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Framework for Performance Measurement System of Inbound Material Supply Chain of Pakistan Railways: A Step Towards Sustainable Development

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This paper deals with the issue of performance measurement system in public sector organization of developing counties through various key performance indicators, keeping in view Pakistan Railways as a case study. This paper also highlights different KPI at three different stages of performance measurement in such type of organizations to propose a complete framework. The subject study is of qualitative nature and it involved literature review of different research studies conducted on performance measurement systems in public sector organizations around world, examination of departmental source record/documents, and interviews of stakeholders. According to some reports Pakistan has the weakest higher education system in the world showing its tendencies towards research environment. Public sector organizations have always been a neglected area in terms of research perspective in the third world countries like Pakistan. PSOs either lack the basic frameworks of performance measurement system or having incomplete/inadequate systems of performance measurement resulting in a further downfall instead of any improvements, which is evident from their performance as well as source documents. The scope of this paper is limited to the inbound material supply chain portion only of Pakistan Railways. Due to lack of an ERP and anticipated difficulty in data collection in a consolidated manner, financial flow and information flow of supply chain is not included in the subject study and only material flow has been taken into account. The findings can be applied to related Public sector organizations' dealing with the same predicaments by using similar performance measurement system based on KPIs keeping strategical, tactical, and Operational, sides in the internal and external perspective. There is major gap in terms of studies on Public Sector Supply Chain Management specifically of Pakistan Railways. The subject case study is unique in its scope in terms of its design and pattern.

1. Introduction

Public sector has always been an entirely different field of study as compared to private sector. There are big void and difference of procedures, as well as, in styles of working between the two. Public Sector in Pakistan is considered to be following a Weberian administrative culture whereas some believe it to be of patrimonial or neo patrimonial nature (Naveed et al., 2023). Public sector not only involves great expertise in the relevant field but also greater accountability (as public money is involved) and excellence in public policies and prevailing laws and regulations, whereas the private sector has its own approaches to tackle the working and it varies from firm to firm (Overman & Schillemans, 2022). The second difference is; public sector is mostly believed to be a facilitator to the general public and profits are not the prime targets but facility and better service are the principal objectives (Maron, 2022). Pakistan railway year book. (2014/15). All this discussion does not construe that a public sector organization must run in loss. An efficient and effective performance measurement system (PMS) will result in better and better results and it may turn a public sector organization into a profit earning organization.

A public sector organization is also termed as State Owned Enterprise (SOE) (Ciolomic & Beleiu, 2023). In Pakistan SOEs are running in great deficit which is of great concern to the general public, as well as government, and are source of enormous impediment to the national exchequer each fiscal year (Muhammad et al., 2023). According to a recent report, Pakistan Railways (PR), Pakistan International Airline (PIA) and Pakistan Steel Mills Karachi, cumulatively posted a deficit of more than a 100 billion rupees during the last fiscal year. The state of affairs will remain same without proper enforcement of an effective and efficient PMS and taking corrective measures as per requirement of the system. Among these three SOEs, Pakistan Railways is selected to be the case study of this paper. The subject organization is selected due to a number of reasons. It is one of the largest SOEs in the country in the civil sector. It consists of more than 90,000 employees, and spread all over the country (Pakistan Railway year book 2014/15). The engineering extensiveness, uncertainty in material demands with certain hikes and drops, diversity of fields involved like Mechanical, Electrical, Civil, Telecommunication, Signal, Education, Hospitals, Workshops (considered as independent factories) makes it an important field of study. Moreover, being itself, a logistics service provider (LSP) gives it yet another dimension with respect to various operations. The study is restricted to Material Supply Chain only to make it more tangible and effective in terms of implementation. The Cycle of Material Supply Chain is further broken down into Inbound Material Supply Chain (IBMSC) which may also be considered as inbound logistics, Internal Supply Chain (ISC) which deals with the forward logistics portion only within the organization, and reverse logistics (RL) which deals with the disposal of waste/useless items generated over the system. This paper will specifically deal with the IBMSC portion only.

Material Supply Chain is the lifeline of any organization. (PRSC, n.d.) The organization is unique in terms of its material requirements and operations within the country. (PRSD, n. d.) Mostly, the equipment required is available from limited number of resources only which are located abroad. The inbound material supply chain involves readily available FMCG to sophisticated system of imports related to Railway Engines their parts and rails from countries having different styles and mode of working across the globe including China, USA and Europe.

(PRSD, n. d.). The system involves thousands of stock items as well as many non-stock items. The Stores branch deals with the duty of determining the demand of the department and their procurement through the purchase branch (Pakistan Railways Yearbook, 2015). The whole procedure is expected to be working in an efficient, economical and expeditious manner (Rahman & Iqbal, 2025). Generally huge and public sector organizations are centralized when it comes to IBMSC, while geographically dispersed organizations are decentralized. In public sector, Finland and Holland are using centralized system for IBMSC flow while in Germany and UK, Decentralized system is in vogue.

PR mostly favours centralised system of procurement (PRJPOC, n. d.). In centralized procurement, the function of purchase of goods, items, commodities, and material is performed by a specific department which in the case of Pakistan Railways is Stores and Purchase Department.

1.1 Research-Questions

The following are the research questions of this study:

i. What are the factors that drive the PM of Pakistan Railways IBMSC?
ii. What are the constraints/problems in PM of Pakistan Railways IBMSC?
iii. What would be the comprehensive framework for the PM of Pakistan Railways IBMSC?

2. Literature Review

Callender (2011) identified the research gap by specifying that there is limited research in the Public Sector SC. Public Sector is a major economic player in any country (Hawkins et al., 2011). It constitutes the largest sector in the purchasing market in the world. Hawkins et al., (2011) defined Public procurement as "*The acquisition of goods and services by government or public sector organizations*". There are legal bindings and various rules are required to be followed in the public sector due to the involvement of public money and considering it as a responsibility towards the public. Callender et al., (2013); and Van Weele, (2010) defined SC as "any combination of processes, functions, activities, relationships and pathways along which products, services, information and financial transactions move in and between enterprises".

Mitchelson, (1992) has used the term capital-intensive for organizations of public sector like Railways. As per Hodge and Coghill, (2011) SC of public sector is considered to be a complex network. A state-owned Railways is considered to be complex organization and the level of complexity is considered to be moderate e.g., Canadian National Railways (Broad, 2006). Esposito and Passaro, (2009) acknowledged the requirement of research in the area of Railways SC and declared that mostly railways of different countries belong to the public sector with unique material requirements. They also highlighted the need of research of Railway SC at the country level. The case of Italian Railway Industry was worked on by Esposito and Passaro, (2009) in the context of Railways SC to address the issue of lack of analysis in the subject field.

A railway in each country is unique, due to geography, organization, administrative, political and social structure of the country (Ahren & Parida, 2009). They projected Railway to run leaner, green by recycling and reducing waste, and improving quality. According to

international railway benchmarking, one of the two most important cost drivers for railway maintenance is the cost of spare parts (Ahren & Parida, 2009). This cost is directly dealt by the Logistics/SC departments and needs to be dealt in an optimized manner.

