

**ROLE OF MAINTENANCE MANAGEMENT OF ROLLING STOCK
IN BANGLADESH RAILWAY
A STUDY TO ASSESS EFFECTIVENESS AND EFFICIENCY**

**Dissertation submitted in partial fulfillment of the requirements for the
Degree of Masters in Procurement and Supply Management**

Submitted by

Md. Shafiqul Islam
MPSM, Batch 7
ID-14282014

Masters in Procurement and Supply Management

February 2015



**BRAC Institute of Governance and Development,
BRAC University**

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February 2015



**BRAC Institute of Governance and Development,
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DECLARATION

It is hereby declared that this dissertation or any part of it has not been submitted elsewhere for the award of any degree or diploma.

February, 2015

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MPSM, Batch 7
ID-14282014
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CERTIFICATE

This is my pleasure to certify that the dissertation entitled "*Role of Maintenance Management of Rolling Stock in Bangladesh Railway: A Study to Assess Effectiveness and Efficiency*" is an original work from Mr. Md. Shafiqul Islam that is completed under my direct guidance and supervision. I also certify that I have gone through the dissertation and found it satisfactory for submission to the BRAC Institute of Governance and Development (BIGD), BRAC University in partial fulfilment of the requirements for the degree of Masters in Procurement and Supply Management.

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PREFACE

This Research Paper entitled “*Role of Maintenance Management of Rolling Stock in Bangladesh Railway: A Study to Assess Effectiveness and Efficiency*” is submitted to BRAC Institute of Governance and Development (BIGD), BRAC University as a requirement for the degree of Masters in Procurement and Supply Management (MPSM).

Maintenance Management plays a strategic role in an organization's competitive success. Maintenance Management of Rolling Stock is very important in any business like mass transportation where integrated material purchasing, Inventory, HRM, Maintenance & Operation Management co-exist and focus on providing satisfactory customers care. The efficient and effective maintenance management is a competitive weapon, which plays a vital role in successful train operation because it is complementary to safe and uninterrupted train services resulting optimum profit and customer satisfaction.

Facilities and practice of Maintenance Management of Rolling Stock vary from country to country depending on types of rolling stock, technology available, financial capability and adaptation of modern management thoughts. But the basic system of maintenance of rolling stock is standard all over the world. Its efficient and effective practice bears a great significance in Bangladesh Railway, a state-owned transport and utility service providing organization with a view to achieving safe, efficient and economic transport service, contributing to the economic growth as well as facing challenging role in national crisis mitigation such as devastating floods of 1988 and 1998, war and transport strikes called on by the private sector transport owners and the opposition political parties.

In case of transport industry maintenance management has been doing the key job for safe, punctual and accident free travel of people and goods. It is universally accepted that inefficient and ineffective maintenance management practice is one of the main hindrances in profit maximization and achieving the customer satisfaction as far as the target level is concerned. Hence, this study on “*Role of Maintenance Management of Rolling Stock in Bangladesh Railway: A Study to Assess Effectiveness and Efficiency*” can be said to be a time-worthy initiative to unearth the invaluable points required to be addressed in both public sector and private transport enterprises.

ABSTRACT

There is no denying to the fact that the safety and reliability of railway transportation system largely depends on efficient maintenance of rolling stock or whatsoever. Such goal needs a scientific and efficient maintenance management.

Bangladesh Railway owns a big fleet of rolling stock, sophisticated and conventional and a vast organization is at work round the clock to look after them for optimum utility and efficient service for its users, for this reason proper maintenance is necessary.

The main objective of this study is to identify the efficiency and effectiveness of maintenance management of rolling stock and its impact on railway operation. The investigation particularly included determining the existing performance of maintenance and productivity of the management which is related to the rolling stock maintenance and also the scope of maintenance management enrichment.

Mainly Data was collected from secondary sources from various monthly reports prepared by mechanical and stores department, statistical Information Book 2013 of Bangladesh Railway etc. Text books, Reference books, published journals, articles, Carriage & Wagon manual, loco shed manual, Workshop manual are studied. Primary data are collected by interviewing employees, shop and depot in-charges, from the seniors, retired and knowledgeable persons and railway officials who are conversant with the maintenance management of rolling stock Bangladesh Railway. Some primary data collected through observation and from secondary maintenance management for assessing efficiency and effectiveness of maintenance management.

BR is a state owned service provider. It provides safe, comfortable and economic transport services to the passengers and thus government is paying Public Service Obligatory (PSO) grant. The losses and declining operational performance is closely related with efficient and effective maintenance management of rolling stock. It is true that the practice of maintenance management in BR is so far from the modern concept of management. The author has tried to assess efficiency and effectiveness of maintenance management and to identify the constraints, weakness, and finally concluding with some

recommendations coping up those issues with modern and current practices in maintenance management system.

The area of the study covered the effectiveness and efficiency of maintenance management of rolling stock of different workshop and sheds (Pahartali, Chittagong, Dhaka, Parbatipur, Dinajpur, Saidpur) of Bangladesh Railway, which was based on primary and secondary data.

After examining and assessing, it was found that existing maintenance management of rolling stock in BR is inefficient and ineffective and the subsequent impact is resulting in a decrease in the earning of BR annually. For a state owned Enterprise, the poor maintenance management can be attributed to the following causes. These are (i) Traditional maintenance system and averaged, under capacity facilities of maintenance, (ii) Inefficient and traditional HRM practice, (iii) Insufficient budget allotment, (iv) Inefficient and ineffective safety management, (v) Want of practice of modern maintenance management.

For improvement of these situations, some specific recommendations have been drawn. These are (i) BR should clearly define its vision, objectives and policies and to follow modern concepts, policies & practice of maintenance management, inventory and purchasing management., (ii) BR should reorganize its manpower management with modern concept of HRM, (iii) BR should invest adequate fund for re-engineering its workshops, depots and loco sheds with modern equipment and facilities, (iv) Adequate budget should be allocated for material purchase, (v) BR should adopt the modern concept, tools and technologies in case of all related management including maintenance management.

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ABBREVIATIONS AND ACRONYMS

MPSM	: Masters in Procurement and Supply Management
BG	: Broad Gauge
BIGD	: BRAC Institute of Governance and Development
BR	: Bangladesh Railway
BRASS	: Bangladesh Railway Automated Support System
CCS	: Chief Controller of Stores
CIDA	: Canadian International Development Agency
CLW	: Central Locomotive Workshop
CME	: Chief Mechanical Engineer
CPCS	: Canadian Pacific Consultant Service
C&W	: Carriage And Wagon
DIR	: Director
DSW	: Divisional Superintendent Workshop
EOQ	: Economic Order Quantity
GOH	: General Overhauling
HRM	: Human Resource Management
ICC	: Inventory Control Cell
ILO	: International Labour Organisation
JDG	: Joint Director General
JIT	: Just In Time
LMH	: Lalmonirhat
MG	: Meter Gauge
MIS	: Management Information System
PHT	: Pahartali
PXC	: Paksey
PP&C	: Production Planning & Control
RFID	: Rapid Frequency Identification
RS	: Rolling Stock
S&P	: Standard & Procedure
SSAE	: Senior Sub Assistant Engineer
TQM	: Total Quality Management

CHAPTER ONE

INTRODUCTION

1.1 An Overview of Bangladesh Railway

1.1.1 Bangladesh Railway in brief

Bangladesh Railway, a principal transportation agency of the country, is a Government owned and Government managed organization. It covers a length of 2877.10 route kilometers employing a total of 25939 (June 2013) regular employees. As railway is a very important mode of inland transport, linking the entire length and breadth of the country, its healthy growth naturally contributes to the economic development of the country.

Till June 2, 1982, the management and development of railway was vested with a Railway Board, comprising of a Chairman and four members. But, for administrative convenience and operational reason, the Railway Board was abolished with effect from June 3, 1982 and the function of the Railway Board was vested with the Railway Division of the Ministry of Communications with the Secretary of the Division working as the Director General of Bangladesh Railway. For the same purpose the Railway bifurcated into two zones, East & West, under the administrative control of two general managers, who are accountable to the Director General of Bangladesh Railway. Subsequently on August 12, 1995 the day to day operation of the Railway was separated from the Ministry and entrusted with director general drawn from the Railway professionals. For policy guidance, a 9(nine) member Bangladesh Railway Authority (BRA) was formed with the Minister Ministry of Communications as its Chairman. In December 2011 Ministry of Railways formed by the Honorable Prime Minister under SRO-361 Rules of Business 1996 Rule-3. The Director General is assisted by Additional Director General and Joint Director General to perform all administrative and policy making jobs.

The General Managers of the two zones are assisted by various specialized departments who are responsible for operation, maintenance and financial management. Each zone is again divided in two divisions, which are the basic unit of operation. The division is headed by a Divisional Railway Manager, who is assisted by Divisional Officers of various specialized Departments such as Personnel, Transportation, Commercial, Finance

Mechanical, Way and Works Signaling & Telecommunication, Electrical, Medical, Nirapatta Bahini etc. Besides there are two workshop Divisions, one in each zone, located at Pahartali and Saidpur, each being headed by a Divisional Superintendent. Further there is a locomotive workshop headed by Chief Executive at Parbatipur for general overhauling of both BG & MG locomotives.

Bangladesh Railway also has Railway Training Academy headed by a Rector, a planning cell headed by a Chief Planning Officer, stores Department headed by a Chief Controller of Stores and Accounts Department headed by an Additional Director General/Finance for coordinating and advising accounting and financial management activities of the two zones. To ensure safety of Railway transportation, Government has set up a separate Directorate under Ministry of Railways to inspect different works of BR relates with the train operation.

1.1.2 Vision

To provide safe, reliable, cost effective and time efficient rail transport service in the country through modernizing, expanding & maintaining rail system in a manner which supports government strategies for economic, social & environmental development.

1.1.3 Mission

- Develop & maintain railway tracks & station infrastructures throughout the country.
- Maintain & upgrade locomotives, coaches & other rolling stocks.
- Maintain & modernize signaling & interlocking system & Telecom system of Bangladesh Railway.
- Ensure safe, speedy & efficient train operation.
- Implement Government transport policy in rail sector.
- Procure modern technology related rolling stocks, Track materials & signaling systems suitable for Bangladesh Railway.
- Manage land asset of Bangladesh Railway.
- Ensure optimum utilization of Development Budget & Revenue Budget of Bangladesh Railway.

1.1.4 Services

BR is one of the largest Govt. enterprises in the country, playing a vital role in the socio-economic development & industrialization of the country. BR is expected to serve both as a commercial enterprise and as a public utility service. As a commercial enterprise, BR has an obligation to generate sufficient revenue to meet its cost and as a public utility service it has a special responsibility to provide transport facilities to large number of passengers and movement of essential commodities for mass consumption. BR is also required to provide transport facilities in emergent situations like flood, cyclone, draught etc. In addition, the Railway has to bear some costs in the matter of education and medical care of railway employees and their wards, deployment of police forces in railway premises, etc. In discharging all these social obligations, BR has to bear certain cost burdens namely 'Social Cost'. Some important items of social cost are noted below.

- Carrying essential commodities and rendering transport facilities to passengers at lower prices than cost of services.
- Operation of un-economic branch lines.
- Carrying Relief Materials at concession rates.
- Carrying military traffic at less than normal tariff.

1.1.5 Compensation for Social Cost

BR is compensated under "Public Service Obligation (PSO)" system for operating specific services which are not commercially viable but socially necessary. This concept has been accepted by the Government, which are being reflected in the Revenue Budget since 1993-94. This replaced the open-ended subsidy and BR has been able to cover its operating expenses.

1.1.6 Financial Statement

Year wise financial Statement of last 5 years are shown in the table 1.1 bellow from which we can understand the financial position of BR. The total operating revenue without considering the effect of Public Service Obligation (PSO) and Welfare Grant of Bangladesh Railway for the year 2012-2013 amounted to Taka 8042.63 million. After meeting the total operating expenses of Taka 15623.81 million, the net operating income for the year came to Taka (-) 7581.19 million.

Table 1.1 Financial Statement of last 5 years (Amount in Million Taka)

	2008-09	2009-10	2010-11	2011-12	2012-13
Total operating revenue (Without considering PSO & Welfare grant)	6253.53	5663.04	6295.46	6034.29	8042.63
Total operating revenue (Considering PSO & Welfare grant)	7417.79	6731.62	7470.70	7264.25	9293.32
Total operating expenses	11727.49	11272.79	14918.19	15671.16	15623.81
Net operating income (Without considering PSO & Welfare grant)	(-) 5473.96	(-) 5609.75	(-) 8622.74	(-) 9636.86	(-) 7581.19
Net operating income (Considering PSO & Welfare grant)	(-) 4309.71	(-) 4541.17	(-) 7447.49	(-) 8406.91	(-) 6330.49

Source: Bangladesh Railway Information Book; 2009 – 2013.

1.1.7 Manpower Statement

Year wise Manpower Statement of last 4 years are shown in the table 1.1 bellow from which we can understand the Manpower position of BR.

Table 1.2 Department wise numbers of Employees

Department	2009 - 10	2010 - 11	2011 - 12	2012 - 13
Administration	998	953	948	911
Nirapatta Bahini	2273	2184	2467	2659
Accounts	941	845	1120	1062
Engineering	4918	4674	4437	4285
Signal & Tele-com.	1305	1256	1241	1225
Estate	170	163	170	163
Mechanical	8519	7910	8134	7772
Traffic	5361	5085	4838	4734
Electrical	1493	1430	1353	1297
Medical	1132	1054	1024	1076
Stores	861	795	726	755

Source: Bangladesh Railway Information Book; 2009 – 2013.

1.2 Background

Maintenance management is the key functional area of management. It deals with the proper care and maintenance of the building, plant, machinery, equipment, rolling stock and furniture of a business enterprise. Maintenance management is very important for reliable maintenance of the assets of an organization. A sound knowledge in anatomy and physiology of the machine/ plant and rolling stock is required to plan and implement its maintenance. Many of us have been working in the maintenance without having any theoretical background. So, on an average we are poor maintenance managers. The reason is that Engineering is an applied branch of science and maintenance is a sub-branch of Engineering. A sound technical knowledgeable management is necessary to apply the skills and technology in performing the maintenance work effectively and efficiently.

Bangladesh Railway (BR) is one of the largest government owned transport facility provider in the country, playing a vital role in the socio-economic development and industrialization of the country. BR has an obligation to generate sufficient revenue to meet its cost as a public service. It has a special responsibility to provide transport facilities to a large section of population and movement of essential commodities for mass consumption. BR is also required to provide transport facilities in emergent situation like flood, cyclone, draught, etc. For providing all of these activities, BR needs sufficient number and workable rolling stock (Carriage, Wagon, and Locomotive). The life of locomotives and carriages are 20 & 30 years respectively. Periodical maintenance needs to ensure efficient operation of Railway and to maintain their condition good. In view of the long life span, it is imperative that these assets are dependent on reliability and availability of rolling stock. Maintenance management can help to maintain uninterrupted train communication by repairing and then supplying rolling stock to the operation department timely, thus increasing the profit.

The Railway is facing tough competition with other modes of transportation. All transport companies try their best to satisfy their customers by strengthening their maintenance management, because maintenance is the competitive weapon for a company. To survive in such a fast growing hard competitive market transport companies are carrying out research to develop maintenance management towards integrated logistic management.

