the goods are dispatched. Once the pre- inspection is completed the goods are delivered to the consignee with an inspection certificate. In the warehouse only the quantity is checked and the invoice is certified for the quantity received. The supplier on the next day submits the bills and in a couple of days receives the payment through electronic fund transfer to supplier bank account. Now the paying authority is able to see the online authenticated contract, consignee acceptance of supplies online and matches the same with supplier bills for passing payment. In this process as atleast 1% interest is saved for the one-month speedier payment process and if the suppliers pass on this savings to the purchaser thorough 1% reduction in quoted price, the IR could save $500 million per year for the yearly material procurement value of $5 Billion.

7.7 Economy towards Value for money (VFM)

Due to inflation each items bid rates will continue to rise year after year procurement cycles. The objective of open contracting in PP is to get VFM through competition. For every contract award, IR analyses the rate reasonability with reference the previous purchase rates. For these comparisons, the indices of inputs of materials, labour etc. are loaded in the price arriving formula for the period between the last bids opening date to the current bid opened date. The wholesale price index, consumer price index, several material price indices and labour cost indices are periodically released by government of India, which are taken to calculate the reasonability of rate through comparison.

After loading the indices between the manual procurement periods and e-procurement scenario the comparisons reflect a reduction at least 2% in the contract award value. Even though it is quite difficult to attribute the quantum of price reduction to each of e-procurement benefits, it is evident that all round benefits like competition, processes efficiency, quicker payment, savings in resources can fetch an effective contract price.

7.8 Turn Over Ratio (TOR)

As IR maintains the supply chain for its operation and maintenance through its 268 warehouse at

strategic locations, it is imperative to maintain an optimized inventory turns for minimizing inventory carrying cost with maximum availability of all materials for IR operations. IR measures and publishes continuously these efficiency turnover ratios (the ratio of inventory balance to the total value of purchase made during the year) to exhibit its improvement. Besides the material stocked with IR at any time is locked up capital, every year Ministry of Railways pay 7% dividend to the Federal Government for the value of materials kept in stock without usage. For optimization IR continue to face challenges in striking a balance between the quantum of inventory to be maintained visa-a-vis risk/loss threats involved in stock out situation or over stock situations.

The study reveals that the TOR of IR has improved during the e-procurement regimen from 14% to 10% during the year 2012-13 [1]. The reduction in TOR could be attributable due to visibility of procurement process planning, utilization of the time saved for better management functions on 24X7 real-time basis, decision supporting systems in conducting the PP and arriving lead-time, Reduction in procurement cycle time, reduction in risks due to wider vendor base and its satisfaction, effective contract monitoring mechanism, Decision supporting systems through Management information.

7.9 Bid Invitation cost

In any PP creating competition among suppliers to obtain best value for money spent is imperative. To reach a wider vendor base it is common practice to advertise the bid invitation in newspapers and journals etc. According to Government of India General Financial Rules in public tendering every notice inviting tender has to be published in the newspapers. For this IR advertises each open contracting bid invitation in multiple newspapers to reach the targeted audience. For each item advertisement, the average cost involved the previous cost was $800.

Consequent to the e-procurement implementation in IR, this expenditure is minimized to a larger extent and brought down to $10 per item. So far in the IR electronic procurement portal 13000 vendors are registered, who regularly watch the tenders floated (so far tender floated in the IR e-procurement portal is 470,000) for them to participate as they desire. Further as vendors are also available in the Railway database on item wise, when an e- tender is uploaded in the website, email and SMS alerts are sent to the respective vendors. However to comply with the public procurement ethics of advertising a skeleton advertisement indicating the list of items is inserted in the popular newspaper and asking the vendors to refer the e-procurement portal of IR to participate in the tender. As the entire bid document is uploaded in the website, the cost savings in issuing exhaustive advertising material is also saved.