The various properties of Pakistan Railways that came under consideration while conducting this research are: PMS in terms of KPIs of; PSO/SOE, Capital Intensive, SC/Logistics intensiveness, being itself a Logistics Service Provider (LSP), material diversity, geographical distributed, and complex nature of the organization structure all integrated at one place. The literature review indicates that none of the papers encompasses all these aspects at a single platform. The evolution of the SC of Railways at international level revolves around national transport operators as customers and suppliers like main manufacturers while at national level there are multiple suppliers/vendors (Esposito & Passaro, 2009).

Pollitt, (2005) believes public sector is different from private sector and needs to be addressed accordingly but some of the models and theories of private sector may be applied to public sector. Hawkins et al., (2011) in line to them detected that there are more similarities in the public and private sector management than differences and the applications may interchangeably be used in both sectors especially in the field of procurement.

Traditionalist concept defines SCM to be a subset of logistics Stock and Lambert, (2001) whereas, relabelling concept believes that SCM is the new name of logistics (Simchi et al., (2000). Council of Supply Chain Management Professionals (CSCMP) was formerly the Council of Logistics Management showing evidence of relabelling concept (Keebler & Plank, 2009). Unionist concept defines logistics to be a subset of SCM Lambert, (2004) while the intersectionist concept believes in intersection of some of the portions of SCM and logistics only (Larson et al. 2007). Logistics Management deals with the optimized flows of products and information within the organization. An important aspect of SCM is to integrate all partners in a single value chain. When SC is restricted to IBMSC than it may also be termed as In-Bound Logistics.

Without measurement; improvement, progress and re-evaluation of direction and course of action is impossible to be determined. Adcroft and Willis, (2005) discussed the importance and need of a performance measurement system (PMS) in Public Sector. They believe that at present PMS requires redesigning with respect to Public Sector. Some of the features or techniques of management may be applied from Private Sector to Public Sector and vice versa (Adcroft & Willis, 2005).

To quantify the efficiency/effectiveness of any action PM can be used (Neely et al., 2005). Companies with PMS as their integral part perform better than companies working without a PMS. Kennerly and Neely, (2003) and Ramaa et al., (2009) believed PMS to be a feedback control system for the purpose of future planning and monitoring based on past performance.

An efficient and effective PMS in a Public Sector Organization (PSO) helps in increased transparency, better accountability, Braadbaart, (2007) improved design and incentives for good performers etc. whereas a poorly defined PMS may result in a further red tapeism and bureaucratic rift along with unrealistic results (de Bruijn, 2002). Researchers like Grosvold et al., (2014) and Klassen and Verreecke, (2012) have worked on the management and measurement of procurement and SC activities of public sector.

In 2009, Keebler and Plank highlighted that most US firms do not comprehensively measure logistics performance. According to them, even the best performing firms appear that they do not realize full productivity and service benefits resulting from PM. They carried out a study on logistics/SC PMS in the USA and also indicated the need of a comprehensive study in logistics/SC PM in rest of the world in the special perspective of SC. Rhodes et al., (2012) mentioned the term "performance" with reference to results in the public sector in Italy was introduced in 2009. They further indicated the formation of an independent body in Italy for three main segments of public sector one of which is PMS of individuals and organizations. Despite all this Rhodes et al. (2012) still believes that the Italian Public Sector PMS was underdeveloped and lacks consistency along with various gaps.

Chopra and Meindl as cited in Wong and Wong, (2008) proclaimed that there are many models encompassing various aspects of PMS of a SC, however, the dynamics of whole supply chain are not captured as whole value chain. According to Kloot and Martin, as cited in Rantanen et al., (2007) "*the drive for reform in the public sector worldwide has focused attention on the PM in PSOs*". As per Cai et al., (2011) and Heng et al., (2005), Customer PSO – Supplier (Private Sector Organization) relations have undergone massive changes at national as well as at international level and needs to be redefined after regular intervals. In order to make this redefinition meaningful on both ends some concrete evidence is required in the form of PMS to evaluate the past performance of both parties and decide the future direction of both of them. In 2008, Anand and Kodali ascertained that there is an increased interest in PM in the field of Logistics and SC. Wong and Wong, (2008) also pointed out the increasing trend towards SC/Logistics PMS benchmarking.

PM is a complex task as it involves multiple inputs and multiple outputs, along with various stakeholders having dynamic requirements which may change from time to time and differ with each other (Parida et al., 2015; Walker & Brammer, 2009). In 2007, Rantanen et al., pointed out, "*There seems to be a lack of in-depth case studies that would reveal the specific challenges faced by PSOs in designing and implementing PMSs.*" Wisniewski, and Olafsson, (2004) had discussed the output (efficiency) and the outcome (effectiveness) of PMS in the public sector. The PMS of Public Sector Supply Chain from the specific perception of sustainability or resilience has been an area of interest for researchers (Versei et al., 2014; Soosay et al., 2012). The absence of a PMS will result in non-management of various industrial activities giving rise to negative social and environmental impacts (Fahimnia et al., 2013; Walker and Brammer, 2009).

Bouckaert and Halligan, as cited in Rhodes et al., (2012, p. 239), showed the adaptability of PMS in three dimensions: measurement, incorporation and use. According to Amaratunga and Baldry et al., (2015), the Procurement Executives' Association, described "*performance management*" as, "*the use of PM information to effect positive change in organizational culture, systems and processes, by helping to set agreed-upon performance goals, allocating and prioritising resources, informing managers to either confirm or change current policy or programme directions to meet those goals, and sharing results of performance in pursuing those goals*". On the other hand, Rouse and Putterill, (2003) gave quite a simple definition as the expectation versus results analysis to bring positive change is PM. It was further simplified in

terms of declaration of PMS as a management tool to find the degree of deviation of actual level from the best-in-class Choy et al., (2007) in any IBMSC.

PM is an integral part of ISO 9001: v.2000 and v.2008. It includes the PM, its analysis and improvements. In USA, the government has developed Program Assessment Rating Tool PART, (2008) in the early 2000s in order to measure performance Phusavat et al., (2009) making it a significant topic even in the 21st century for developed, developing and under developing countries. In Finland, PM is considered to be an obligation for all PSOs (Salminen et al., 2007).

With increasing competition in the global arena PM is getting more importance Sheng and Trimi, (2008) each passing day over the last two decades Hoque, (2009, p. 647). PM is considered to be a major contributor to achieve brilliance in the field of logistics Lapide, (2006). In fact the field of study is so important that The BestLog project (Best Practices in Logistics) was initiated to identify and promote best practices in the field of Logistics and SC in EU (Cuthbertson & Piotrowicz, 2008).

Firstly, it is acceptable to enhance the procurement performance of public sector by using the strategies of private sector Boyne, (2002) and Walker and Brammer, (2009) and secondly PMS is mostly cost based in majority SC as it is much easier to perceive the concept in terms of numbers by the managers. Ballou et al., (2000) and Rantanen et al. (2007) alleged that one of the problems with designing of a comprehensive PMS in a PSO is conflicting goals of the stakeholders and non-realization of actual objectives. Stakeholder theory is considered to be of vital nature when the dimension of sustainability is added to the SCM (Carter & Easton, 2011). The strategy of Analyse, Design, Develop, Implement, and Evaluate (ADDIE) must be incorporated while designing a PMS of any SC (Broad, 2006). An important aspect in the preparation of KPIs of a PMS is the inclusion of performance consultants' e.g. Hile Group, performance consultants, helping in performance improvement of Canadian National Railway's US operations in 2000-2001 (Broad, 2006). The concept of performance audit was also implemented in the public sector of Italy and France (Rhodes et al., 2012).