So, by studying and assessing the present maintenance management of rolling stock and by developing model thereby in improved productivity, reduced cost, timely repair by

utilizing existing technology and innovated maintenance technique to meet the country's transportation needs of both passenger and traffic based on an optimal inter-model mix and to provide this transportation at least on cost basis to the society, while maintaining financial viability of the system.

1.3 Problem statement

The major problem of Bangladesh Railway in relation to maintenance management of rolling stock in various workshops is inefficient and ineffective maintenance management. maintenance management of rolling stock is an integrated and continuous process. It is just like a chain connecting one link to the next. The links of maintenance management are mainly material purchase and inventory control, Human Resource Management, Maintenance, Production and operation Management, Budgetary control and Safety management etc. Each link of this chain is equally important for efficient and effective operation of Maintenance Management. Success of one depends on the success of other management operation. Adequate inventory helps an organization for performing proper maintenance according to the requirement of the maintenance departments. In this way every efficient activity of different department can ensure the effective and efficient maintenance management.

1.4 Justification of the Research

Maintenance management is crucial for sustaining long life, safety performance of a machine, plant and rolling stock. In Bangladesh Railway, rolling stock maintenance starts at the day of historical start of Railway on 15th November 1862, during British period. In the meantime since 1972, the Railway Organization Management Structure has been reorganized four times. These changes also affect the Maintenance Management of Rolling Stock. But during the time, maintenance technology has undergone vast improvement and challenges in the twenty first century, a period characterized by innovations brought about by the information age and the globalization era. This study in fact, highlights this theme. To face these challenges, maintenance management should be at the highest standard of excellence in Education, Training of professionals in Rolling Stock maintenance and logistics. But the Rolling Stock management of Bangladesh Railway is very much lagging in terms of technology and models. This paper is an attempt to examine the level of efficiency of Maintenance Management of Rolling Stock in Bangladesh Railway.

1.5 Research Questions

- (a) To what extent the present maintenance management of rolling stock efficient and effective enough to run the operation smoothly?
- (b) What are the causes of under utilization of Central Locomotive workshop?
- (c) What are the constraints to maintain a good maintenance management of rolling stock in Bangladesh Railway?
- (d) Is there any effect of maintenance management of rolling stock on revenue of Bangladesh Railway?

1.6 Research Objectives

The overall objective of the study is to identify the effectiveness and efficiency of maintenance management of rolling stock and its impact on Bangladesh Railway. The Specific objectives are:

- a) To examine the managerial efficiency & effectiveness in the maintenance of rolling stock at Chittagong and Dhaka workshops.
- b) To identify the causes of under utilization of Central Locomotive workshop.
- c) To identify the constraints, problems and weakness in present maintenance management of rolling stock.
- d) To find out the impact of existing maintenance management of rolling stock on the earning of Bangladesh Railway.
- e) To identify areas where progress is impeded.

1.7 Methodology

1.7.1 Nature of the study

The study is explorative in nature. The study is based on existing practice of maintenance management of rolling stock in mechanical department in Bangladesh Railway. The report is the reflection of guidance of course supervisor and organizational supervisors.

1.7.2 Study Area

The area of my study covered the efficiency and effectiveness of maintenance management of rolling stock of different workshop and sheds (Pahartali, Chittagong, Dhaka, Parbatipur, Dinajpur, Saidpur) of Bangladesh Railway, which was based on primary and secondary data.

1.7.3 Source of Data

1.7.3.1 Primary Data

Primary data are collected by interviewing employees, shop and depot in-charges, from the seniors, retired and knowledgeable persons and railway officials who are conversant with the maintenance management of rolling stock Bangladesh Railway.

1.7.3.2 Secondary Data

The sources of secondary data are the analysis of past studies and existing data. Text books, Reference books, published journals, articles, Carriage & Wagon manual, loco shed manual, Workshop manual are studied. Data used in the study are secondary in nature and have been collected from the documents available in workshops and Railway Information Book. As Maintenance Management is interrelated to both managerial and technological aspects and integrated system with other departments, are studied.

1.8 Scope

Maintenance management of rolling stock in Bangladesh Railway is carrying out the monitoring and evaluation of their maintenance performance in accordance with the set scheduled maintenance program. But an independent study is intended from the concern authorities to find out the gap of compliance of maintenance in Bangladesh Railway. The research is carried out on maintenance management practiced in Mechanical Department in Bangladesh Railway. An attempt is made to provide an overview of BR's current status and performance. This study is such an approach for ascertaining the facts of maintenance in Bangladesh Railway.

1.9 Limitation of the study

The limitations of this study have come from both its scope and its methodology. The particular subject is extremely extensive in nature. To evaluate the maintenance management is a complex task and its impact; it is required to study the performance of the management. This performance depends on the performance of other related departments which need thorough study. But here, because of its widespread nature and time limit only 90 days, worked mainly on maintenance management side. So, performance of the department may not depict the total scenario of the maintenance management. Hard effort was provided to make the study worthwhile and meaningful, even there exists some limitations. Besides mechanical department some other departments directly maintain their stock that is not included in this study. Lack of appropriate measurement yardstick and complexity of interlink among the other department and information availability constitutes one of the major limitation of the report. So in Brief limitations in this study are (i) Complexity of interlink, (ii) Extensive nature, (iii) Non-availability of accurate data, (iv) Dynamic standard etc.

CHAPTER TWO

LITERATURE REVIEW OF MAINTENANCE MANAGEMENT FOCUSED ON ROLLING STOCK

2.1 Introduction

The history of transportation is very old. But the history of railways is not so old. The railways are a younger member of the transport family. On land, the sledge, the litter, the cart, the chariot, the tramway, borne by man or drawn by animal and on water, the raft, the canoe and the boat moved by wood and wind, all these are much older means of transport. The modern railway was a development of the horse-drawn wagon or tramway, used in England in sixteenth to eighteenth centuries for haulage of minerals to rivers or ports. As the roads were bad and wagons had to be guided through tunnels, someone thought of laying down wooden planks for the wheels to run on. The planks wore out quickly and then someone else put iron plates to nail them down to reduce wear. The wooden plants and wheels were replaced with iron. The history of railway is closely linked with the growth of civilization of mankind and Maintenance Management plays a key role from the beginning of the Railway transportation. Till its commencement in 1862, different workshops, loco sheds, Carriage and Wagon repair Depots were established for repairing and maintenance of rolling stock and other equipments. More than century old is the Maintenance Management practice in Bangladesh Railway. At the initial stage maintenance operation was limited but in course of time as railway increased its operational activities, new sophisticated rolling stock were added along with the traditional ones and responsibility and activity of Maintenance department increased. The present concept of Maintenance Management also developed in the then railway.

2.1.1 Working Area

Maintenance Management of Rolling Stock is an integrated and continuous process. It is just like a chain connecting one link to the next. The links of Maintenance Management are mainly material purchase and inventory control, Human resource, Maintenance, Production and operation Management, Budgetary control and Safety management etc. Each link of this chain is equally important for efficient and effective operation of

Maintenance Management. So the working area of Maintenance Management means the summation of working area of all the above mentioned management. Success of one depends on the success of other management operation.

2.1.2 Type of Maintenance

As per British Standard No. 3811 Last revised in 1984 different types of Maintenance procedures are shown in figure 2.3 below schematically.

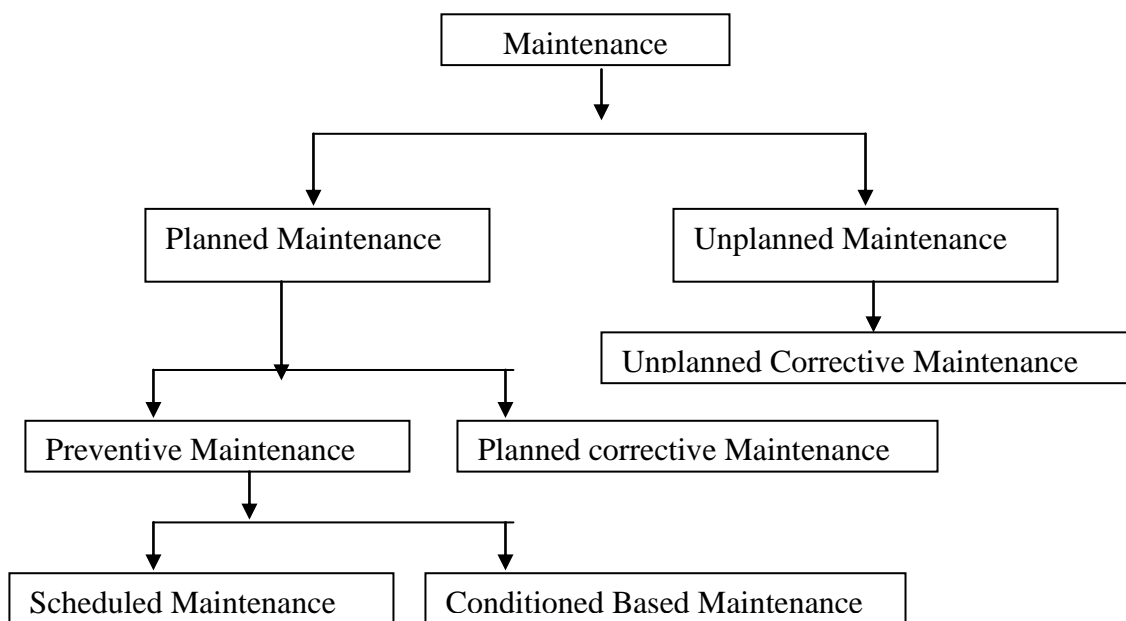


Figure 2.1 Schematic Diagram of Maintenance types

2.2 Objectives of Maintenance Management of rolling stock

A sound and modern knowledgeable Maintenance Management is one of the primary requirements of superior performance, safety and comfortable Railway communication. The function of Maintenance work is to increase the profitability of plant that can be achieved by using Maintenance work to raise the level of equipment performance and increasing availability of Rolling Stock. However, the maintenance work also has to be paid for and so an increased level of maintenance work adds to the running costs of the

company, reducing profitability. The graphs shown in the figure 2.2 below illustrates the effects of Maintenance costs on total production costs.

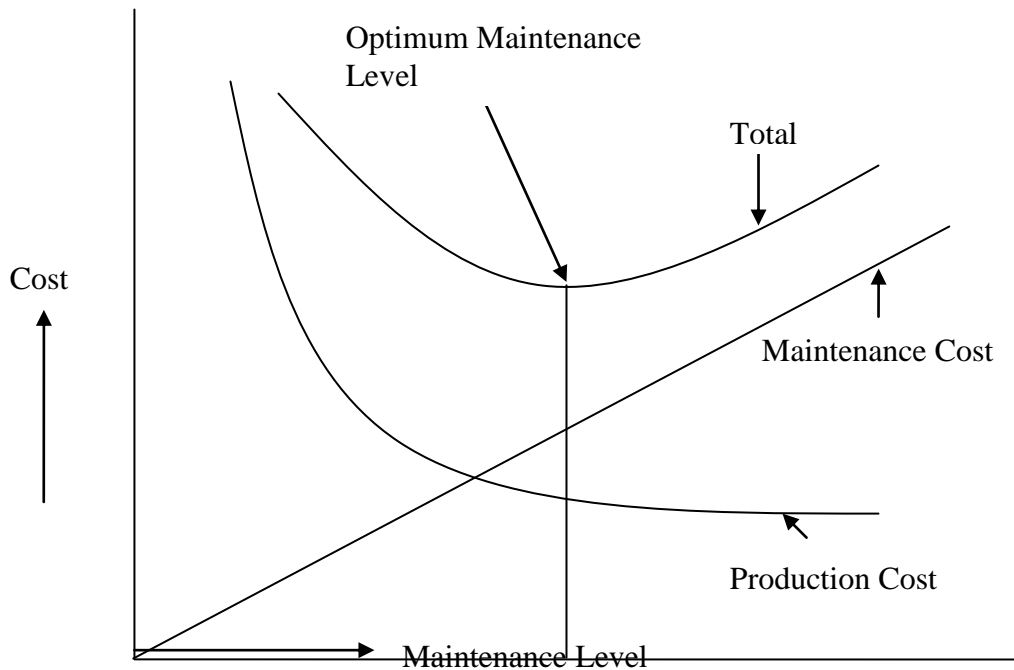


Figure 2.2 Effect of Maintenance costs on total production costs

The situation is that for a very low maintenance activity very high production costs are incurred due to frequent interruptions of production because of equipments failure. The main objective of Maintenance Management is to maintain an optimum level of maintenance with superior quality without compromising in the matters of safety. The objectives of maintenance department meet the objectives of Railway- (a) Increase in Revenue, (b) Reduction of direct cost, (c) Increase in productivity is to be retained on a “No loss, No Profit” basis.

2.3 Rolling Stock Maintenance steps

F&G schedule repair work flow chart of locomotives is shown in figure 2.3:

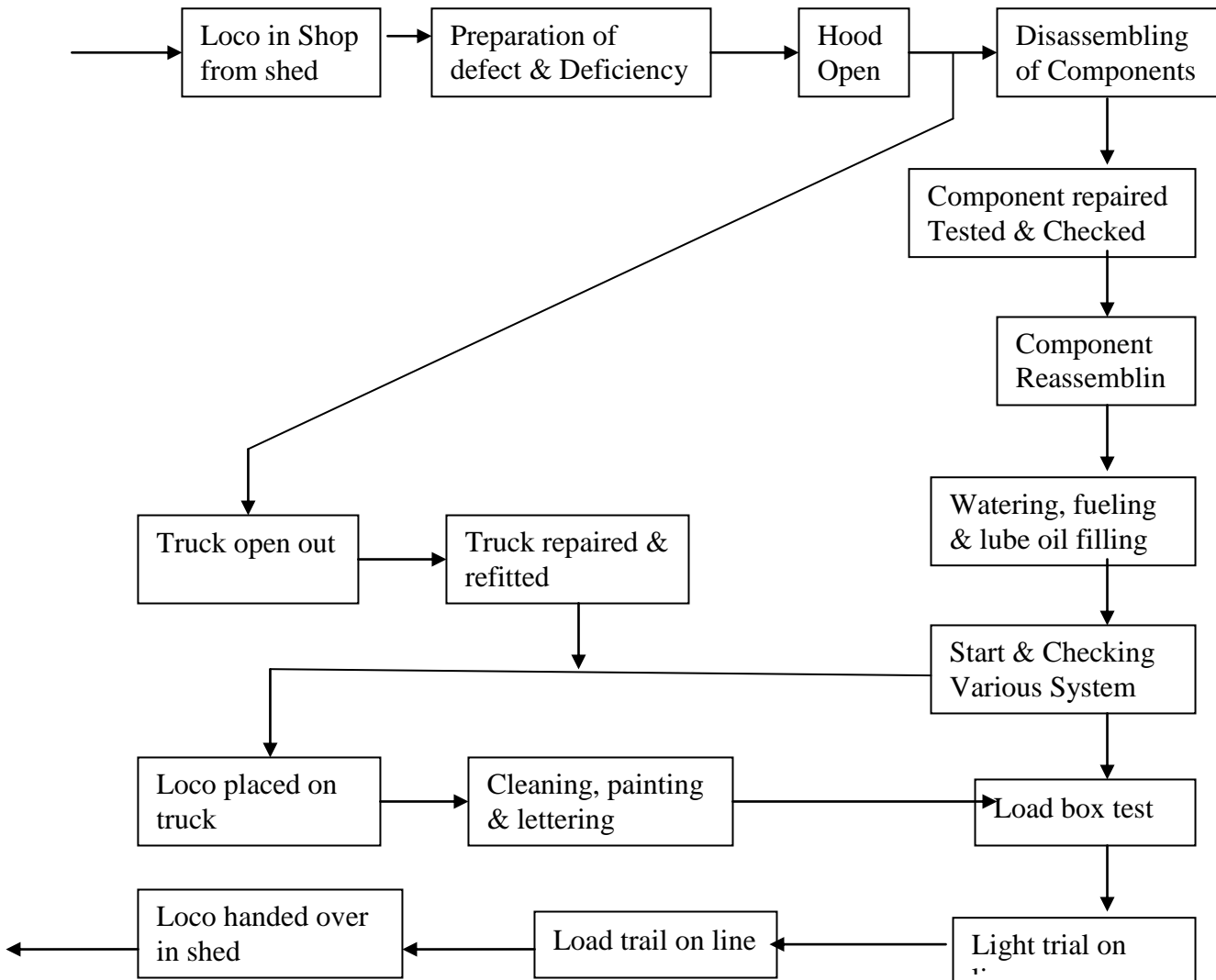


Figure 2.3 F&G schedule repair work flow chart of locomotives

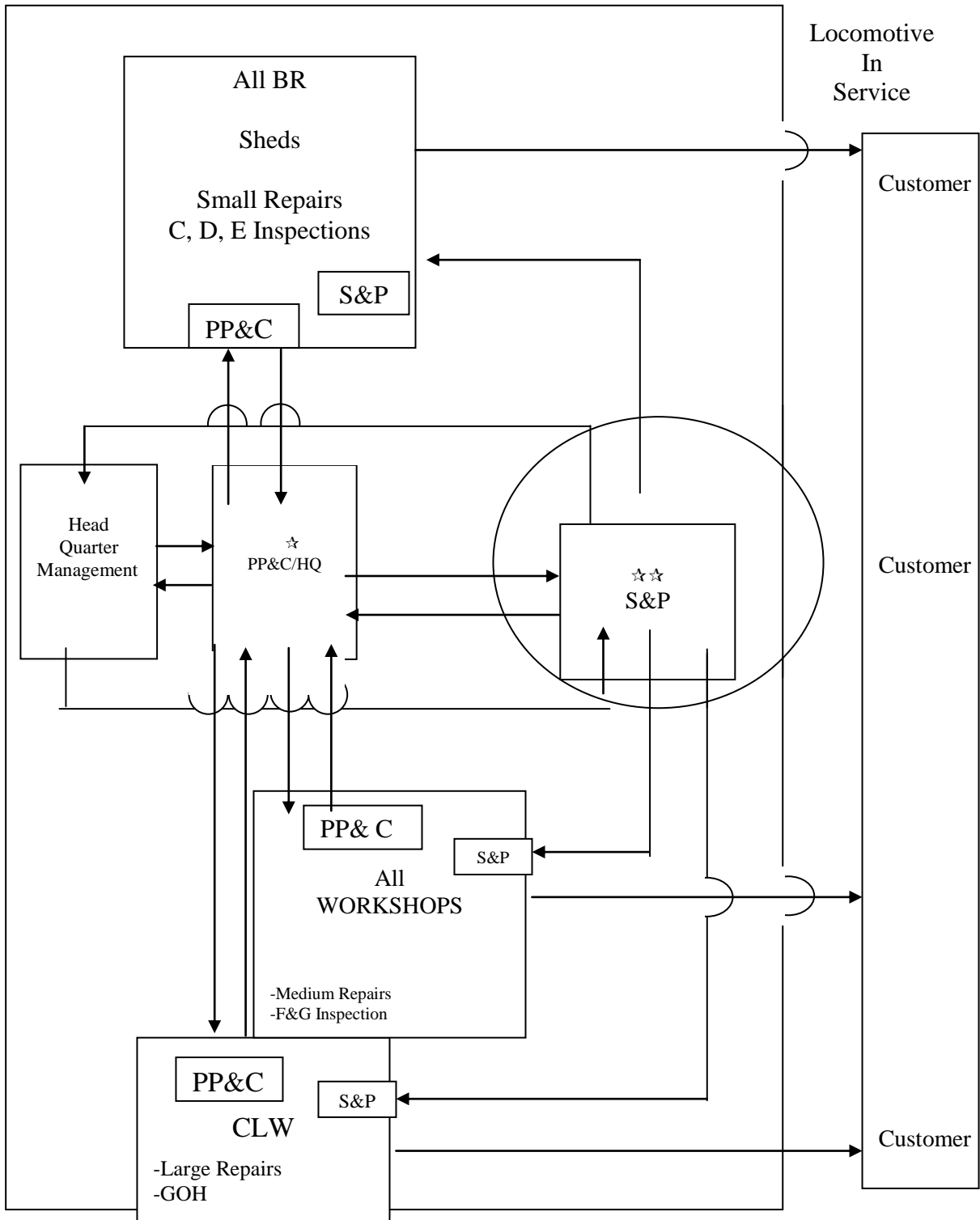
2.4 Description of Rolling Stock

The Stocks or vehicles which are moving on Rail line and can not easily be withdrawn for rail line is called Rolling Stock. Rolling Stock includes Locomotives, Passenger Coach, Goods Wagons and all other types of coaches and wagons.

2.4.1 Locomotives

Locomotive is a power house mounted on a frame and produces motion power for traction on railways. Bangladesh Railway locomotive maintenance relationship map is shown in

figure 2.4 by which we can understand the flow and dependency of different department regarding proper locomotive maintenance.



PP&C* Key to Productivity, Cost, Labour, Materials.
 S&P** Key to Quality, Time Standards, Mods, Specifications.

Figure 2.4 Bangladesh Railway Locomotive Maintenance relationship map

There are basically two types of Traction in Bangladesh Railway Locomotive.

- 1) Diesel traction by Diesel Electric Locomotives.
- 2) Hydraulic traction by Diesel Hydraulic Locomotives.

The total fleet as on 30th June 2013 comprised 258 Diesel Electric (73 BG, 185 MG) and 30 Diesel Hydraulic (7 BG & 23 MG) locomotives. The type-wise breakdowns of Locomotives are shown in table 2.1 below:

Table 2.1 Locomotives Position in Bangladesh Railway

Year	B.G. locomotive	M.G. locomotive	Total
2008-2009	78	208	286
2009-2010	78	208	286
2010-2011	71	188	259
2011-2012	78	217	295
2012-2013	73	185	258

2.4.2 Coaching Vehicles

At the end of the year 2012-2013, BR had a total of 1,505 Coaching vehicles out of which 1,472 are for passengers and 33 are for luggage parcels, mails etc. as well as for departmental use. The type-wise breakdowns of Coaching vehicles are shown in table 2.2 below:

Table 2.2 Coaching Vehicles Position in Bangladesh Railway

Year	B.G.		M.G.		Total	
	Passenger carriages Coaching Vehicles	Other	Passenger Carriage Coaching Vehicles	Other	Passenger Carriage Coaching Vehicles	Other
2008-2009	312	14	1139	21	1451	35
2009-2010	322	04	1150	33	1472	37
2010-2011	312	12	930	17	1242	29
2011-2012	312	12	1144	21	1456	33
2012-2013	312	12	1160	21	1472	33

2.4.3 Freight Wagons

At the end of the year 2012-2013, BR had a total of 9879 wagons comprising 6717 Covered, 998 open and 2164 special type wagons. The type-wise breakdowns of Locomotives are shown in table 2.3 below:

Table 2.3 Freight Wagons Position in Bangladesh Railway

Year	B.G.		M.G.		Total	
	Wagon Units	Wagon 4Wheelers	Wagon Units	Wagon 4Wheelers	Wagon Units	Wagon 4Wheelers
2008-2009	1929	2680	7069	9229	8998	11909
2009-2010	1916	2667	8054	10441	9970	13108
2010-2011	1916	2667	6944	9168	8860	11835
2011-2012	1916	2667	8058	10383	9974	13050
2012-2013	2087	30009	7792	10100	9879	13109

2.5 Basic Principle of Rolling Stock Maintenance

Rolling Stock Maintenance is divided into preventive maintenance and breakdown maintenance. Preventive maintenance means planned inspection, adjustment, testing and other actions in accordance with certain standards and procedures to prevent trouble from occurring. On the other hand, breakdown maintenance is conducted after trouble occurs.

Compared to breakdown maintenance, preventive maintenance has the following characteristics:

- Planned inspection, testing and other actions to maintain equipment performance and function enable prevention of trouble in operation.
- At the same time, preventive maintenance covers a large number of parts and equipment to increase a risk of human error, such as incorrect wiring, sometime affecting system reliability. Breakdown maintenance causes suspension of equipment operation, decreasing the utilization rate. On the other hand, preventive maintenance can prevent a trouble from developing into a major accident – a major disadvantage of breakdown maintenance is that it will result in extensive breakdown.
- Preventive maintenance is essential in finding a potential breakdown of safety-related parts.
- Preventive maintenance requires relatively a large amount of cos.

2.6 Facilities and equipments required for overall maintenance

Overall inspection of rolling stock involves dismantling and overhauling of major components. Facilities and equipment for overall inspection are arranged according to the sequence of operations, from arrival, overhauling, inspection, repairing reassembly, to departure:

- **Incoming inspection track:** Inspection pits for under floor equipment and elevating platforms to inspect rooftop equipment.
- **Outgoing inspection equipment:** Comprehensive circuit testing equipment and service outlets.
- **Car body lifting/loading facility:** Overhead traveling crane.
- **Car body inspection facilities and equipment:** Car body storage yard, safety equipment and device for work at elevated place, fork-lift etc.
- **Body paint shop:** Equipment and device for grinding, masking, painting and drying.
- **Bogie inspection facilities and equipment:** Equipment and devices for overhauling, measurement and inspection on distortion, painting, reassembly and running test.
- **Wheel and axle inspection facilities and equipment:** Equipment and devices for ultrasonic test, magnetic particle test, wheel lathing, bearing inspection, cleaning of axles and axle boxes etc.
- **Traction motor inspection facilities and equipment:** Equipment and devices for insulation test, rotation test, automatic testing of armature, washing and air blowing of component.
- **Electrical component inspection facilities and equipment:** Testing equipment for motor, generator and other electrical equipments.
- **Mechanical component inspection facilities and equipment:** Equipment and devices for testing and cleaning of brake controllers, solenoid valves, air component, air valves and other mechanical part.
- **Machining and related facilities and equipment:** Machinery and tools for grinding and machining of steel and other materials as part of equipment maintenance.
- **Warehouse:** Storage for materials and spare parts.
- **Energy supply and pollution control facilities and equipment:** Boilers, air compressors, water supply facilities and waste water treatment plants.
- **Testing laboratory:** Testing equipment and facilities for test of lube-oil, water and fuel oil.

2.6.1 Maintenance inspection Cycle

Maintenance inspection Cycle is illustrated in table 2.4

Table 2.4 Maintenance inspection Cycle

Type of Inspection	Cycle/ Inspection	Time Taken	Place	Remarks
C	45 days	6-8 hrs	Loco Shed	Light Schedule
D	90 days	8 hrs	Do	Do
E	180 days	16 hrs	Do	Do
F	1 year – 6 months	10 days	Workshop	Heavy Schedule
G	3 years	21 days	Do	Do
GOH	6 years	45 days	CLW	

2.6.2 Maintenance of Coaches and Wagons

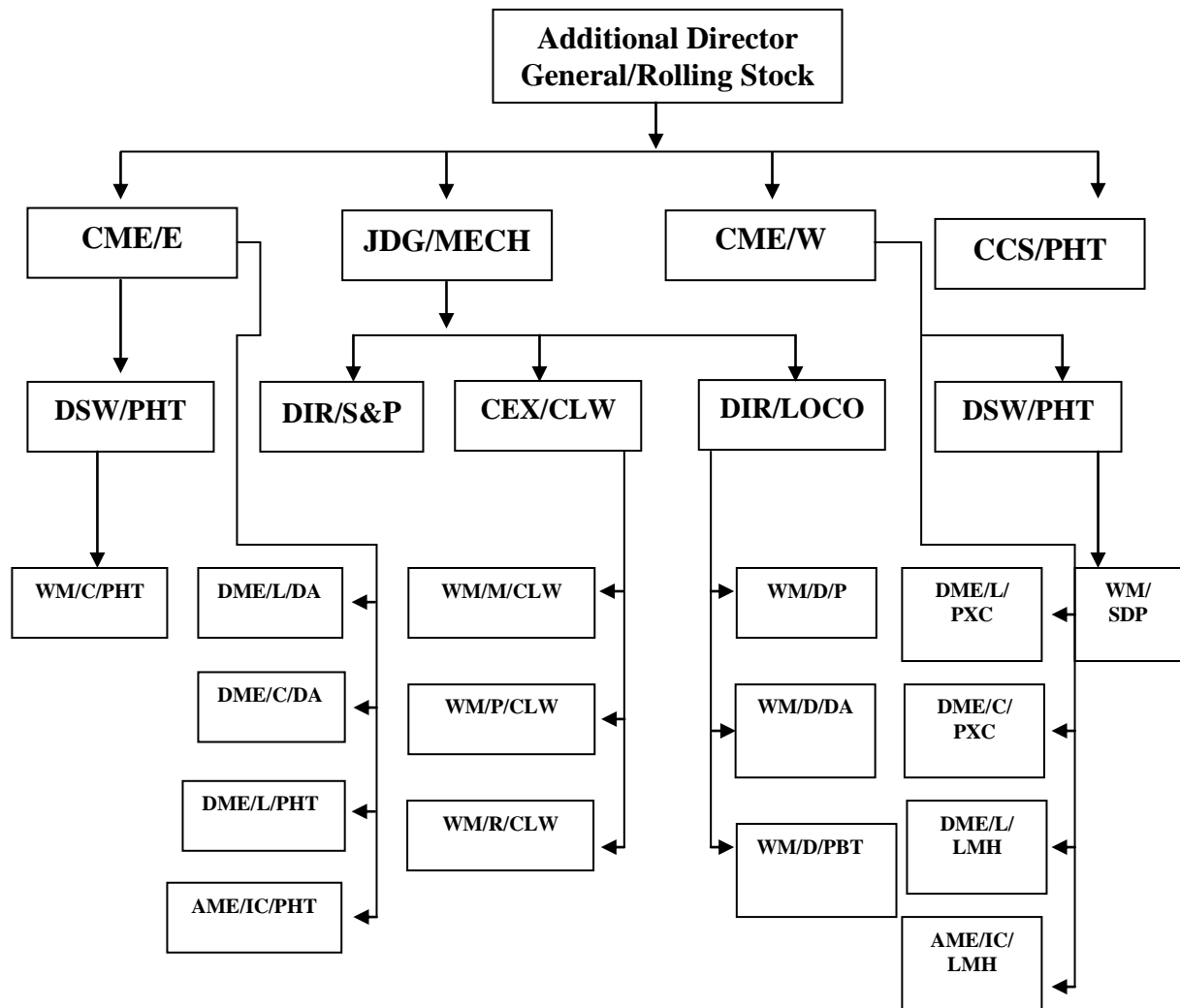
The planned preventive maintenance as applied to the coaches and wagons on the Railways is classified under the following heads:

1. Periodic overhaul in the workshop.
2. Schedule and Breakdown Maintenance in carriage and wagon on sick lines.
3. Running repairs at terminals or yard.