7.10 Process Efficiency and Procurement Effectiveness

7.10.1 Commercial Tabulation

After bids are opened, for the next stage of deciding contract award, commercial evaluation, technical evaluation of the bids received is a vital input for assessing the most advantageous bid. IR follows the PP ethics of accepting the lowest acceptable offers meeting with tender requirements. In the e-procurement as all the commercial and technical details of the bid is entered and captured online in a structured form, both commercial comparison of all offers and technical comparisons of bids are generated automatically which can be accessed by the stakeholders of PP decision making. While studying the archive files of the sample item's contracts reveal that after bid opening date it took 7 to 10 days to prepare a commercial tabulation statement, which in turn is vetted by the finance branch for its correctness involving another 5 days. After receiving receipt from the finance, the file had to be sent again to the technical department for technical evaluation which took another 7-10 days. The benchmark time fixed for these two-tabulation comparisons by IR is 15 days each including the time involved in back-and-forth file movements. Now this time is saved as these comparisons are instant and always available online.

7.10.2 Availability of items and Crisis reported items

For operation and maintenance of IR, un-interrupted supply of materials is essential. But for the risks such as trade failure, sudden fluctuations in the material requirements, ineffective planning, excessive consumption due unforeseen situations and other technical problems and delays in procurement function, always some items runs out of stock. To address such risks and to take remedial actions at regular intervals, co-ordination meetings at

zonal Railway level is conducted with the warehouse managers, consumers, finance branch and PP

Authorities. In these meetings the crisis items reported as critical by the field units are included in the agenda were found to be only 22 items in comparison to the earlier average of 55 items projected as critical during manual procurement regime five years back. The improvement could be attributable to the e-procurement benefits of real-time information availability for monitoring and taking remedial actions promptly. The study reveals that in recent times IR has seriously took the issue of all round availability of items, which reflected in the improvement of availability of 98% from the 86% availability during manual procurement periods.

7.11 Competitive Markets

In manual procurement, one of the challenges faced is to send the bid enquiry to all the probable competitive sources who can offer bids meeting with IR requirements. Despite the open bid invitation through advertisements, if the advertisement does not reach the most competitive supplier the purchaser cannot get most advantageous bid. Similarly, the challenges like sending bid documents and receiving bids through postal/courier is fraught with delays that sometime leads to missing of competitive offers, thereby the contract award is at higher rates. After e-procurement, the data collected shows that for each tender the number of bids has increased from five to nine showing better competition. In comparison to manual tendering for each item the number of approved vendors to supply the item has increased from 4 to 6, reflecting a wider vendor base that results in better competition, lesser rates with more number of bids in e-procurement system.

8. Conclusion

The gist of the consolidated comparison of measured metrics in e –procurement is in table 9 (Year 2021)

Table 9

Key performance Indicator	Erstwhile manual system	Implemented e-procurement system
Re-engineered online procurement planning time	125days	14days
Procurement office file pages average (paperwork)	285pages	15pages
Bid opening time fixed after tender approval	90days	21days
Time involved in opening the bid after due date	60 minutes	5minutes
Commercial comparative evaluation of bids	3 days	Eliminated (soft copy)
Bid opening to actual contract award date	95days	20days
Lead time involved from award to delivery	60 to 300days	30 to 150days
Advertisement cost in open contracting	$ 800 per tender	Only $10 to publish
Average open bid competing vendors	5	10
Average number of suppliers for the item	4	8
Inflation/price index adjusted product cost	NA	8% average reduction
Un-interrupted products availability for operations	86%	99%
Inventory Turnover Ratio	30%	11%
Monthly crisis reported to corporate office	55 items	10 items only
Time lag between supply and vendor payment	35days	7days

At a time when, it appears that there is lack of research in measuring the e-procurement benefits in governments continuously through specific metrics, in this study it was demonstrated through the e-procurement archived secondary data that there are several benefits in e-procurement compared to the manual procurement in IR. Within the available time some of the KPI data were retrieved for study and the e-procurement performance benefits were measured with reference to the earlier procurement methods. This paper lays a foundation that IR has to embed in their information systems to capture continuously the performance indicators and monitor it continuously so that consistent improvement can be attempted. Such a performance measurement in efficacy of procurement can be tool to reflect the actual performance

measures and inter-se position among different public procurement authorities spread across the IR network.

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