The role of PMS in sustainability of a SC of public sector was discussed by Varsei et al. in 2014. According to Varsei et al. (2014, p. 243), the strategic goal of assessment and making necessary redesigning and reconfiguration of an effective flow of material throughout the SC through PMS is discussed by Simchi-Levi et al.; Chopra and Meindl, while involving activities like materials acquisition, manufacturing, packaging, transportation and recycling, along with their negative environmental and social impacts due to improper management was discussed by Wisner et al. and Fahimnia et al.

Supply Chain Operation Reference (SCOR) Model is considered to be a standard operational cross industry reference with respect to PMS of SC (Field, 2006; Wong & Wong 2008). They claimed that SCOR model fails at certain instances e.g., it does not address the issue of integration synchronization. However Geary and Zonnenberg, (2000) claims that SC with implementation of SCOR yielded better results than SC working without SCOR.

French Public Sector procurement IBMSC criteria is "*quality, price, technical value, aesthetic and functional characteristics, performance in environmental protection, performance in professional integration of populations in difficulty, global usage cost, profitability,*

innovativeness, after-sale service and technical assistance, delivery date and delivery or execution time. They may be weighted or prioritized according to the particular context." (Mamavi, 2015 p. 110)

PMS is the primary phase of measurement and analysis for the optimization of any system within and outside any organization (Parida et al., 2015). According to them, past performance helps in defining/reshaping the future. According to Bradshaw and Chang, as cited in Mamavi, (2015 p. 112) Besides other important factors supplier's past performance is a critical factor in determining the procurement cases of public sector and must be considered in all case of IBMSC.

Neely et al., (2000) highlighted the issue of lack of in-depth study regarding the complexities involved in designing a proper PMS. They declared the work done in this field is shallow and needs to be worked upon. As the complexity of the SC increases it becomes impractical to take into account all the different aspects of sustainability Hubbard, (2009) or PMS into a single framework showing the research limitations of the study. Grosvold et al., (2014) identified the research gap in the area of PMS with respect to public sector in terms of KPIs. The literature review also confirmed that the majority of papers addressing PMS in SC domain of PSO are conceptual, not fieldwork based and that there is a clear lack of field research (qualitative and quantitative) (Cuthbertson & Piotrowicz, 2008). Even the industry standard model in vogue i.e. SCOR model is limited and is not properly defined to encompass the whole SC as a single chain (Cuthbertson & Piotrowicz, 2008).

In 2006, Broad indicated the vital nature of key stakeholder's role in designing PMS. The current study will do so while taking Pakistan Railways IBMSC as a case study. A multi criteria hierarchy has been used to model a PMS in the Swedish Railways (Ahren and Parida, 2009; and Stenstrom, 2012). They discussed the problem of large number of KPIs and improper definition of these KPIs in Railways.

According to Bouckaert and Halligan, as cited in (Rhodes et al., 2012, p. 239), there are three dimensions of a PMS: measurement, incorporation and use. All seven dimensions of PMS discussed by Alsyouf, (2006) are relevant to Railways SC as a PSO. They include financial, society, consumer, production, support functions, human resource and the supplier (Alsyouf, 2006). PMS for Railways is required in terms of KPIs as claimed by Wisniewski and Stewart, (2004) and validated by Rantanen et al., (2007) for optimization Gelders et al., (2007) through concerned managers by establishing a framework and finally a model with KPIs and benchmarking to achieve excellence and customer satisfaction (Grigoroudis & Siskos, 2004). The first step in PM is to identify the key performance indicators (KPIs) and the second step is to modify them as per requirements from time to time (Sheng & Trimi, 2008). These Performance Indicators (PIs) or (KPIs) play critical role in the success of a PSO and are used for PM (Adcroft & Willis, 2005).

There are general set of KPIs, however, for each industry specific KPIs need to be designed as per their requirements e.g. in 2005, Mather tailored Maintenance Scorecard (MSC) from Basic Score Card (BSC) for the field of Railways. Park et al., (2005) implemented Balance Score Card (BSC) for PMS of a SC. Rhodes et al., (2012) highlighted the introduction of KPIs in terms of traffic light colours, namely green - adequate situation, yellow – needs attention, and red – worrying in the public sector of Brazil in 2007. The program included railways for the

implementation of the subject system. In 2010, Ministry of planning of Brazil issued guidelines for development of PMS in terms of KPIs in the public Sector (Rhodes et al., 2012). By using KPIs to gauge performance in Railways IBMSC, the objectives of cost reduction and performance enhancement can be achieved, while creating reliable and sustainable supplier base for the entire system (Ahren & Parida, 2009).

Kumar et al., (2013) argued on the use of multiple KPIs and while defining these KPIs SWOT analysis must also be carried out. Besterfield et al., (2002) described the attributes of KPIs as: useful, simple, understandable and few in numbers. Woodhouse, (2000) believes in the maximum number of KPIs for a certain manager or process should be limited from four to six whereas Shreve, (2003) proposed six to eight KPIs depending on situation. In this research the author has worked on at max ten KPIs with analysis of most important to least important one through interviews (qualitative) of the stakeholders involved or through weighted score model (quantitative) through a questionnaire to assign weights from most important to least important in each category. It is also understandable that strategic KPIs will be lesser than the tactical in number and operational KPIs will be greater in number than the tactical KPIs. 37 KPIs were identified with respect to Logistics or SC by Keebler and Plank in 2009 (Keebler & Plank, 2009). Adcroft and Willis, (2005) divided KPIs into internal/external perspectives. KPIs may be divided into strategic, tactical and operational categories (Gunasekaran et al. 2001; Gunasekaran et al. 2004; Parida & Chattopadhyay, 2007; and Parida et al., 2015). Parida and Chattopadhyay (2007) have developed a multi-criteria performance measurement hierarchical MPM framework which was evaluated with positive results at Swedish Railway by (Ahren & Parida, 2009; and Stenstrom, 2012).

Mitchelson (1992) affirmed that materials management operation in a capital-intensive environment is not only critical but also extremely complex and it is reasonably challenging to design the related KPIs for an optimized PMS. He also indicated the requirement of different kind of KPIs of a PMS involved in the activities of IBMSC and ISC of Railways due to an altogether different dynamics of the organization and diversity of the *material* involved. Yet, Rantanen et al., (2007) explored that in-depth case studies are rare to be found in PSOs whereas the requirements are unique in most cases and need to be designed in the specific perspective of each organization. PMS in terms of KPIs in Italy, Portugal and Spain was introduced in the 21st century and is still a topic of discussion and research. Rhodes et al., (2012). In the field of Railways, PMS is facing the difficulties of poorly defined and large number of KPIs (Ahren & Parida, 2009; Stenstrom, 2012). Stenstorm et al., (2013) mapped KPIs for Railways infrastructure and compared them with European Standards. In Spain, and Italy KPIs in the public sector were adopted in 2010 (Rhodes et al., 2012).