Table 2.5 Carriage & Wagon Maintenance Schedule of Bangladesh Railway

Name of Schedule	Interval	Work done time	Place done
A Trip Inspection	After One Trip	2 - 2 ½ hours	Wash pit/ C&W depot
B	3 months	8 hours	Sick line/ C&W depot
Lift Enamel	18 months for Mail & Express 12 months for Intercity	15 days	Workshop
POH	6 years for Mail & Express 4 years for Intercity	27 days	Workshop
GOH	12 years	50 days	Workshop

2.7 Organization of Maintenance Management of Rolling Stock



Note:- WM = Works Manager
 DME = Divisional Mechanical Engineer
 AME = Assistant Mechanical Engineer
 IC = In Charge
 P = Production.
 R = Repair

E = East
 W = West
 C = Carriage
 L = Locomotive
 M = Maintenance
 D = Diesel

Figure 2.5 Organogram of Maintenance Management of Rolling Stock

2.7.1 Organization of Chief Mechanical Engineer's Office

Mechanical Department is sub-divided into two main spheres of activities, Running Districts and Shops. Pahartali Carriage & Wagon Workshop is under Chief Mechanical Engineer/East. The running districts of Paksey, Lalmonirhat and Saidpur workshops are under Chief Mechanical Engineer/West. The Central Locomotive workshop and Diesel

locomotive workshops of Dhaka, Pahartali & Parbatipur are under Chief Mechanical Engineer/Loco.

All Head quarters are responsible for Standardization, Specification, Trials, Modifications, Preparation of yearly Maintenance Schedule Programmed and Procurement.

2.7.2 Responsibility of Workshop Organization

The Mechanical Workshops are responsible for the following:

- 1) Repair and reconditioning of Rolling Stock.
- 2) Repairs and reconditioning of plant and machinery.
- 3) Manufacturer of Spare parts for the repairs of plant machinery or rolling stock.
- 4) Manufacturer of articles required by the store department for general use
- 5) Construction and assembling of a) Coaching Vehicle, b) Good Vehicles.
- 6) Manufacture of articles of various kinds for a) Other Government department, b) Outside parties.

2.7.3 Responsibility of running District

The running districts are responsible for the following:

- 1) Light repair and inspections of rolling stock.
- 2) Trouble Shooting of rolling stock during running in train.
- 3) Trip inspection of rolling stock.
- 4) All kinds of accident salvage work and routine maintenance work of Relief Train.
- 5) Train operation, fuel management etc.
- 6) Economical utilization of power for train operation.
- 7) Provision, training and tests of locomotive crews.
- 8) Certifying that trains are fit to run.

2.7.4 Organization of Districts

The district Mechanical Engineer or Assistant Mechanical Engineer has under his control loco sheds and carriage and wagon depot located at convenient point for operation, repairs, and maintenance of rolling stock. The loco sheds are under the charge of a Senior Sub Assistant Engineer Loco Maintenance (SSAE/IC/LM). Loco shed in-charge depending upon the number of locomotives based at the shed. Carriage and Wagon Depots are under the charge of a Head Train Examiner (SSAE/IC). Loco and Carriage & Wagon Inspectors

are provided in each district to help the officers to keep a check on the condition of Maintenance and Operation.

2.7.5 Organization of the Workshops

The workshops are subdivided into shops, which are under the supervision of SSAE/IC and under them SSAE's and Mistries to assist them in the work of supervision.

The shop is a unit not only for the purpose of technical control but also for those of financial and cost control.

2.7.6 Specific responsibility at the Chief Level Management

a) Chief level Engineering

- i.** To review, update/develop and technical evaluation of rolling stock, component and equipment specifications.
- ii.** To conduct wear tests of rolling stock components establishing economic service life limits and replacement/overhaul at intervals.

b) Rolling Stock Maintenance

- i.** To ensure works at Workshops, Running Sheds, Depots and Maintenance facilities of the Zone as an effective and efficient operating unit.
- ii.** To Review, Evaluate and update scheduled maintenance materials and procedures, developing programme to meet locomotive maintenance requirements and to provide maximum fleet availability/reliability.
- iii.** To establish and enforce reasonable time limits for performance of light and heavy scheduled inspection investigating variance for nominal durations.
- iv.** To organize and co-ordinate the Rolling Stock as required, through the Workshop Managers and Divisional Mechanical Engineers of the Zone to ensure locomotive schedule and program are adhered to.
- v.** To perform random "on time" inspection of locomotive.
- vi.** To ensure Rolling Stocks are provided by Running shed and workshop remains consistent with operational demand.

c) Material Planning

- i.** Notify Stores Department at any early date of any unusual demands for Materials to be used for new upgrading programmed.
- ii.** Advise Stores depot at any discontinuation of materials due to obsolescence.
- iii.** Co-ordinate Stores depot, supply of materials and parts as required to the Shop and sheds to avoid any loss of locomotive availability for material shortage.

d) Manpower Management

- i.** Develop and update training programmed for Rolling Stock Maintenance, Laboratory analysis and staff in relation to Rolling Stock operational efficiency.
- ii.** Order, postings, adjust, transfer and promotions in Mechanical cadre beyond the jurisdiction of Executive officers.
- iii.** See the Personal Establishment matters.
- iv.** Ensuring proper safety precautions to be followed by all employees under his control.

e) Planning

- i.** Plan and implement strategies that will improve Rolling Stock (locomotives) availability with a target of 90% reducing on-line failures with a target of 1,00,000 KM between failures and minimize Maintenance cost.
- ii.** Plan and implement strategies that will improve locomotive & rolling stock utilization in terms of load factor and un-service locomotive hours.
- iii.** Plan systematic improvement of overall operation economy.

2.7.7 Specific responsibilities of Floor level officers

a) Planning

- i.** Plans the continuous improvement of Rolling Stock and Component maintenance, repair and overhaul operations.
- ii.** Plans systematic upgrading and improvement of Workshops, Loco sheds and Depot facilities and equipment.
- iii.** Plan and implements strategies that will improve Rolling Stock availability and reduce on-line failure and operating costs.

b) Maintenance

- i.** Manage the workshop, Running shed(s) & Depots of the division as effective and efficient operating units.
- ii.** Ensure work continuity is maintained in and between workshop and running shed/depot and running districts.
- iii.** Develop improvement programs for divisional fleet availability reliability and reduced operating cost.
- iv.** Establish work priorities and ensure the priorities are adhered to.
- v.** Established allowable time limits for all class of scheduled maintenance inspections.
- vi.** Check that Stores Department supply material adequately and posts promptly for shop and shed operations & report detention times of Rolling Stock due to lack of same to appropriate authorities.
- vii.** Investigate component failures and take corrective action where necessary and assign responsibility.
- viii.** Ensure quality control inspections on the Rolling stock maintenance and completion in accordance with prescribed regulation.
- ix.** Ensure proper safety precautions are followed by all supervisors and staff.
- x.** Investigate violations of conduct of employees under his jurisdiction, take appropriate disciplinary action and ensure disposal of disciplinary proceedings within prescribed time limits.
- xi.** Ensure staff salary and overtime bills are complied accurately, signed and submitted on time and annual increments to all staff sanctioned timely.

2.8 Areas of Maintenance Management of Rolling Stock in BR

Like other maintenance and production works Maintenance Management of Rolling Stock has the following subject areas of work:

2.8.1 Maintenance Strategy

There is no clear cut strategy in Bangladesh Railway. For this reason there is no specific strategy for maintenance of Mechanical department. Rolling stocks are repaired or overhauled for the Railway's internal customer of Traffic Department. Policy of the all workshops, loco sheds and depots to perform the schedule repaired as programmed to decrease the overdue of Rolling Stock and increase the availability. As a Government

Organization, Mechanical department is responsible for maintenance of Rolling Stock. So, they do not face any competition. Flexibility strategy has been adopted to maintain variety of Rolling Stock.

2.8.2 Inventory Control Management

Inventory for the Railway consists of spares to keep locomotives and other rolling stock in service through scheduled maintenance, or return them to service with minimum delay if breakdown occurs.

Inventory can be assets for the railway if properly managed, or a liability if not properly managed. As an asset maximum return must be generalized for the invested capital. Maximum return can be realized from having that amount of material which keeps diesel locos and Rolling stock in service to operate trains and generate profit for the railway. The minimum return or liability results from purchase of excess or unnecessary material. The objective of inventory control is to keep balance inflow of material issues thereby lowering operating costs and reducing waste.

2.8.3 Aggregate Planning

- a) Headquarters of Mechanical department plans for the coming years work load. They first take information which rolling stocks are going to be due and overdue in the concerning year in which month. From the collected data they fix up the monthly target and the Rolling Stock name and number. Then they prepare a month-wise yearly repair schedule. Actual target is higher. Actual target is calculated by the basis of total holding/based Rolling stock and their schedule type. But in Bangladesh Railway most of the workshops capacity is now less than their actual target. Headquarters fixes a target each year on the basis of budgetary constraint and over due position.
- b) Assessment has been done for spare parts (especially non-stock) and consequently demand placed to the Stores Department.
- c) All floor level Management is responsible to plan for stocking the recurring used spare parts.
- d) Manpower and Process design are already fixed. All works manager plan how to do their maintenance work with their present manpower. Inventory level, budget and facilities.

- e) As per yearly maintenance schedule program, floor Managers plan to bring the Rolling Stock in the workshop. Prior demand is placed to the Operation districts with mentioned Number of Rolling stock and pushing in the shop date. The Chief Controllers of Rolling Stock will co-ordinate and withdraw the Rolling Stock for operation consulting with Running District Officers and push the same in the workshop.
- f) All floor level Managers do their Monthly Maintenance Plan after meeting with their Section In Charge. And all Section In Charge disseminates the plan to the Mistry level.

2.8.4 Forecasting

Forecasting plays an important role in all aspects of business. Maintenance management personnel use forecasts to make periodic decisions, involving capacity planning, facility lay out and for continual decision about Maintenance Planning, Scheduling and Inventory. Operational/Running districts are the customers of maintenance department. Their demand is to make their availability of rolling stock up to 90%. The numbers of Rolling Stock is more or less fixed; their Maintenance Schedule time is prescribed by Manufacturer. So it is easy to forecast how many are scheduled in the coming year. Demand of Rolling Stock repair is horizontal in nature.

In case of unplanned Maintenance, Bangladesh Railway follows the previous trend in under repair of Rolling Stock. Forecasting of material is done by their experience and by recommendation of the manufacturer.

2.8.5 Scheduling

Work schedule is prepared on the basis of target out turn of each workshop which is prior prepared and supplied form Headquarters. Every single Rolling Stock has an identification number. In Monthly Work schedule program specific Rolling Stock are included along with their schedule type and work starting and finishing date.

This schedule again breaks down into section basis. Every section (shops) has given the time to finish their work.

As per scheduled programmed every sectional work order (Work loading) is placed on every section and Material requisition is placed in store. Work Managers maintain Out turn board and Work progress chart (Gantt Chart).

2.8.6 Capacity Planning

All maintenance workshops, loco shed, C&W depots were established many years ago as per requirements at that time. Capacity of these establishments and facilities need to be reassessed.

2.8.7 Material and Purchasing Management

Purchased materials, parts and components represent a growing percentage of the cost of maintenance. These purchased goods often represent 60% to 70% of the cost of repair. The increase in materials handling costs coupled with higher transportation and distribution costs have also forced management to focus its attention in these areas.

Material management is defined by the American Production and Inventory Control Society (APICS) as the grouping of management functions supporting the complete cycle of material flow, from the purchase and internal control of production materials to the planning and control of work in process to the warehousing, shipping and distribution of the finished product.

In Bangladesh Railway Stores Department is vested with the responsibilities to purchase, store and supply raw materials, finished product, accessories and spare parts to cater for the repair and maintenance works of Rolling Stock at workshops, loco shed and C&W depots. The Rolling Stock fleet own by BR is not sufficient to proper operation of railway. So it requires highest level of availability. The maintenance schedule is so tight that failure in expected out-turn will cause a massacre in Train operation and thus the importance of procurement of 24,571 items of locomotive and 8,000 items of carriage & wagon and others rolling stocks spare parts effectively and efficiently is the key concern in Bangladesh Railway. Out of these 24,571 items of spare parts, for 701 items are locally produced. It figures out that about 97% of locomotives spare parts are to be procured from outside Bangladesh countries.

To procure total 33,000 items 20% from home and 80% from abroad effectively and efficiently is really a challenging and hard pressing job.

Now let us try to look at the purchasing management in store department in Bangladesh Railway, Chittagong to perceive how properly it discharges its responsibilities. For Purchasing management store department has got a store code written in 1952 and according to store code, BR – especially the store department had been purchasing goods before the Public Procurement Rules-2008 was introduced.

For the accurate analysis of effectiveness and efficiency of purchasing management, purchasing management is divided into two areas – foreign purchases and local purchases.

A) Foreign purchase

97% of locomotives spare part and 80% of total railway materials are procured from foreign sources. For procurement of locomotives spare parts there are 30 manufacturers/suppliers in USA, Canada, UK, Germany, Hungary, India and Japan. Spare Parts are procured from them by adopting restricted tendering method. They participate in tender through their appointed local agents. Diesel locomotive spare parts are of special and complicated type. These have no drawing and specification. These are procured on the basis of parts number and description and the manufacturers can identify these parts and quote their rates against them. The purchaser has no tool to justify the price and quality thereof because these are customized products. To know the price of these items market approach is not applicable. But cost approach is possible though stores department or broadly in Bangladesh Railway there is such a cell assigned with responsibility to justify the price through cost approach. In foreign purchase, the Stores department faces the following problems:

- a) Against every tender rate for 7% - 40% items are not quoted for which tendering is invited more than once and processing time increases.
- b) Different suppliers/ manufacturers propose different shipment period.
- c) Suppliers fail to delivery spare parts in time.
- d) Suppliers fail to supply all the spare parts awarded to them.
- e) Some supplied spare parts are wrong or defective.
- f) Suppliers do not respond quickly to warranty obligations.
- g) Change in Delivery/Supply.
- h) Lack in marketing preview.
- i) Sources, location and evaluation of suppliers.

After analysis of cited problems it is found that-

- (a) Spare parts are not delivered in time, in right quantity, of right quality and at right price.
- (b) Ordering cost for re-tendering increase (Paper and correspondence cost), purchasing is associated with default cost (Cost for insurance, claims, customs duty, refund claim, claims for short supply or damaged materials legal advisor fee), set-up cost

and quality cost (testing fee, contingent expenses). Time required for spare parts is more than planned time. These phenomenon are shown in table 2.6 and 2.7.