Rubinson and Pfeiffer, as cited in Gelders et al., (2007, p. 172) has indicated the need of framework of PMS in terms of KPIs to achieve the goal of success for an organization. Frameworks may range from a basic/primary level to advanced level (Parida et al., 2015). The framework may base on theory, common sense, description, intuition, or logic (Rouse & Putterill, 2003). They elaborated frameworks to be the defining outline of several boundaries and relationships among various defined/designed parameters of the system. The framework is the base of model building and further evolves into a model which is further evolved into an end

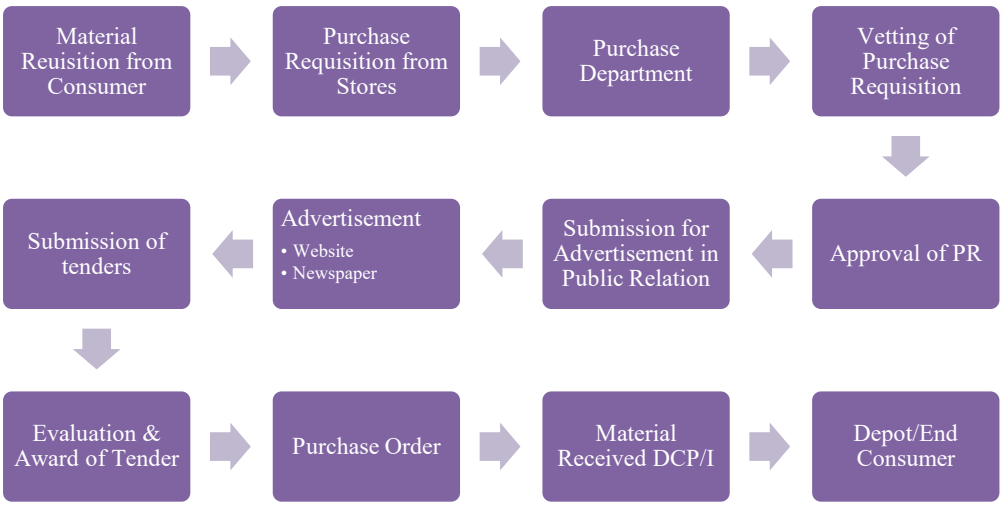
product i.e. final PMS. As it is considered to be a base line work in relations to PSO SC as well as Railways SC, hence it is kept a framework instead of a model or comprehensive PMS. This framework may be flawed or contains various issues which can only be rectified after repeated tests by the concerned industry professionals.

In order to keep the IBMSC system efficient and effective, a certain set of KPIs also known as KSIs are required to be designed and enforced. Cuthbertson and Piotrowicz (2008) identified that mostly cost, time, quality and customer are extensively used KPIs while social and environmental factors are generally ignored. Material cost for IBMSC plays an important role while designing the KPIs as discusses earlier by many managers (Kumar et al., 2013). Ahren and Parida (2009) specified the need of further research in finding methods for selection and evaluation of KPIs in the Railways SC. The purpose of this study is to fill in the gaps and design a framework for performance measurement with respect to IBMSC system of Pakistan Railways. The designed performance measurement system is based on KPIs which are different for Strategic, Tactical and Operational in the internal and external perspective.

2.1 How PR IBMSC works

It is widely accepted by the researchers that a supply chain is a system involved in moving a product or service from supplier to consumer. When it is restricted to IBMSC, the system will reduce to the movement of product or service from first tier supplier to the organization only, i.e. a B2B relationship comprising of one client (PR) and one or multiple vendors.

Figure No 1: Activities involved in IBMSC of P.R. (PRSD, n.d.)



Note: Developed from the inferences obtained from Pakistan Railways source documents

The system of IBMSC is dealt by Stores department and purchase departments (PRYB, 2014 - 15). The procurement demand/requirement of the consuming departments namely, electrical, mechanical, civil, telecom, signal, and medical is submitted to the stores department in the form of Material Requisitions (MR) (PRJOC, n.d.). This material requisition is either by creating a new stock item or through existing stock items (PRSC, n.d.). If a new stock item is created its average monthly consumption AMC all over Pakistan is determined by the head of the consuming department (PRSD, n. d.). There are three types of movements in the IBMSC namely, material flow, information flow, and funds flow. The study will deal only with the flow of IBMSC

and measuring the performance of this flow. This includes forecasting which is based on three years moving average of any particular item (called stock usage report SUR) (PRSC, n.d.) and procurement through purchase branch. It also includes quality assurance of the products. The warranty claims are dealt by the purchase department but are excluded from this study as it is a reverse logistics activity (PRSD n. d.).

2.2 Key Statistics in IBMSC

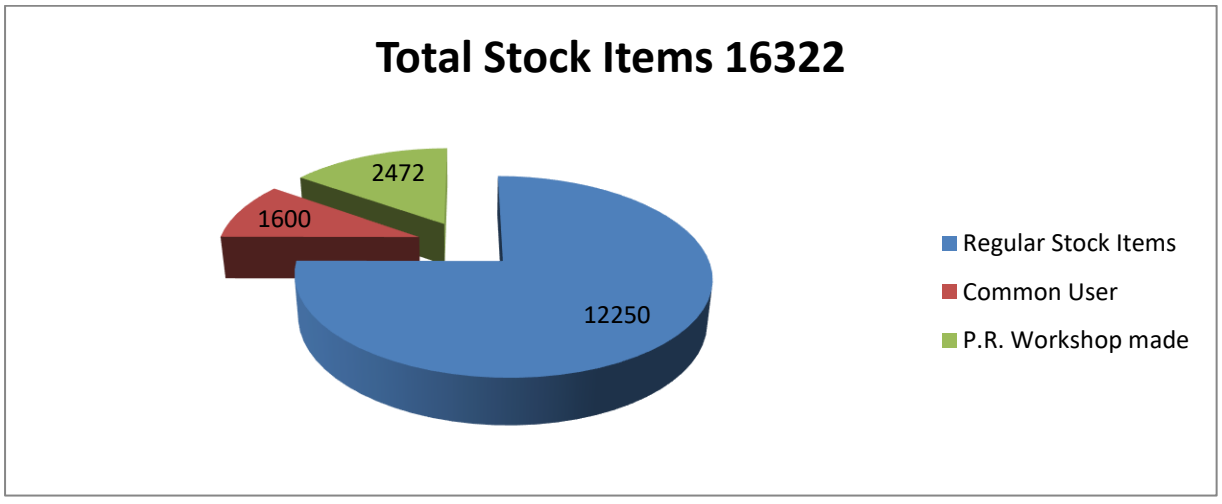
Table No 1: Break up of Amount spent on procurements by Pakistan Railways

Procurement By Purchase Department Year 2014-15	(Amount in Million Rs.)
Imports	1018.889
Customs Duty & Sales Tax etc.	248.363
Indigenous Purchases	
CCP/TSO	2394.220
Steel Shop/MGPR	9.442
Divisions Superintendents Other than CCP	9.324
Sea Freight (Internal)	29.017
Fuel other than operation	59.160
Value added in Workshops	256.614
Value added in Steel Shops	26.529
Total	**4292.558**

Note: Data taken from PRYB 2014-15

Regular stock items pertaining to Mechanical, Civil, Electrical, Signal & Telecommunication Departments and different other consumers are stocked in 17 Stocking Depots located at Lahore, Karachi, Hyderabad, Sukkur, Quetta, Jehlum and Rawalpindi to ensure un-interrupted supply of material to the end users (PRYB, 2014-15).

Figure No 2: Break-up of Pakistan Railways Items



The details of the amount spent is mentioned through table 1 as under:

Currently there are 16322 Regular Stock Items whereas 1600 items have been declared as common user items and the principle of Just in Time (JIT) is applied in common user items as well as for local purchase (PRYB, 2014-15). Moreover, there are 2472 Pakistan Railways

Workshop Made Items; Local Items are 8698 while Imported Items are 5152 (PRYB, 2014-15). An important aspect of procurement of Pakistan Railways is its unique requirements. The level of expertise, technology used and nature is quite sophisticated, complex and time consuming.

Due to lack of ERP system, no concrete PMS exists for PR's IBMSC. The purpose of this paper is, performance measurement is done at various occasions and ignored on others instead of making and implementing a comprehensive performance measurement system.

3. Research Methodology

The research paradigm used to conduct this research is *Interpretivism.* The framework for PMS is subjective in nature and may change or have multiple approaches to deal with. It may vary with respect to organization, time, country, culture and technology involved. PM should be designed as per requirements of the organization in which they have to be implemented (Kaplan and Norton, and Pongatichat and Johnston, as cited in Phusavat et al., 2009 p. 647). Phusavat et al., (2009) used the research method of interview and review of documents to find the necessary PM in the PS. Woodside and Yin, as cited in Wahyuni, (2012 p 72.) had defined case study as a research method used for in-depth analysis of real life phenomena in its actual context. Yin declared that case studies are suitable for all such kind of activities involved in generating significant consequences (Yin, 2014). The study may be considered as a Type II: Single Case Study with Embedded Design. Qualitative research method is used to conduct the subject study. There are numerous difficulties in obtaining information from PS, especially in countries like Pakistan. Keeping in view the above problem, a non-probabilistic / non-statistical sampling technique is used. Purposive Sampling is used in this case.

Pakistan Railways (PR) case study has been chosen, because the organization is unique in terms of its material requirements and operations within the country (PRSD, n. d.). The IBMSC involves readily available FMCG to sophisticated system of imports related to Railway Engines, their parts and rails etc. from countries having different styles and mode of working across the globe including China, USA and Europe (PRSD, n. d.). The system involves thousands of stock items as well as many non-stock items. The whole procedure is expected to be working in an efficient, economical and expeditious manner. The unit of analysis is the management (managers) involved in the IBSC of Pakistan Railways. This includes managers working in Stores Department (SC managers of focal firm), Purchase Department (SC managers of focal firm), Consuming Departments (Civil, Electrical, Mechanical, Telecommunication, Traffic, Hospitals, and Signal departments; end consumers / managers), first-tier suppliers (managers) and reverse logistics first-tier purchasers (managers). The reliability of this study is ensured through triangulation; a well-established scientific method for reliability of content, through department's source documents, archival records, participant's observation, and semi-structured interviews. As it is a single case study hence external validity (generalizability) may not be obtained. However, construct validity and internal validity are realized. Three types of protocols have been observed during the current research namely case study protocol, interview protocol, and reporting protocol. As per my knowledge, this is the first kind of study that investigates the PMS for PSOs IBMSC, taking Pakistan Railways as a case study.

As the literature review has already established that very little research has been done in the subject area and keeping in view the level of employment of SC concepts in the subject

organization and country, data triangulation is used to verify the results of the study, including interviews (guided / semi structured) with the managers of stakeholder organizations and focal firm involved in whole system of IBMSC. All the frameworks that have been discussed earlier in literature review have one or more drawbacks. In short none of the existing frameworks are fully suitable for the subject study. The PR SC is unique and distinct, so the requirements are also different. Being a PSO, capital intensive, engineering distinct, geographically distributed, culturally different, itself LSP, general as well as specific material requirements, makes it a matchless candidate for exploratory research. The study is designed to be a framework, because it is the base line work in the subject field and may contain flaws and errors. The framework needs to be tested extensively in order to further evolve into a comprehensive model. It defines the boundary conditions, relationships among the stakeholders involved and the whole SC.

3.1 Drivers of Performance Measurement

Parida et al., as cited in Kumar et al., (2013, p. 238) proclaimed that PM is required because of the fact that improvement is directly dependent on measurement and is the basis to decide the various changes at different levels. Keebler and Plank, (2009) believes that by logistics PM in a SC, the objective of cost reduction in the whole SC may be achieved and even some of the best firms failed to grasp the true potential of the concept. In order to achieve the objectives of good governance, transparency, and accountability, PM is an essential management tool in any public sector organization (Phusavat et al., 2009). One of the major drivers of PMS is previously poorly defined measures (Bourne et al., 2003). PM increases SC integration (Gunasekaran et al., 2001). Parida and Kumar (2006) identified six drivers of PMS namely; measuring values, justifying investment, revising resource allocations, focus on knowledge management, adapting to new trends, and implement organizational structural changes. Varsei et al., (2014) declared involvement of various stakeholders and institutional pressures as the main drivers of performance.

The above mentioned may also be considered to be the major drivers of PM of PR's IBMSC. There are some common business goals in most of the organizations and are applicable in the case of PR also, these are:

The sixth question was a detailed one; it was "What are the factors that drive the Performance Measurement of PR Material Supply Chain?" the question was further sub-divided into three sub-questions which are What are the factors that drive the PM of PR IBMSC?, What are the factors that drive the PM of PR IMSC?, What are the factors that drive the PM of PR RL?

All the participants answered with five or more than five factors. Some of these factors were common while others were different. The factors that derive the Performance Measurement, found common in the sub questions are listed together, whereas the rest will be explained against each category.

- Transparency.
- Accountability.
- Good Governance.
- Adapting to new trends.
- Overall System optimization.

- Sustainability.
- Improved System Reliability.
- Better Conflict Resolution between various stakeholders.
- Better Employee performance.
- SWOT Analysis.
- To track, monitor and optimize progress, targets and objectives of individuals and sub-processes.
- Better SC integration.
- Previous non-measurement led to poor performance.
- Improper Designed PMS.
- Overall SC Cost Reduction.
- Better Decision making by stakeholders.
- Implementation of Governmental policies, procedures and rules.
- Better Resource Allocation.
- Better Quality Product Availability.
- Following International Standards.
- Better Understanding of systems and processes.
- Lesser Stock outs.
- Standardization of processes and products.
- Actual System Cost can be evaluated.
- Improvement in Buyer-Supplier Relations.
- Improving Time Efficiency through Better Scheduling of tasks and activities.