Table 2.6 Lead time problem in tendering

* Supplier Name	Required Shipment period	Offered shipment period	Effect	Impact on maintenance
M/S ABC LTD	6 Month	8 Month	Increase in lead time	Ineffectiveness & inefficiency
M/S XYZ LTD	6 Month	10 Month	Increase in lead time	Ineffectiveness & inefficiency
M/S RM LTD	6 Month	12 Month	Increase in lead time	Ineffectiveness & inefficiency
M/S GHK LTD	6 Month	9 Month	Increase in lead time	Ineffectiveness & inefficiency
M/S CBA LTD	6 Month	11 Month	Increase in lead time	Ineffectiveness & inefficiency

* For official secrecy actual suppliers name are not given

Table 2.7 Material not delivered in time

* Contract reference	Last date of delivery	Actual date of Delivery	Effect on Lead time	Impact on maintenance
Reference-1	31/10/2013	31/12/2013	2 months increase	Ineffectiveness
Reference-2	23/05/2013	30/11/2013	6 months increase	Ineffectiveness
Reference-3	20/10/2013	26/01/2014	3 months increase	Ineffectiveness
Reference-4	14/08/2013	29/03/2014	7 months increase	Ineffectiveness
Reference-5	05/05/2014	Not delivered	Uncertainty	Ineffectiveness

*For official secrecy actual contract number can not be given

- (c) To know the price of goods in foreign through market approach is difficult, currency fluctuations cause more local currency to make payment creating pressure on budget, sometimes unfavorable payment terms are to be faced, greater delivery period adds high inventory level, expending shipment is costlier, legal issues such as payment of liquidated damages and arbitration, more transport cost and incidental charges are associated

B) Local Purchase

20% materials are procured from local markets. Some of these materials are standard and readily available in the local market. For such type of materials lead-time should be lower than that of foreign materials and JIT philosophy for purchasing readily available materials in local market may be introduced. But stock replenishment method of foreign and local materials is the same. In local purchase the following problems exist:

- (a) Suppliers fail to supply materials.
- (b) Delay in delivery time.
- (c) Reject for inferior quality.
- (d) Failure to comply warranty obligation.

2.8.7.1 Nature of purchasing management in BR

BR is a state owned organization. Purchasing management in BR is managed by the rules and regulations of the government and hence it is shaped as public purchasing. Public purchasing is associated with the following problems:

- i. Source of authority:** laws or regulations define Authority, professionalism is not encouraged.
- ii. Budgetary restriction:** It is usual phenomenon. In BR to procure Locomotive spare parts require taka 45 crore whereas govt. allocates only taka 18 crore for this purpose. As a result not all required spare parts are procured to support repair and maintenance works.
- iii. Outside pressure:** Taxpayers or other suppliers having unethical standard create pressure on the purchaser to move to biased evaluation.
- iv. Government support of public service:** Govt. wants to support public service from the purchaser within scarcity of resources.
- v. Absence of interest cost:** For huge capital block, no need to pay interest for revenue procurement, which causes inefficient purchasing.
- vi. Inadequate inspection facility:** BR has no required standard of inspection facility, which adds cost of quality.
- vii. Lack of traffic expertise:** Transportation cost is not evaluated like cost of goods sold and efficiency in procuring transportation service is not achieved.
- viii. Advertising:** No flexibility in advertising where it is mandatory though it sometimes may reduce the price of goods.

- ix. Evaluation procedure:** It should be strictly followed as per regulation. Purchaser has no freedom to deviate from it to have the goods at lower price.
- x. Small business favoritism:** Govt. wants to favor the small business and the purchaser is under pressure for this.
- xi. Procurement of used equipment:** There is no rule of procuring used equipment and purchaser faces problem to procure such material.

2.8.7.2 Centralized Standards and Procedures (S & P) Management

i. Purpose: These services has been supported the locomotive maintenance program by

- a) Removing ambiguities.
- b) Eliminating useful data on failures.
- c) Accounting useful data on failures.
- d) Provide abase for analysis and remedial action.
- e) Initiate quality assurance programs.
- f) Develops specifications for use suppliers.

ii. Standards and Procedures Management group: A group of officers have been working for fulfilling the above purpose. The aim of this management was broad. The CIDA consultant proposed an organogram with specific responsibilities of each level. But still BR does not implement it fully. The S & P group partially has been working with inefficiently.

2.8.7.3 Responsibilities of S&P

- a) Develop and implement task specific maintenance instructions.
- b) Provides continuous support to the running sheds and works of the locomotive maintenance group with current standards procedures (maintenance instructions) including updates to the shed and workshop manuals and maintenance instructions.
- c) Plan, Designs and co-ordinates all modifications to locomotives which will improve locomotive efficiency, performance and safety.
- d) Evaluates and recommends for approval any unusual, nonstandard repairs proposed to locomotives.
- e) Co-ordinate through out all departments the trials, testing and final assessment alternative materials, spare parts, components or systems to replace hard to get, absolute or failure prone items.

- f) Evaluates new procedures and tooling which may improve workshop/shed productivity.
- g) Co-ordinate the development of related methods procedure and specifications.
- h) Collect a wide range of failure information and analyzes the data, find out the causes of failure and recommends remedies or improvement.
- i) Assess the quality of workmanship in the locomotive workshop and sheds and writes reports regarding quality assurance audits and makes recommendations.

BR has owned the standard locomotive maintenance instruction procedure. Loco Failure analysis module and quality assurance methodology was developed by CIDA consultant in 1999. BR has been trying to work according to their guide line. But the S&P section has not been yet staffed fully. Therefore, the S&P group does not work properly. A locomotive maintenance relationship map is given in figure 2.4 to see how the S&P works are interrelated to maintenance management.

2.8.7.4 Operational Performance

In view of the high investment cost of railway infrastructure, the intensity of track utilization is an important dimension of productivity. Locomotive, coach and wagon productivity are indicators of efficiency, of utilization of a railway's assets while staff productivity measures the efficiency of staff utilization. BR's track utilization, locomotive, coach and wagon productivity as well as staff productivity figures are lower than that of other developing countries in the south and Southeast Asian regions.

Partly for the low productivity and operational performance statistics BR is losing traffic as, if the traffic were at the levels in the 1970s and 1980s, then the productivity and operational performance statistics would look better. However, it also reflects the reality that in the past, BR's staffing was allowed to grow too large and that it has been using its assets efficiently. Labor cost, which consumed 59.6% operating expenses in FY 1992, separation program implemented with ADB assistance. One of BR's most serious operational problems is the lack of capacity on its busiest routes particularly the Dhaka - Chittagong corridor and the western line to India. Many sections on this corridor have already reached their maximum desirable line capacity. This results in low average speeds, low rolling stock turnaround times and longer waiting times for cargo to find slots on wagons. Containers for Chittagong bound to Dhaka need to wait about 10 days to find a slot on container trains.

A further operational problem is the number of accidents especially derailment in BR from FY 2013, there were a total of 151 derailments on the BR system including main lines, branch lines and yards (table 2.8 and 2.9). Although there were no fatalities or injuries as a result of these derailments, nevertheless, these not only cause delays in train operations and availability but also point to the need to improve operational and maintenance practices in BR.

Table 2.8 Train Accident

Year	Collisions	Derailments	Fire in Train	Obstruction	Total
2008 - 09	7	08	-	34	449
2009 - 10	2	403	-	34	439
2010 - 11	1	392	-	18	411
2011 - 12	-	138	-	16	154
2012 - 13	3	133	-	15	151

Table 2.9 Casualties due to Accident

Year	Passenger		Railway Employees		Other Persons		Total Casualties	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
2008 – 09	1	10	1	25	20	64	22	99
2009 -10	-	-	-	98	11	40	11	138
2010 -11	-	-	7	143	10	17	17	160
2011 -12	-	-	11	94	35	56	46	150
2012-13	-	-	2	112	38	54	44	166

2.8.7.5 Tariffs

Since BR has been tasked to meet social as economic objectives, social and political factors have often outweighed commercial considerations in the process of tariffs setting. As a result there has been sustained under pricing of passenger service, which is cross subsidized by freight services. Compared with other countries, the ratio of BR's average, passenger fare per passenger – km to average freight tariffs per ton-km is very low. The ratio for Bangladesh is 0.26 compared to 1.2 for China, 2.2 in Japan and 0.7 in Thailand. Passenger services account for 8% of BR's services but contribute only 28% of gross

revenues. The financial performance has declined for past 4 years as a result of stagnant passenger tariff and freight volume. The operating ratio has deteriorated since FY 2000.

2.8.7.6 Financial Performance

Like many other railways, BR is a loss-making entity. In Financial Year 2013, BR's revenue was Taka 804 crore and the operational costs Taka 1562 crore. The working ratio i.e. operating expenses divided by total revenues is 1.94 and the operating revenues are not sufficient to cover operating expenses. The financial performance steadily declined since FY 2000 as a result of stagnant passenger tariff and freight volume. The Government has been subsidizing the BR through deficit financing and Public Service Obligation (PSO)/welfare grants to make up the losses. Decline in the financial performance was arrested only temporarily by the staff separation program in 1997-1998.

2.8.8 Quality control

Control can be defined as the process of management which constrains events to follow plans. The process of control is essential with other closely related management functions and here a broader view will take of the whole subject of the control of production.

2.8.8.1 Conventional controls used in Industry

The idea of control can be represented in elementary form by the simple figure 2.6 below:

Name of control	The plan	The in put parameter controlled	The out put measured	Feed Back	Aim of the Control
Maintenan- -ce control	Maintenance programmed	Batch frequency phase and quantity	Number of stocks required in given period	Progress reports, shortage list and orders/ stocks overdue list.	To constrain out turn to follow the program.
Quality control.	Acceptance limits.	Negligible.	Quality achieved.	Quality control reports and rejects notes	To Keep quality within limit
Budgetary control	Budgets	Negligible	Expenditure & receipts.	Budget variance reports	To keep costs within required limit
Inventory Control	Inventory program	Negligible	The investment in stock	Inventory reports.	To keep the invest within required limit

Figure 2.6 Conventional controls used in Industry

Today, however, more and more companies recognize the value of using quality as an offensive strategic weapon. Quality dimensions are performance, features, reliability and conformance, durability, serviceability, aesthetic and perceived quality.

Within the quality literature, seven basic tools have been identified that can assist managers in organizing, displaying and analyzing process generated data. These seven basic quality control tools are process flow charts, run or trend chart, scatter diagram, cause & effect diagram, pare to chart, histograms and statically process control charts.

2.8.8.2 Quality control of rolling stock maintenance in BR

After completion of scheduled repair locomotives performance are measured by a load box test stand. Central locomotive works shop in Parbatipur has been done load box test regularly but other Diesel workshops do not test locomotive regularly. Maintenance of locomotive in loco shed has not been assured by any quality control group.

In case of carriage & wagon repair in Saidpur railway workshop there is a quality control section comprising one senior sub-assistant Engineer from works shop and two SAE from operational division. But they have not found proper guidance and support from the management. Even they are not properly equipped or trained. In others C&W works shop and depot there is no quality control group. Maintenance managers or floor level SSAE's look after the quality.

2.8.9 Works Measurement

The subject of work measurement for establishing time standards has been controversial since the day of Taylor. Nevertheless organizations need some form of standard time estimates to do planning and budgeting and many companies use them with success in work design. In any event, it is important to understand the basic industrial engineering method used to set standards, they are as follows:

- i.** Time study (stop watch & micro motion analysis).
- ii.** Elemental standard time data/Historical times.
- iii.** Predetermined motion-time-data.
- iv.** Works sampling.

Here it is mentioned that in case of maintenance work, work measurement is complex and difficult. Maintenance work has no standard work volume. Work volume differs from rolling stock to rolling stock even though the same type of rolling stock and same type of

repair. In case of locomotive F&G schedule repair take 10 & 21 days respectively. But from experience it is found that actual work increased or decreased from the prescribed standard work volume. Except unplanned maintenance other planned repair schedule works in BR are fixed by CPCS consultant. But BR failed to complete the most of the scheduled maintenance repair works within time which is shown in table 2.10.

In case of C&W repair time fixed for schedule lift enamel and POH (periodic overhauling) are 15 & 27 days respectively but actually it has been taken 30 days or more in both types of repair BR has not been measuring workers work performance since long.

**Table 2.10 Scheduled VS. Actual Average Working Time
Pahartali Carriage and wagon workshop**

Type of Stock	Lift Enamel (LE)			Periodical Overhauling (POH)		
	Period Year	Schedule working time days	Actual average time days	Period Year	Schedule working time days	Actual average time days
Intercity BG	1	15	21	4	27	32
Intercity MG	1	15	17	4	27	33
Mail, Local BG	1.5	15	28	6	27	29
Mail,Local MG	1.5	15	27	6	27	29
Wagon BG	-	-	-	3.5	6	14
Wagon MG	-	-	-	3.5	5	6

2.8.10 Human Resource Management:

There is no separate Human Resources Management department in Bangladesh Railway. Personnel department has been seeing the HRM works. But all personnel works of work shops has been doing respective works manager including their safety, security and industrial laws. HRM works perform by maintenance manages are below:

- i. Assessing the man power.
- ii. To preserve the personal records of all employees as a personal file of each employee.
- iii. To recruit, select training and promotion.

- iv. To reward, punish and motivating the employee.
- v. Giving yearly increment, monthly salary, leave, sick and safety.
- vi. To ensure pollution free environment, security, welfare and legislative support.

For training of maintenance employees especially for locomotive maintenance staffs, there are four workshops training units, established in 1992. All are equipped with modern facilities by the guidance of Canadian consultant. But due to shortage of trainer effectiveness of training program become poor.

There are another two training schools under C&W work shops, one in Saidpur another in Pahartali, Chittagong. There are more than 30% employees of BR in mechanical department, so man power development is more important to contribute in maintenance of rolling stock.

2.8.11 Safety management

Safety is closely related to the maintenance works. If maintenance is poor, it increases risk of unsafe operation and accident occurs due to unsafe its increases high volume of maintenance work which incurred great financial loss. So safety management is essential for maintenance management. Protection against injury and of life arising out of employment is the essential of safety engineering. It requires a deliberate policy of promoting safety by designing and ensuring safe systems of work besides use of safe equipment and education on safety to avoid loss of life, time and money. Introduce of self regulatory system, which encourage people to be vigilant to think constructively about safety and to act voluntarily in their joint interest form top management to ground worker. It is the basic requirement for adaptation within reasonable time and cost to achieve protection and durable result. It should be understood accidents are caused; they are not made to happen.

Safety: Railway accidents are most painful for the Railway division. Some of the accidents damage rolling stock seriously and cause loss of lives. During the year 2012-2013, a total of 151 train accidents (table 2.8) occurred in Bangladesh Railway of which 76.82% were caused by technical defects in rolling stock, track, signaling and interlocking apparatus. Major causes of accident are due to inefficient maintenance. Road side failure of rolling stock is other kinds of accident for this passenger suffer extremely; these decrease the goodwill of railway resulting decline in earning.

Safety measures: Some of the steps taken to avoid accidents include:

- i.** Modification of the signaling system is being carried out to minimize chances of human error in causing accidents.
- ii.** Auxiliary warning system, for giving advanced warning about signals at danger to the driver of the train.
- iii.** There has been progressive increase in use tie tamping and ballast cleaning machines for track maintenance.
- iv.** For monitoring track geometry and running characteristic of the track, sophisticated track recording cars, oscilographs cars and portable accelerometers are being used.
- v.** Maintenance facilities for rolling stocks have been modernized and upgrade at many depots.
- vi.** To prevent cases of cold breakage of axles, work shops have been equipped with ultrasonic testing equipment for timely detection of flaws in the axles.
- vii.** Whistle board/speed breakers and road signs have been provided at unmanned level crossing and visibility for drivers has been improved.
- viii.** Audio-visual publicity campaigns to educate road users for safe crossing at level crossing gate are organized periodically.
- ix.** Training facilities for drivers, guards and staffed connected with train operation have been modernized including simulators for training drivers.
- x.** Performance of the staff connected with the train operation is being constantly monitored and refresher training arranged wherever necessary.
- xi.** Periodical safety drives are conducted to inculcate safety consciousness among the staff.

Safety related factors and matters are shown in figure 2.7 below:

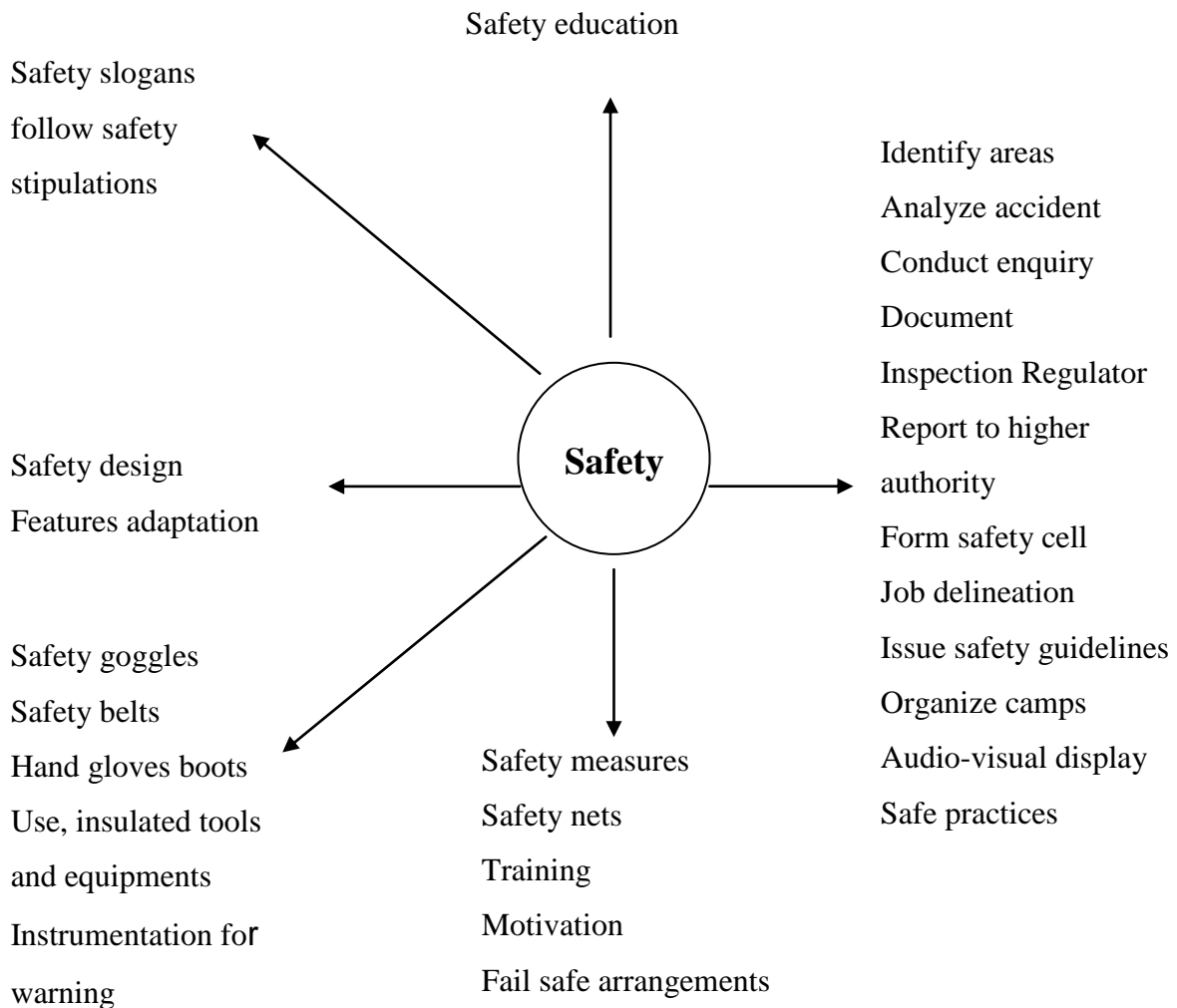


Figure 2.7 Logical Diagram of Safety maintenance

CHAPTER THREE

MAINTENANCE MANAGEMENT: ASSESSING EFFECTIVENESS OF ROLLING STOCK IN BANGLADESH RAILWAY

3.1 Introduction

Maintenance Management of Rolling stock deals with the proper care of maintenance of the rolling stock (locomotives, carriage and wagon) of Bangladesh Railway. It is technologically integrated system covering a broad array of fields: Inventory Control, Material & Purchasing management, HRM and budgetary control management. Function of Maintenance Management depends upon the function of all of these works. So effectiveness of maintenance management of rolling stock is the synergy of effectiveness in HRM, Material & Purchasing, Inventory and Budgetary management as a whole.

3.2 Effectiveness of Human Resource Management

Form existing HRM practice in BR, manpower data mechanical department shown in table 1.2 and present man power development system it is crystal clear that Human resource management in BR is inefficient, the reasons are as follows:

- a) Workers satisfaction is not part of a management job, it is the entire job. But BR does not follow this ideology. Maintenance of rolling stock is highly labor oriented work. Effectiveness of HRM is greatly influenced by productivity of the employee. Traditional personnel department has been seeing the HRM function in BR. Modern concept of HRM has no place in BR. No proper man power analysis has been done; as a result, BR failed hire required manpower in right time, in right number and in right place. Skilled worker decreases day by day but surplus worker are sitting idle. So the average productivity of man power is only around 65%.
- b) BR is a Government organization. So the culture of appraising and encouraging the employee is not practiced. Due to the bindings of govt. rules and regulation motivation is completely absent, motivation of the manpower and personnel incentive is not possible easily. As a result, people do not work enthusiastically. Hence output remains poor which we can understand from table 3.1, 3.2, 3.3 and 3.4.

**Table 3.1 Budget allocation & out-turn position of Carriage & Wagon
Pahartali workshop Chittagong (figure in million taka)**

Year	Material budget required	Budget allocation	Wagon out-turn (Nos.)	Unit/ Working day
2008 - 09	66.70	50.80	23.60	1.73
2009 - 10	77.30	59.10	23.30	1.66
2010 - 11	66.70	50.80	23.60	1.73
2011 - 12	100.00	46.60	23.60	1.76
2012 - 13	100.00	32.20	28.20	1.87

**Table 3.2 Wagon out-turn position
Pahartali workshop Chittagong (figure –in million taka)**

Year	Material budget required	Budget allocation	Wagon out-turn (Nos.)	Unit/ Working day
2008 - 09	14.7	10.3	849	4.51
2009 - 10	12.0	10.5	772	4.69
2010 - 11	17.1	11.6	723	4.28
2011 - 12	12.0	14.1	771	4.43
2012 - 13	22.6	15.1	630	3.80

**Table 3.3 Repair and material budget for Locomotive/Diesel Workshop
Budget figure in Crore taka**

Year	Dhaka		Parbotipur		Pahartoli		CLW		Total	
	Reqd	Alld	Reqd	Alld	Reqd	Alld	Reqd	Alld	Reqd	Alld
2009 -10	7.00	5.33	11.00	7.16	12.00	6.46	20.00	8.34	50.00	27.29
2010 -11	7.00	5.92	12.00	6.86	12.00	9.58	20.00	15.36	51.00	37.72
2011 -12	6.00	5.19	16.00	6.46	15.00	8.49	15.00	14.87	52.00	35.01
2012 -13	6.17	4.84	11.61	6.99	15.11	10.14	20.00	15.00	52.89	36.97
2013 -14	9.04	4.89	12.83	6.99	15.12	10.09	30.00	20.00	66.99	41.97

Note: Reqd – Required

Alld – Allocated

Table 3.4 Out-Turn of Central Locomotive Workshop, Parbatipur

Financial Year	No. of loco out-turn Capacity	No. of loco out-turn Planned	No. of loco out-turn Actual	Remarks
2008 - 09	48	25	19	Workshop established in the year 1991
2009 - 10	48	28	18	
2010 - 11	48	24	25	Manpower Sanction = 544,
2011 - 12	48	26	27	On roll = 335
2012 - 13	48	20	16	

- c) Management is not the direction of thing – it is the development of people. But BR management does not emphasize the development of the people. Budget sanction, staffing the vacant post and other facilities are also poor. So, the people of BR are not properly trained. People are not becoming familiar with the modern management. So, the productivity of manpower decreases.

3.3 Effectiveness of Maintenance Management

Present capacity of the workshops, loco sheds and C&W depot, infrastructures, equipment and floor level managers are inadequate to proper maintenance of rolling stock. All workshops except central locomotive work shop were established about 50 years ago. Diesel workshops were mainly established for maintenance steam locomotive.

After then they were converted into diesel workshop with less facilities. So, the capacity of the workshops is less to maintain the whole rolling stock fleet as per their scheduled maintenance time as we can see table 2.10. From existing maintenance practice, productivity, out turn and failure of rolling stock it is showed that maintenance system in BR is inefficient. The causes are as follows:

- a) Less capacity of infrastructure others facilities.
- b) Less productivity of manpower. Productivity of manpower is 65% as reported by CPCS consultant. So, the effectiveness of maintenance is poor.
- c) Lack of modern equipment.
- d) Management is not open to all for communication of information. People are not well informed about their job. So, output does not meet the target.
- e) Maintenance Management of rolling stock is a fully technical department. It needs continuous development of people and organization should be a learning organization. But BR's management is autocratic type so the efficiency level is low

and the reliability of rolling stock decreases, increasing road failure of rolling stock result decreased availability we can see table 3.5, 3.6, 3.7.

Table 3.5 Locomotive Failure

Year	Dhaka	Chittagong	Lalmonirhat	Paksy	Total
2009	189	160	79	80	508
2010	216	148	56	60	480
2011	197	130	56	65	448
2012	175	138	56	65	434
2013	140	111	81	66	398

Table 3.6 Locomotive Performance Metre Gauge

Year	Loco km./ day /loco on line	Loco Km./day /loco in use		% of Average Loco under of awaiting repairs daily to Average total loco in line	Hrs.Worked/ day/ loco available for use
		All Engines	Goods Engines		
2008 – 09	172	238	174	18.7	10.1
2009 - 10	168	235	173	27.4	13.8
2010 - 11	172	240	171	20.1	13.7
2011 - 12	173	242	174	28.5	15.0
2012 - 13	172	241	173	33.7	13.7

Table 3.7 Performance of Coaching Vehicle Metre Gauge

Year	Km./Vehicle./ day on line		% of AV. Loco under of awaiting repairs daily to AV. Total loco in line Hrs. Worked/day/ loc available for use	
	Passenger	Other Coaching	Passenger	Other Coaching
2008 – 09	264	90	11.3	15.2
2009 - 10	265	90	11.9	13.5
2010 - 11	249	73	8.85	16.0
2011 - 12	261	79	23.6	2.02
2012 - 13	294	117	19.4	9.52

- f) Performance of maintenance department is related to the performance depends on external environment like transportation industry context and country context. Transportation industry has been developing without long term planning. Government towards development of road is ignoring the urgent need of investment in the railways. As a result, of the uneven invest policy there was a phenomenal growth in road and road transport sectors. This handicap coupled with uneven competition from a rapidly expanding road sector put BR in a serious financial crisis. As a result, BR's market share is decreased significantly.

In case of country context explanations are bellow:

Bangladesh is a poor country in the world. Back support give by country is not enough for a heavy industry like railway. 80% of spare part of locomotive has been purchased from abroad, All rolling stocks have been purchased from various offshore countries from various manufacturers according to the choice of donor countries. These created greater problems in the case of purchasing, stocking and managing inventory and also create labor expertise problem. An employee has to know the multidimensional works. These constrains are also responsible for ineffectiveness of rolling stock maintenance management. Geographical constrains is another problem for BR. Railway is profitable in long range of transport and mass commodity. BR has only 300 km long direct rail line. So, railway has been facing tough competition with other modes of transport. Above mentioned external problems have affected the performance of BR as well as affect the performance of maintenance management.

3.4 Effectiveness of purchasing Management

From overseeing problem associated with foreign and local purchase, nature of purchasing management, existing practices of purchasing management, Centralized vs de-centralized purchasing system, date analyses from exhibits, it is clear that purchasing management in BR is ineffective for the following reasons:

- The objective of effective purchasing management is to procure materials in right quantity, from right source, at right price, in right time and of right quality. The above discussion shows that these set right objectives are not achieved and as a result, the purchasing management in stores department is not effective.

- In developed countries where only 5% material failure is acceptable; but since Bangladesh is seller market, dependent on offshore countries, material failure exceeds 5 % causing ineffectiveness in purchasing which we can understand from table 3.8.

Table 3.8 Availability of Materials (Locomotive Spare Parts)

Serial No	Purchase case No	No of items for which tender was invited	No of items for which no tenderer quoted price	Availability of material
1	Case-1	978	319	67.36 %
2	Case-2	569	216	62.04 %
3	Case-3	753	101	86.59 %
4	Case-4	896	60	93.10 %
5	Case-5	545	46	91.56 %

- For official secrecy actual purchase case no. are not given.
- Railway has taken initiatives to discuss the problems with the suppliers. But supplier's local agents attended the meeting, not the offshore suppliers. Perception states that the local agents can not perhaps make their supplier understand the railway's problems and needs. The purchaser does not have an opportunity to visit suppliers and exchange views in persons. From the end of the purchaser several correspondences have been made with the suppliers but most of them remain un-respondent.
- Some suppliers communicate to their views. From the local agents what is learnt is that the demand of Bangladesh Railway is a niche to the offshore supplier, BR has age-old rolling stock and the spare parts of which have been obsolete due to changing technology, to meet railway demand they are to rescheduling the production plan which may cause suffering to their prospective customers having deal of significant dollar amount. Taking all these factors into consideration the fact tells that much portion of ineffectiveness of purchasing management is beyond the control of stores department. Time has come to think over revising efficiency and effectiveness in purchasing management in a new dimension.

- Lack of computer based MIS managers are not getting information on call; as a result, decision making is delayed causing ineffectiveness in purchasing Information flow involves transmitting orders and updating the status of delivery is done manually, monitoring of implementation is weak As store department is not related to out turn of rolling stock and railway's daily operation they are enjoying some relaxation and reluctant mentality of employee is reducing the efficiency of purchasing management.
- Financial flow consists of credits terms, payments and payment schedule, plus consignment and title ownership is done manually instead of computer application, which also causes ineffective purchasing.
- Lack of proper training, motivation and development of store personnel is another major cause of ineffective purchasing.

3.5 Effectiveness of Inventory Management

From existing practices of inventory management and some data analyses of table 2.7, 3.9, it is found that in BR inventory control is not effective because materials can not be supplied to the consumer in time for which maintenance is hampered.