3.2 Constraints/Problems

Generally, there are various constraints in PM of an organization (Kumar et al., 2013). Different researchers pointed out various constraints in different public as well as private sector organizations. The ones listed below are believed to be suitable for the fulfilment of the scenario of IBMSC of PR.

All the participants answered with five or more than five constraints. Some of these constraints were common while others were different. The constraints/problems in Performance Measurement of PR, found common in the sub questions are listed together, whereas the rest will be explained against each category.

- Lack of ERP System/computerization.
- Significant Time and resource investment.
- Lack of accountability.
- Usefulness of PMS.
- Difficulty in conflict resolution.
- Undefined goals.
- Unacceptable results of PMS.
- Correct defining and identifying the KPIs.
- Impractical strategy/policy.

- Design Usefulness and Credibility.
- Lack of Resources.
- Low HR Development.
- Involvement of too many stakeholders difficult to manage.
- Lack of ownership.
- Data Collection.
- Mismanagement of respective bodies.
- Measurement mistrust.
- Fear of misuse against employees or sub-departments.
- Lack of understanding of procedural working.

Kumar et al. (2013) offered the use of shortlisting specific KPIs from common KPIs as per situational needs of the organization and also divided them into internal and external perspectives. The framework for PMS of IBMSC of PR is given in figure 3 below:

Figure No 3: Proposed Framework of Performance Measurement System PMS of Pakistan Railways in terms of KPIs

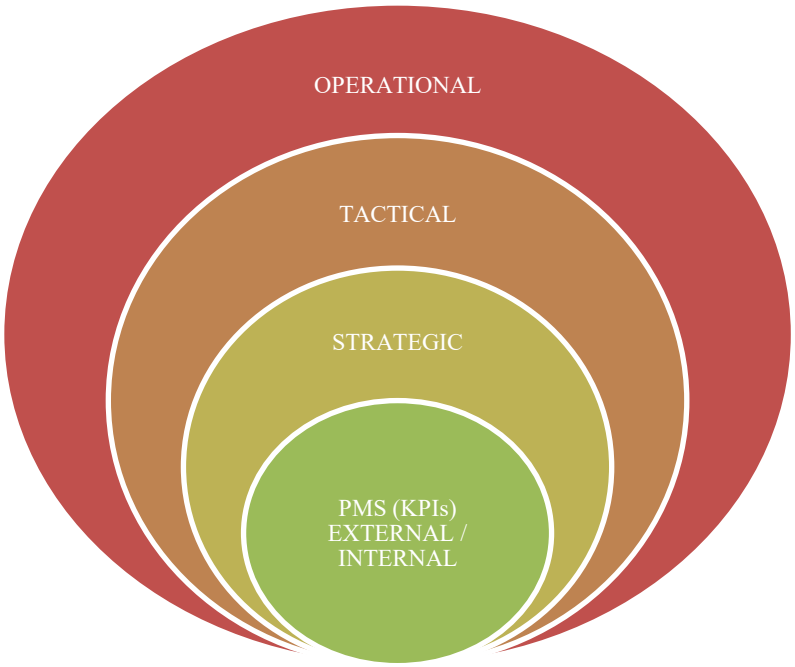


Table No 2: KPIs obtained from Interviews for PMS of PR IBMSC

		Strategic	Tactical	Operational
		HR requirement.	System Capacity utilization rate.	Order cycle time.
	I	HR availability rate.	No. of products increased.	Inventory obsolescence.
I	N	HR utilization.	Forecast accuracy.	Lot Size Flexibility.
N	T	Cost Saving through	Increase in procurement volume.	Average Response time.
B	E	healthy Competition.	Internal Conflict Resolution %.	Contingency including
O	R	ROI.	Avg. Time taken to resolve conflicts.	Demurrage.
U	N	Total System Capacity.	Cost savings through direct purchase.	Procurement Cycle time.
N	A	Profit gain/loss due to	No. of orders/time.	Response to consumer
D	L	market trend.	% Increase in Purchase orders.	enquiries.
		Competition Improvement	System Efficiency.	Payment Processing time.
		Rate.	System Effectiveness.	Response to consumer
M		Increase in Suppliers.	Scheduled Task time efficiency.	enquiries.
A		Productivity.		Flexibility to change.
T				Expeditious work in
E				emergencies.
R				Contract flexibility.
I				Order consistency.
A		Supplier Reliability.	Lead time variability.	Fill Rate.
L	E	Supplier Past Performance.	No. of over/short/ defective delivery.	Invoice accuracy.
	X	After Sales Service.	Supplier Share growth/product.	Customer Service Response
	T	Return on Sales.	Taxes to Government.	Time.
S	E	Product Diversity.	Incomplete/Complete Sale orders/yr.	Product Price variance.
U	R	Fulfilment of industry	Delivery Terms variability.	Product Accuracy.
P	N	regulations.	% Complete Purchase orders / yr /	Order consistency.
P	A	Maintain Industry &	supplier.	Delivery consistency.
L	L	Environmental Standards.	Best in class services.	On-time delivery.
Y				Avg. Response time.
				Perfect Order Fulfilment.
C	J	Buyer-Supplier	Transparent tendering.	Meantime of procurement.
H	O	Relationship.	Standardized products.	Flexibility to meet particular
A	I	HR capacity building.	Effective Contract utilization rate.	needs.
I	N	Policy Flexibility.	Overall system reliability.	No of successful contracts.
N	T	Service Level.	Overall Equipment Effectiveness (OEE).	Variable Order Quantity.
		Mutual assistance in	No. of External Conflicts.	Response time to problems.
	I	solving problems.	External Conflict resolved %.	Logistics Costs.
		Supplier Development.	Product Q/A and Q/Standards	Inquiry Response Time.
	+	Net IBMSC System	Effective Fund utilization.	No. of Perfect Orders.
		Improvement.	Effective Contract utilization.	PM Cost.
	E	HR efficiency.	Consumer satisfaction Level.	Correct Order Processing.
			Ability to meet particular needs.	
			Performance Improvement through PM.	

4. Discussion and Analysis

PMS has become an essential tool towards performance enhancement of any organization. The factors like public sector organization, geographically distributed organization, capital

intensiveness, engineering extensive and itself logistics service provider makes the importance of PMS critical for the organization. Moreover, there is an increasing demand of bringing around good governance and transparency in the public sector. The IBMSC of government is of significant quantity as the government is the largest client in any country. Mostly monitoring and evaluation systems are apprehended by organizations due to unfavourable results but in order to proceed in a forward direction PMS is the first step in defining the path of the organization. Being an SOE, PR needs to pay much more attention towards developing a comprehensive and detailed framework of PMS which can further be evolved into a comprehensive PMS of the organization. The performance evaluation is done at different levels and in lesser details and cannot be measured as a whole system (one unit with sub units) along with supplier integration into a single value chain. There are some joint goals that can be viewed in external as well as internal perspective jointly. Researchers used strategic PM to measure long term goals / objectives and are mostly decided by top management. Similarly, tactical PM is used to measure midterm goals / objectives and are mostly decided by middle tier management (time horizon for tactical PM is one year), and lastly operational PM is used to measure short term goals / objectives and are mostly decided by lower tier of management (time horizon for operational PM is day to day activities).