Table 3.9 Material Against which re-tender invited in 2013-2014

*Tender Case No.	Description of material	Causes of re-tendering	Effect of re-tendering	Impact on maintenance
1	Lamp Holder	Failure to supply materials	Lead time increases & availability decrease	Ineffectiveness
2	Fancy ceiling	Failure to supply materials	Lead time increases & availability decrease	Ineffectiveness
3	Disc Signal MCI	Failure to supply materials	Lead time increases & availability decrease	Ineffectiveness
4	Tyre Steel	Failure to supply materials	Lead time increases & availability decrease	Ineffectiveness

* For official secrecy actual Tender case No. are not given

Again as ABC analysis is not properly carried out in BR some items some inventory become out of stock and overstocked.

- Transportation of railway inventory plays a vital role for an effective inventory system. To meet the emergency need of different consumer, materials should be transferred from one stocking depot to another depot. But a traditional railway transport system has been taking more time. This is one of the causes of inefficiency, in inventory management.

3.6 Effectiveness of Safety Management

Safety management of BR is not effective. Review of operating performance of BR cannot be completed without taking a look at its safety record. Collisions, derailments, and level crossing accidents are considering train accident. Table 2.8 shows no. of train accidents and table 2.9 shows the casualties of BR. Policies pertaining to train examination of freight trains and maintenance of other rolling stocks need to be placed on a firm footing. The turnout of coaches and wagons from workshops and sick lines with reject able defects is another safety hazard, apart from being wasteful, requiring urgent attention. Safety is an essential element of transportation service and forms a foundation of railway business. Accidents related to rail transport are roughly divided into those which affect safety, including passengers, and those which disturb rail transport service; the former is referred to as the rail operation related accident, while latter as the rail service interrupting accident.

3.6.1 Prevention of operation related Accident

i. Prevention of accident

In order to prevent railway accidents, it is important to establish an effective accident prevention system and to provide appropriate guidance and assistance, and to promote training, in order to provide raised safety concerns among employees, while improving their knowledge and skills related to accident prevention. Equally important is that every employee makes his or her best effort to assure safe train operation by holding oneself in readiness for accident prevention, and by realizing the importance of safety.

ii. Accident prevention system

A division-wise prevention system involving headquarters and field operations needs to be maintained so as to establish an organization accountable for accident prevention activities. But BR has no accident prevention cell.

iii. Important Points Related to Accident Prevention

BR has been unsuccessfully maintaining a low level of safety. Another most important factor is employees. Particularly it is important BR employees to maintain careful checking and communication related to daily operations in order to assure that required procedures and practices are followed. Furthermore, employees are expected to obtain knowledge, skills and technical expertise to handle emergency cases. Only through these efforts, accident prevention and safe train operation can be assured.

iv. Introduction of New Technology, Education and Training:

- a) Upgrading of education and training to raise awareness for accident prevention.
- b) Upgrading of facility and equipment maintenance technology.

Safety and efficiency are interlinked. Accidents and equipment failures result in loss of capacity, irreparable loss of life and property, gross inconvenience to the customers, payment of heavy amount of compensation and a chain reaction of inefficiency and immobility - all of which had adverse impact on railway finances. On the other hand, low efficiency leads to more accidents and failures. BR now has been running in this vicious cycle. So, the performance of safety management is poor. The vicious circle, must be broken, key to which is higher standards of maintenance and timely replacements of depleted assets.

CHAPTER FOUR

MAINTENANCE MANAGEMENT: ASSESSING EFFICIENCY OF ROLLING STOCK IN BANGLADESH RAILWAY

4.1 Introduction

Maintenance management is the practice of coordinating the flow of spare parts, component, equipment and schedule due rolling stocks towards workshops and proper utilizations of human resource, machine, technology and other facilities. Maintenance management of rolling stocks depends on many factors, which make a link like a chain. The links of Maintenance management are mainly Material management & purchasing, Inventory, HRM, Schedule maintenance and Budget. So, the efficiency of Maintenance management of rolling stocks is the synergy of efficiency in Material/spare parts purchasing and supply, inventory control, human performance and budget as a whole.

4.2 Efficiency in Human Resource Management

Maintenance management (Mechanical) department has 7771 employees, which is 29.96 % of all railway man power (table 1.2). HRM function has been doing by traditional personnel department. So the HRM function in BR is inefficient for the following reasons:

- i. BR does not practice modern human resource management. Manpower analysis, recruitment, selection, training & development have not done in timely and properly .As a result work is held up for proper staff. On the contrary workshops are over staffed.
- ii. Most of the staffs are uneducated and under motivated. There is no scope to motivate the workers.
- iii. The facilities, safety and securities are not sufficient and up to date. Employees are not being aware of safety and management does not take any initiative to aware of employees.
- iv. Lack of encouragement to develop an executive to have independent thinking, entrepreneur and human skilled.
- v. Training was found mostly inadequate for the needs of maintenance of rolling stock.

- vi. Most of the related officers of maintenance management are not properly trained on management and HRM.

4.3 Efficiency in Maintenance Management of Rolling stock

Maintenance management of rolling stock in BR is not efficient for the following reasons:

- More time is taken than the pre-fixed standard time to repair the rolling stock. It simply the wastage of man power and increases cost of maintenance and cost involved for unutilized the rolling stock.
- Break down and under repair rate of rolling stock in comparison to other country is larger. It creates hazard in train operation, as well as decreases the rolling stock availability causing low quality of maintenance.
- Road failure of rolling stock is also out of limit. Due to road failure, operation of railway management faces enormous problem and good will of railway transport decreases.
- BR cannot maintain the quality standard of maintenance of rolling stock. Providing less amenities and facilities of customers.
- Maintenance management failed to maintain the target level of availability of rolling stock, resulting punctuality of goods and passenger train failure frequently. Resultantly, BR losses earning.
- Huge amount of rolling have been running over due, it tends to increase accident.
- Passenger coaches are being repaired out sourcing keeping workshop physical resources underutilized, which causes cash out flow.
- To clear the backlog of scheduled overdue, locomotives are overhauled under project management at Central locomotive work shop. This is the result of continuous failure of maintenance management to up to date the rolling stock maintenance.
- Central locomotive workshop has been under utilized since its establishment. Targeted out turn is 24 locomotives but maximum out turn of previous year was 17 locomotives.
- Rolling Stock availability is insufficient and also much below the generally accepted industry standards as shown in table 4.1.

Table 4.1 Availability of Rolling Stock

Type	Stock owned		Ineffective Stock		Effective Stock		% Availability	
	2012	2013	2012	2013	2012	2013	2012	2013
Locomotive BG	78	73	21	14	57	59	73.08	80.82
Locomotive MG	217	185	79	66	138	119	63.59	64.32
Carriage BG	324	324	97	76	227	248	70.06	76,54
Carriage MG	1165	1181	259	310	906	871	77.77	73.75
Wagon BG	2540	2870	243	391	2297	2479	90.43	86.38
Wagon MG	9460	9153	1343	1679	8117	7474	85.80	81.66

Availability target is 90% and 80% availability is good.

- Training of maintenance staff is inadequate for the needs of BR. Absence of in-depth training and technical assistance from high level management; skilled development of workers declined which causes inefficient maintenance.
- Workshop training units were to be an effective way to address immediate skill upgrading for locomotive maintenance and provide on going refresher training for proper maintenance. But maximum posts of trainers are vacant now. Resulting in inadequate training in the maintenance of workers. It is the inefficiency of maintenance management of rolling stock.

4.4 Efficiency in purchasing management

From chapter 2 and tables maintenance management of rolling stocks is found to be inefficient for the following reasons:

Railway materials, spare parts, and components are of specialized nature. Most of the sources of these materials are limited and are situated in Dhaka and Chittagong. For existing decentralized purchasing system different procuring entities procure almost same material sources at different prices and thus more financial resources are required and economies of scale are lost.

Ordering cost for re-tendering increases (paper cost, correspondence cost), purchasing is associated with default cost (cost for insure claims, customs duty, refund claims, claims for short supply or damaged materials legal advisor fee), set-up cost and quality cost (testing fee, contingent expenses). The requirement for spare parts is more than planned time and causes more stock-out-cost.

In foreign purchase, currency fluctuation causes more local currency to make payment creating pressure on budget, expediting shipment is costlier, legal issues such as payment of liquidated damages and arbitration, more transport cost and incidental charges are associated which altogether lead to more financial resources. Not using price forecasting technique it can not ensure purchase at right price in case of foreign purchase.

4.5 Efficiency in Inventory management

Inventory for the railway consists of spare parts to keep rolling stock in service through scheduled maintenance. The inventory control in BR is not efficient for the following reasons:

Present inventory size is of Taka 250 crore associated with a good amount of inventory cost leading to requirement of more financial resources. Giant inventory consisting of 33,000 items needs more physical and human resources.

BR is losing the opportunity cost of investing Taka 250 crore in other important sector development. Not practicing ABC analysis properly leads to stock-out-cost or overstock cost that causes financial loss to BR. No inventory model befits BR's Inventory practices and comparative study between EQO and Reorder quantity for transport cost incurred, BR, in most of the time is deprived from cost-savings.

4.6 Efficiency in Material purchasing management

From chapter 2 and table 2.6, 2.7, 3.9, material purchasing management in BR is found to be inefficient for the following reasons:

- Ordering cost for re-tendering increases (paper cost, correspondence cost), purchasing is associated with default cost for insurance claims, customs duty, refund claim, claims for short supply or damaged materials legal advisor lee), setup cost and quality cost (testing fee, contingent expenses). Time required for spare parts is more than planned time and causes more stock-out-cost.

- In foreign purchase, currency fluctuation causes more local currency to make payment creating pressure on budget, expediting shipment is costlier, legal issues such as payment of liquidated damages and arbitration, more transport cost and incidental charges are associated which altogether lead to more financial resources.
- Railway materials are of specialized nature. Most of the resources of the sources of these materials are limited and are situated in Dhaka and Chittagong. For existing decentralized purchasing system different procuring entities procure almost same materials from the same sources at different prices and thus more financial resources and required and economics of scale are lost.
- Not using price forecasting technique does not ensure purchase at right price in case of foreign purchase.

4.7 Efficiency in budget allocation

Financial resource is the major factor of maintenance operation. But maintenance department has been facing deficit budget since long. Rolling stocks and its spare parts in general is very expensive need sufficient amount of budget. From table 3.1, 3.2, 3.3, 3.4, 4.2 it is seen that budget sanction for maintenance of rolling stocks is inadequate.

Table 4.2 Repair and Material Budget for Diesel Workshop/PHT/CTG

Financial Year	Holding Loco nos	Repair required			Out turn Schedule				Material budget required crore	Budget Allocated crore
		F nos	G nos	Total nos	F nos	G nos	Total nos.	Spl nos		
2009 - 10	107	32	18	50	26	10	36	296	12.00	6.46
2010 - 11	107	37	33	70	28	18	46	317	12.00	9.58
2011 - 12	116	36	33	69	22	21	43	281	15.00	8.49
2012 - 13	116	34	33	67	27	19	46	210	15.11	10.14
2013 - 14	121	32	27	59	23	15	38	196	15.12	10.09

NOTE: F = F schedule, G = G schedule

CHAPTER FIVE

MAINTENANCE MANAGEMENT OF ROLLINGSTOCK SWOT ANALYSIS

5.1 Introduction

A **SWOT analysis** (alternatively **SWOT matrix**) is a structured planning method used to evaluate the **strengths, weaknesses, opportunities and threats** involved in a project or in a business venture. A SWOT analysis can be carried out for a product, place, industry or person. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective. The degree to which the internal environment of the firm matches with the external environment is expressed by the concept of strategic fit.

Strengths: characteristics of the business or project that give it an advantage over others.

Weaknesses: characteristics that place the business or project at a disadvantage position.

Opportunities: elements that the project could exploit to its advantage.

Threats: elements in the environment that could cause trouble for the business or project.

In chapters three and four the effectiveness and efficiency in Maintenance management of rolling stocks have been discussed. After in depth study of maintenance management of rolling stock some constraints and weaknesses have been noticed. Maintenance management is the technically and logistically integrated management of material & purchasing, inventory control, HRM, budgetary control and maintenance system itself. So, constraints and weaknesses in all these areas are being discussed separately as follows:

5.2 Human Resource Management

- a) Absence of modern human resource management department.
- b) Traditional way of managed human resource by personal department.
- c) Constraints to computerized data collection of employees.
- d) Lack of experts in HRM.
- e) No policy for apply HRM.

- f) Inadequate training facilities and training policy.
- g) Insufficient management development program.
- h) Railway Training Academy and four work shop training units have not been properly utilized, and the logical implementation of the comprehensive maintenance training program at these institutes would contribute towards creating a railway institution of higher learning.

5.3 Maintenance system and management

- a) Constraints to apply recent trends in maintenance management.
- b) Lack of modern management concept.
- c) Absence of participatory management.
- d) Under educated, unskilled and under motivated manpower.
- e) Inadequate management training and development policy.
- f) Want of proper and modern machinery and equipments.
- g) Shortage or not in time delivery of materials.
- h) Trade unions' intervention.
- i) Shortage of skilled labor, lack of quantitative approach of maintenance.
- j) Absence of work measurement to calculate the individual worker performance.
- k) Lack of adequate internal material handling facilities and unsatisfactory method of storage in maintenance station.
- l) Scarcity of financial resources.
- m) Flexible monitoring and poor managerial of control.
- n) Strict control in job assignment.
- o) Constraints in incentive plans for the works.
- p) Absence of efficient and effective staff management.
- q) Low technological level.
- r) Inadequate work manual, inferior managerial instruction.
- s) Lack of mechanization of the work.
- t) Absence of total quality control work.
- u) The maintenance management is .the shortage of trained and skilled personnel.

- v) Inadequate resources to properly train its maintenance staffs. The situation is expected to worsen, as inadequate basic training perpetuates poor leadership and inadequate overall practices.
- w) Inadequate management information system for timely decision making, planning and control.
- x) Lack of full utilization of Central Locomotive Workshop at Parbatipur.
- y) Lack of program for management and technical support.
- z) Failure of organizational structure and job descriptions to evolve with changing technology consequently inadequate development of managerial skills & attitudes.

5.4 Material and Purchasing

- a) Make or buy decision and the concept of best buy are not in practice on a regular basis. Make or decision may increase the effectiveness and efficiency in purchasing management.
- b) For procurement of capital equipment lease or buy decision should be taken which is not at all in practice in Bangladesh Railway. In most of the cases lease decision saves money since the concept of outsourcing is increasing day by day.
- c) Absence of vendor evaluation procedure. Every purchasing department should evaluate the vendor on the basis of delivery time, quality, price and service with a view to rating the vendor, which will contribute to the effectiveness and efficiency of purchasing management.
- d) Vendor development program is not in practice.
- e) Absence of Computer application and introduction of EDI.
- f) Absence value analysis/engineering.
- g) Environmental, social and political aspects are not assessed.
- h) Price forecasting technique is not found.
- i) Transportation and freight administration are not carried out.
- j) Promotional development to supplier- purchaser relationship and maintaining tight with them are absent.
- k) There is no professional institute or purchasing management and arrangement of training for the purchasing officials and staffs.
- l) Absence of supplier's selection criteria.
- m) Lack of information about suppliers.
- n) No concept of supplier's management.

- o) No existence of market research price determination cell.
- p) Inadequate protection against collusive, coercive, fraudulence and corruption.
- q) Reluctance to introduce price protection clause.
- r) No policy for forward buying, speculation and gambling.
- s) No presence of standardization and specification cell.
- t) Bureaucratic structure instead of corporate structure.
- u) Lack of strategic purchasing management in stores department.
- v) Lack of experts in transportation administration, fare structure and economic mode of transport analysis.