5. Conclusion and Future Research Areas

IBMSC plays a pivotal role in the success of a capital-intensive organization in today's competitive world. In order to achieve the goal of resilience, efficiency and effectiveness, a remarkable devised PMS is need of the hour. The PMS will enhance the performance of the system with continuous monitoring and feedback. In the absence of a well-designed and tailor-made ERP system, the efficient and effective working of any kind of PMS is a difficult task and is a major limitation towards the implementation of this study. Many kinds of PMSs are available for various SC, however for the subject purpose; the design of a proper PMS is rare. The purpose of this study is to propose a framework for PMS in the specific scenario of Pakistan Railways' IBMSC, a case study. The proposed framework is based on various KPIs. These KPIs are further subdivided to indicate and monitor strategic, tactical, and operational matters in internal and external perspectives. The whole KPIs are designed from literature review and experience of the organization. The list of KPIs needs to be further verified, and validated through qualitative or quantitative analysis. Different weights may be defined to calculate each KPIs depending on its significance and the results be evaluated for any positive change in the PMS. A similar analysis may also be carried out to determine the key risk indicator (KRIs).

6. References

(Pakistan Railways Joint Procedure Office Orders (PRJPOC)

(Pakistan Railways Source Documents (PRSD)

Adcroft, A. & Willis, R. (2005). The (un)intended outcome of public sector performance measurement. *International Journal of Public Sector Management*, *18*(5), 386-400.

Ahren, T. & Parida, A. (2009). Maintenance performance indicators (MPIs) for benchmarking the railway infrastructure: a case study. *Benchmarking – An International Journal*, *16*(2), 247-258.

Alsyouf, I. (2006). Measuring maintenance performance using a balanced scorecard approach. *Journal of Quality in Maintenance Engineering*, *12*(2), 133-149.

Anand, G. & Kodali, R. (2008). Benchmarking the benchmarking models. *Benchmarking: An International Journal*, *15*(3), 257-91.

Besterfield, D., Besterfield-Michna, C., Besterfield, G. & Besterfield-Sacre, M. (2002). *Total Quality Management*, Prentice Hall International Inc, Upper Saddle River, NJ.

Bourne, M., Mills, J., Wilcox, M., Neely, A. & Platts, K. (2000). Designing, implementing and updating performance measurement systems. *International Journal of Operations & Production Management*, *20*(7), 754-771.

Bourne, M., Neely, A., Mills, J. & Platts, K. (2003). Implementing performance measurement systems: a literature review. *International Journal of Business Performance Management*, *5*(1), 1-24.

Bowersox, D. J., & Closs, D. J., (1997). Brazilian logistics: a time for transition. *Gestao & Producao*, *4*(2), 130-139.

Bowersox, D. J., Closs, D. J., & Stank, T.P., (1999). 21st Century Logistics: Making Supply Chain Integration a Reality. *Council of Logistics Management*, Oak Book, IL.

Boyne, G. (2002). Public and private management: what's the difference? *Journal of Management Studies*, *39*(1), 97-122.

Braadbaart, O. (2007). Collaborative benchmarking, transparency and performance evidence from the Netherlands water supply industry. *Benchmarking: An International Journal*, *12*(6), 677-92.

Broad, M. L. (2006). Improving performance in complex organizations. *Industrial and Commercial Training*, *38*(6) 322-329.

Callender, G. (2011). Alignment of inter-agency supply chains to enhance public sector performance management. *International Journal of Productivity and Performance Management*, *60*(1), 9-23.

Carter, C.R. & Easton, P. (2011). Sustainable supply chain management: evolution and future direction. *International Journal of Physical Distribution and Logistics Management*, *41* (1), 46-62.

Chan, F., Chan, H. & Qi, H. (2006). A review of performance measurement systems for supply chain management. *International Journal of Business Performance Management*, *8*(2/3), 110-124.

Cho, D.W., Lee, Y.H., Ahn, S.H., & Hwang, M.K. (2012). Framework for measuring the performance of service supply chain management. *Computers & Industrial Engineering*, *62*(3), 801-818.

Choy, K.L., Chow, H.K.H., Lee, W.B. & Chan, F.T.S. (2007). Development of performance measurement system in managing supplier relationship for maintenance logistics providers. *Benchmarking: An International Journal*, *14*(3), 352-68.

Ciolomic, I. A., & Beleiu, I. N. (2023). What are State-Owned Enterprises?. *Revista de Management Comparat International*, *24*(3), 418-429.

Cuthbertson, R. & Piotrowicz, W. (2008). Supply chain best practices – identification and categorization of measures and benefits. *International Journal of Productivity and Performance Management*, *57*(5), 389-404.

de Bruijn, H. (2002). Performance measurement in the public sector: strategies to cope with the risks of performance measurement. *International Journal of Public Sector Management*, *15*(7), 578-94.

Esposito, E. & Passaro, R. (2009). Evolution of the supply chain in the Italian railway industry. *Supply Chain Management: An International Journal*, *14*(4), 303-313.

Fahimnia, B., Reisi, M., Paksoy T., & Ozceylan, E. (2013). The implications of carbon pricing in Australia: an industrial logistics planning case study. *Transportation Research Part D: Transport and Environment*, *18*, 78-85.

Field, A. (2006). Keeping SCOR. *Journal of Commerce*, *5*, p. 1.

Garcia, F. A., Marchetta, M. G., Camargo, M., Morel, L., & Forradellas, R. Q., (2012). A framework for measuring logistics performance in the wine industry. *International Journal of Production Economics*, *135*(1), 284-298.

Gattorna, J. Day, A. & Hargreaves, J. (1991). Effective Logistics Management. *Logistics Information Management*, *4*(2), 2-86.

Geary, S. & Zonnenberg, J.P. (2000). What is means to be best in class? *Supply Chain Management Review*, *4*(3), 42.

Gelders, D. Pieter, J. Mirjam, V. & Seydel, E. (2007). Performance communication of the Belgian Railway. *Journal of Communication Management*, *11*(2), 170-181.

Grigoroudis, E. & Siskos, Y. (2004). A survey of customer satisfaction barometers: some results from the transportation-communications sector. *European Journal of Operational Research*, *152*, 334-53.

Grosvold, J. Stefan, U. Hoejmose, Jens K. & Roehrich, (2014). Squaring the circle. *Supply Chain Management: An International Journal*, *19*(3), 292-305.

Gunasekaran, A. Patel, C. & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations & Production Management*, *21*(1), 71-87.

Gunasekaran, A., Patel, C. & McGaughey, R.E. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics*, *87*(3), 333-47.

Hawkins, G. Gravier, J. & Powley, H. (2011). Public versus private sector procurement ethics and strategy: what each sector can learn from the other. *Journal of Business Ethics*, *103*(4), 567-586.

Heng, M.S.H., Wang, Y.C.W. & He, X. (2005). Supply chain management and business cycles. *Supply Chain Management: An International Journal*, *10*(3), 157-61.

Hubbard, G. (2009). Measuring organizational performance: beyond the triple bottom line. *Business Strategy and the Environment*, *18*(3), 177-191.

Inman, R.A., Sale, R.S., Green, Jr, K.W. & Whitten, D. (2011). Agile manufacturing: relation to JIT, operational performance and firm performance. *Journal of Operations Management*, *29*(4), 343-355.

Jothimani, D. & Sarmah, S.P. (2014). Supply chain performance measurement for third party logistics. *Benchmarking: An International Journal*, *21*(6), 944-963.

Keebler, J. S. & Plank, R. E., (2009). Logistics performance measurement in the supply chain: a benchmark. *Benchmarking: An International Journal*, *16*(6), 785-798.

Kennerly, M. & Neely, A. (2003). Measuring performance in a changing business environment. *International Journal of Operation & Production Management*, *23*(2), 213-229.

Klassen, R.D. & Vereecke, A. (2012). Social issues in supply chains: capabilities link responsibility, risk (opportunity) and performance. *International Journal of Production Economics*, *140*(1), 103-115.

Kumar, U., Galar, D., Parida, A., Stenstrom, C., & Berges, L. (2013). Maintenance performance metrics: a state-of-the-art review. *Journal of Quality in Maintenance Engineering*, *19*(3), 233-277.

Lambert, D. M., (2004). The Eight Essential Supply Chain Management Processes. *Supply Chain Management Review*, *8*(6), 18-26.

Lapide, L. (2006). MIT's SC2020 project: the essence of excellence. *Supply Chain Management Review*, *10*(3), 18-24.

Larson, P. D., Richard F. P., & Halldorsson, A., (2007). Perspectives on Logistics vs. SCM: A Survey of SCM Professionals. *Journal of Business Logistics*, *28*(1), 1-24.

Mamavi, O., Nagati, H., Pache, G., & Frederick T. W. (2015). How does performance history impact supplier selection in public sector? *Industrial Management & Data Systems*, *115*(1), 107-128.

Maron, A. (2022). Public service, private delivery: Service workers and the negotiation of blurred boundaries in a Neoliberal State. *Work, Employment and Society*, *36*(6), 1060-1077.

Mather, D. (2005). *The Maintenance Scorecard: Creating Strategic Advantage*, Industrial Press, New York, NY.

Meena, P.L. & Sarmah, S.P. (2012). Development of a supplier satisfaction index model. *Industrial Management & Data Systems*, *112*(8), 1236-1254.

Mitchelson, M. (1992). Materials Management in Capital-intensive Industries. *International Journal of Physical Distribution & Logistics Management*, *22*(3), 15-19.

Muhammad, M., Chaudhry, M. A., Syed, S. H., & Saeed, M. (2023). Instability of government revenues and expenditures: implications for budget deficit in Pakistan. *Quality & Quantity*, *57*(6), 4971-4983.

Naveed, S., Jadoon, M. Z. I., & Farooqi, M. R. (2023). HRM in the public administration in Pakistan: from personnel administration to strategic alignment. In *Handbook on Asian Public Administration* (pp. 311-326). Edward Elgar Publishing.

Neely, A., Gregory, M. & Platts, K. (2005). Performance measurement research development in the last decade and a research agenda for the next. *International Journal of Operations and Production Management*, *25*(12), 1264-1277.

Neely, A., Mills, J., Platts. K., Richards, H., Gregory, M., Bourne, M., & Kennerley, M. (2000).

Overman, S., & Schillemans, T. (2022). Toward a public administration theory of felt accountability. *Public Administration Review*, *82*(1), 12-22.

Pakistan Railways Stores Code (PRSC, n.d.)

Pakistan Railways Yearbook (PR YB 2014 – 15)

Parida, A. & Kumar, U. (2006). Maintenance performance measurement (MPM): issues and challenges. *Journal of Quality in Maintenance Engineering*, *12*(3), 239-251.

Parida, A. Kumar, U. Galar, D. & Stenstorm, C. (2015). Performance measurement and management for maintenance: a literature review. *Journal of Quality in Maintenance Engineering*, *21*(1), 2-33.

Performance measurement system design: developing and testing a process-based approach. *International Journal of Operations & Production Management*, *20*(10), 1119-1145.

Pollanen, R. (2005). Performance measurement in municipalities: empirical evidence in Canadian context. *International Journal of Public Sector Management*, *18*(1), 4-24.

Rahman, K., & Iqbal, Q. (2025). Optimizing railway train selection in Pakistan using confidence-driven intuitionistic fuzzy methods with einstein-based operators. *J. Intell Manag. Decis*, *4*(1), 66-77.

Rantanen, H. Harri, I. Antti, K. & Kujansivu, P. (2007). Performance measurement systems in the Finnish public sector", *International Journal of Public Sector Management*, *20*(5), 415-433.

Rhodes, M. L. Biondi, L. Gomes, R Melo, A. I. Ohemeng, F. Perez-Lopez, G. Rossi, A. & Sutiyono, W. (2012). Current state of public sector performance management in seven selected countries. *International Journal of Productivity and Performance Management*, *61*(3), 235-271.

Robinson, E.P., Sahin, F. & Gao, L.L. (2008). Master production schedule time interval strategies in make-to-order supply chains. *International Journal of Production Research*, *46*(7), 1933-1954.

Rouse, P. & Putterill, L. (2003). An integral framework for performance measurement. *Management Decision*, *41*(8), 791-805.

Sheng, H. & Trimi, S. (2008). M-government: technologies, applications, and challenges. *Electronic Government: An International Journal*, *5*(1), 1-18.

Shreve, D.W. (2003). *Integrated Condition Monitoring Technologies*, IRD Balancing LLC, Worthington, OH.

Soosay, C. Fearne, A. & Dent, B. (2012). Sustainable value chain analysis – a case study of Oxford Landing from "vine to dine". *Supply Chain Management: An International Journal*, *17*(1), 68-77.

Stenstrom, C. (2012). Link and effect model for performance improvement of railway infrastructure. *Licentiate thesis, Lulea University of Technology, Lulea*, ISBN 1402-1757.

Stenstrom, C., Parida, A., Kumar, U. & Galar, D. (2013). Performance indicators and terminology for value driven maintenance. *Journal of Quality in Maintenance Engineering*, *19*(3).

Stock, JR & Lambert, DM. (2001). Strategic Logistics Management, *4th edition*. Boston: McGraw-Hill International Edition.

Uyarra, E. & Flanagan, K. (2010). Understanding the innovation impacts of public procurement. *European Planning Studies*, *18*(1), 123-143.

Varsei, M. Soosay, C. Fahimnia, B. & Sarkis, J. (2014). Framing sustainability performance of supply chains with multidimensional indicators. *Supply Chain Management: An International Journal*, *19*(3), 242-257.

Walker, H. & Brammer, S. (2009). Sustainable procurement in the United Kingdom public sector. *Supply Chain Management: An International Journal*, *14*(2), 128-137.

Wisniewski, M. & Stewart, D. (2004). Performance measurement for stakeholders: the case of Scottish local authorities. *International Journal of Public Sector Management, 17*(3), 222-233.

Woodhouse, J. (2000). Key Performance Indicators in Asset Management. *Woodhouse Partnership Ltd*, Institute of Asset Management, Bristol.