5.5 Inventory control

- a) Railway materials are specialized in nature, 80% materials are importable, bulk quantity is procured, and that is why mode of transport is sea, which is slower. So lead time is greater causing greater stock.
- b) Underutilization of BRASS program.
- c) Want of skilled and trained person in inventory department.
- d) Less coordination among store depots, inventory control cell and works shop.

5.6 Budgetary constraints

- b) Insufficient budget allotment for maintenance of rolling stock.
- c) Lack of modern financial instrument to prepare, monitor and control of maintenance budget.
- d) Lack of information about maintenance cost and coordination between accounts and maintenance department.
- e) BR budget allotment is depends upon government policy.
- f) The problem in financial management and accounting was found to be the lack of management information on financial performance indicators and overall result.
- g) Inappropriate assessment of customs duties on BR imports of spares and parts. Custom duties on spares parts for locomotives exceeded 100% on average.

5.7 Strategies to overcome constraints and weakness

The following strategies help to overcome present constraints and weakness of maintenance management of rolling in BR, which are describing below:

5.7.1 Purchasing

- a) Before gaining to procure spare parts, the purchaser in consultation with the technical department undertakes make or buy decision and before going to procure capital equipment buy vs. lease analysis to be undertaken on the use of procurable equipment to take investment decision.
- b) A standard procedure for evaluation of vendor's performance should be introduced which will ensure delivery, price and service of material in right manner.
- c) Computer application in purchasing management is to be increased, EDI (Electronic Data Interchange) is to be established so that purchasing management can be converted into the information management. Computer application in purchasing will give the following benefits: * Electronic handling reduces clerical, manual effort and ordering cost, * MIS will be available instantly, * Control over operation is improved.

Computer can bring application in following areas which is shown in figure 5.1:

i) Purchasing operating system:

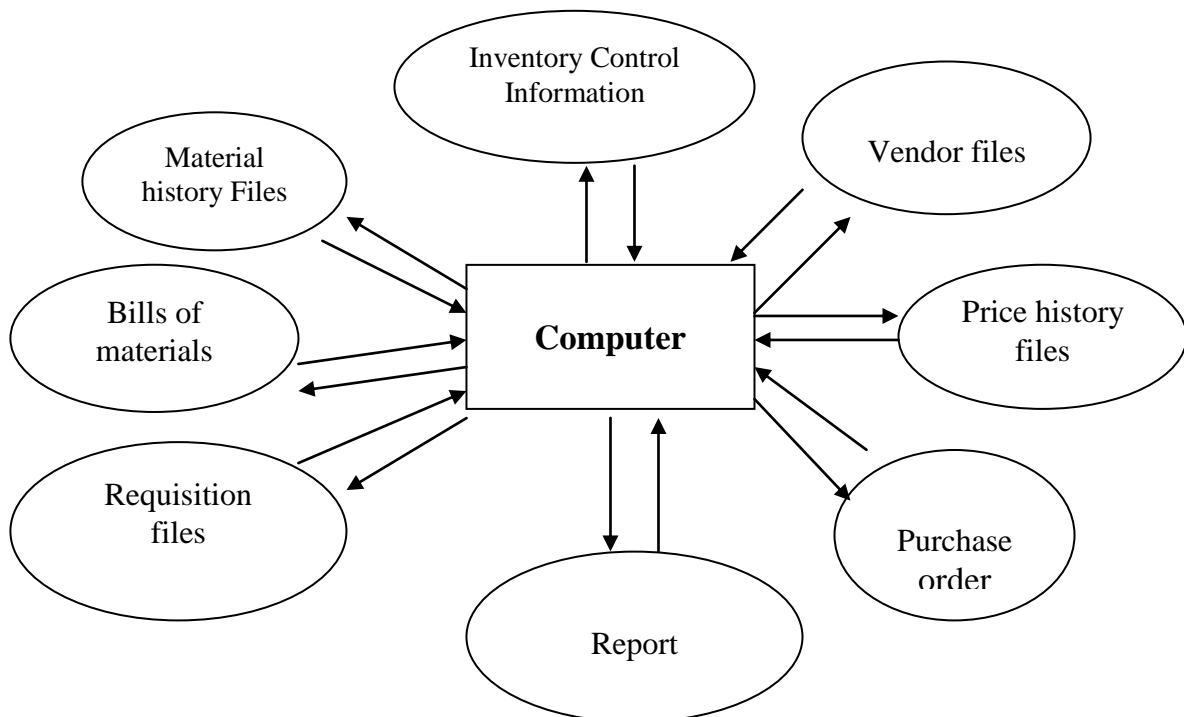


Figure 5.1 Purchasing operating system

ii) Management report system: Management can have report instantly such as vendors' performance evaluation reports (figure 5.2).

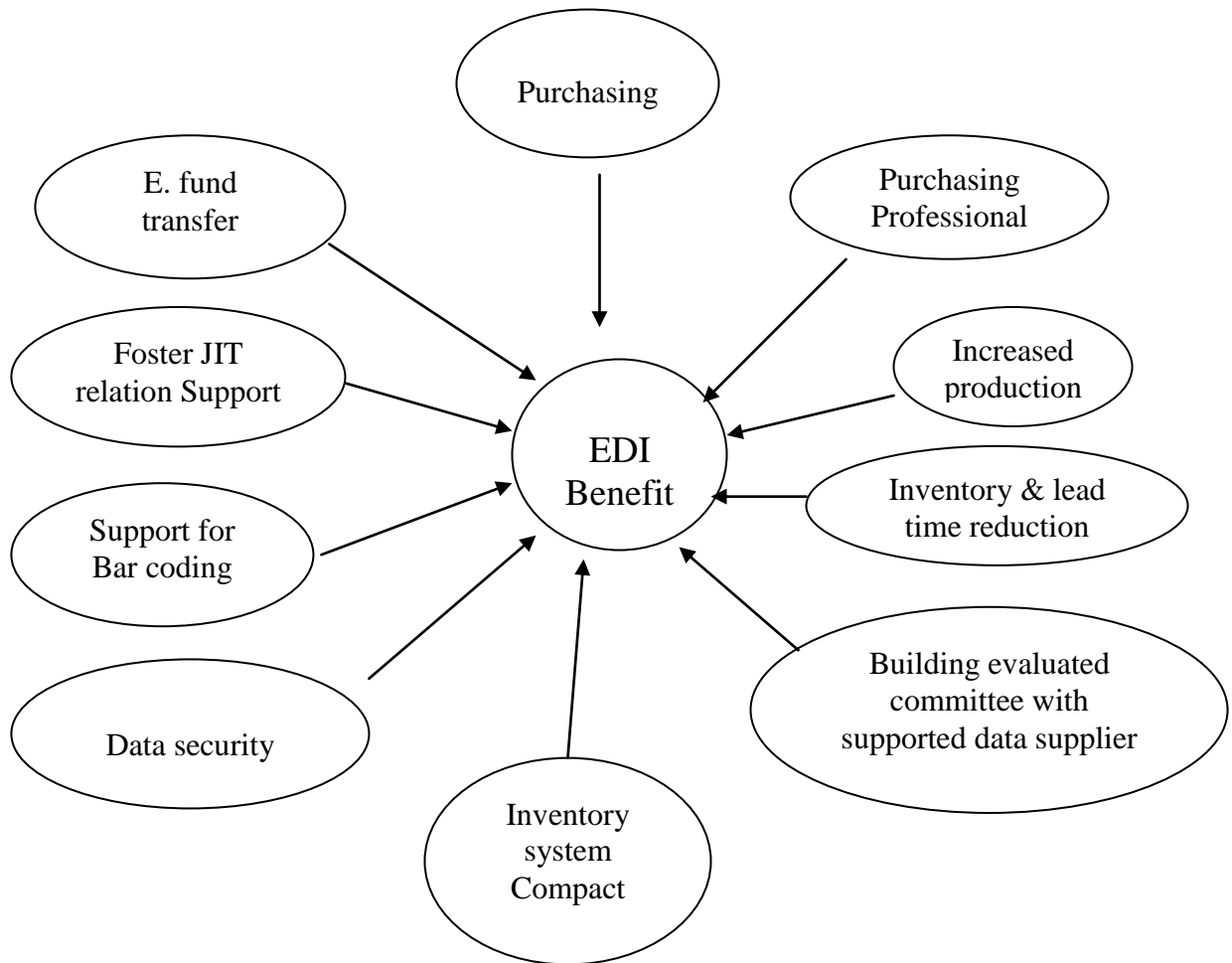


Figure 5.2 Management report system

iii) Decision Assistant (decision Support) System: Models of computerization such as quotation analysis, price discount analysis, systematic analysis, fare analysis, Formal buying and future trading models helps in supporting decision as to expedite procurement. From data collected as to computerization in purchasing it is seen that computer uses are in the following areas which is shown in figure 5.3:

On line decision support system----- 40%

On line purchase order processing----- 64%

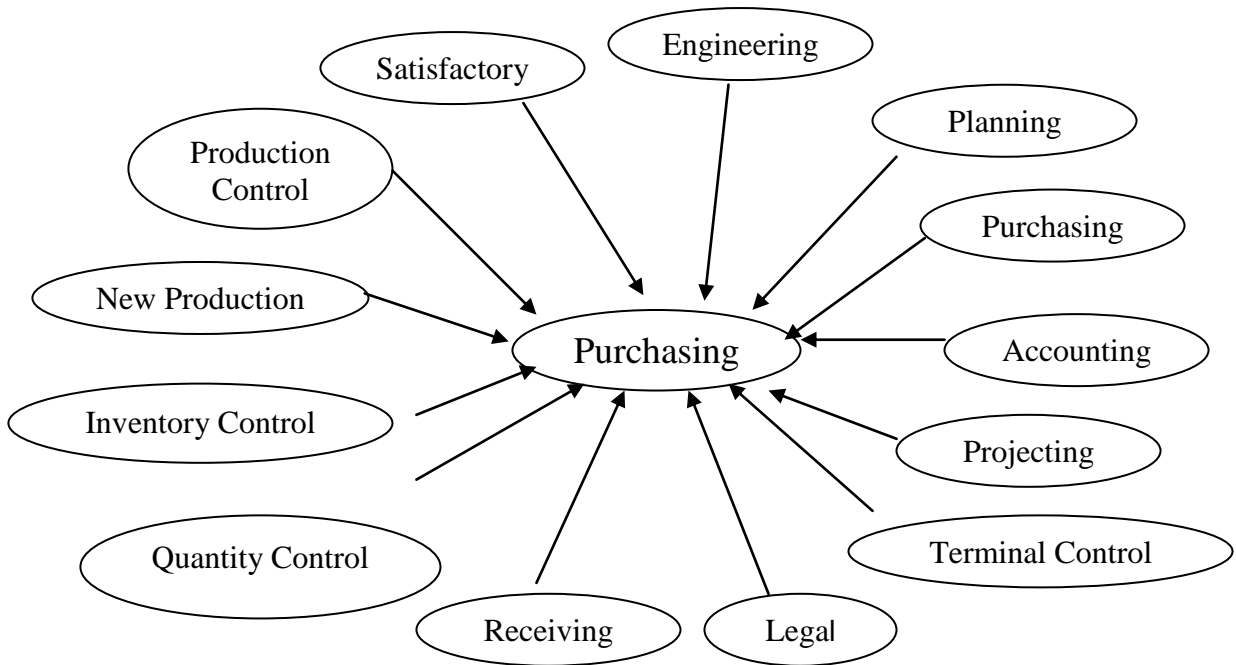


Figure 5.3 Decision Assistant (decision Support) System

iv) External information flows to Purchasing as follows:

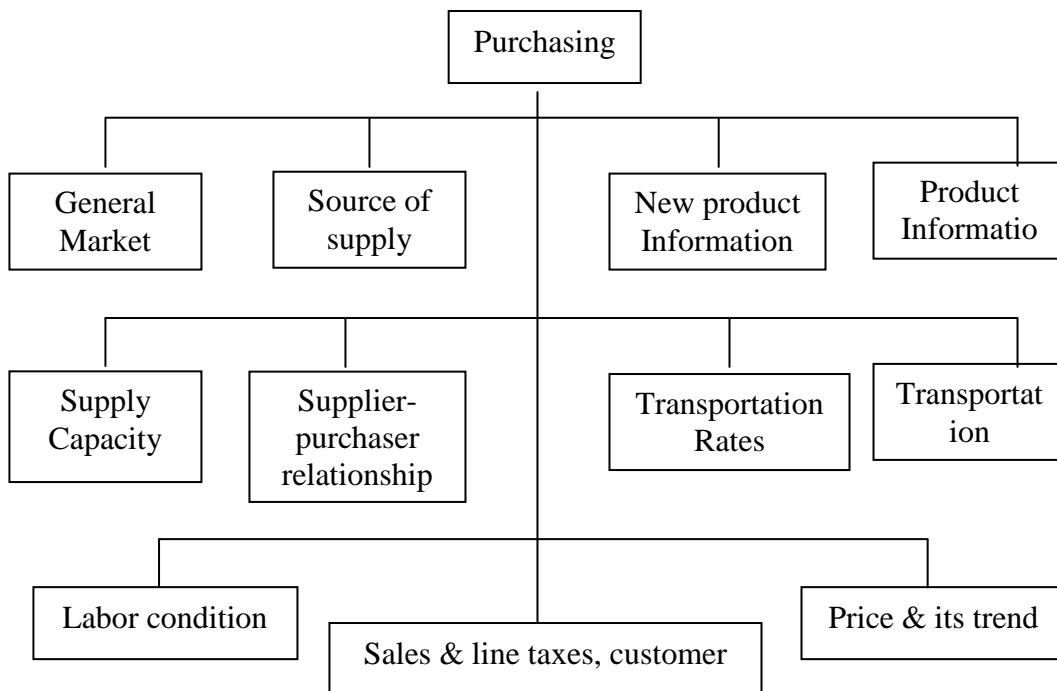


Figure 5.4 External information flows to Purchasing

- d)** Concept of “Best Buy” can be introduced to achieve the value for money in \ purchasing management.
- e)** There should be a cell of market research to develop source, to have information about new product & value analysis in terms of function, cost, esteem, utility and obsolescence.
- f)** Price forecasting determines purchase budget, cash flow and inventory limits. Normally 10% increase in price, as minimum per year is a thumb rule. But for accurate forecasting, data collected and analyzed by using moving average method, exponential smoothing, regression analysis and extrapolation methods for long term forecasting are required to introduce in stores department to have control over price to ensure purchase at right price.
- g)** There are professional institutes for purchasing management in Africa, UK, New Zealand, Trinidad and Middle East but not in Bangladesh. So a professional training institute in purchasing is to be set up in Bangladesh.
- h)** To have information about supplier, the purchaser is to be develop a machinery to collect all these things, catalogues, microfilms tiles, industrial advertising, trade directories, sales representative vendors file, visit to suppliers from high commission and embassy of different countries and the purchaser is also to develop the tool for choosing the suppliers and maintaining coordination between the parties.
- i)** Government should apply law without delay for collusive, coercive, corruption and fraudulence practices.
- j)** Standardization and simplification should be established in purchasing department to bring price benefit.
- k)** For bureaucratic streamline decision making in purchasing is causing delay in purchasing materials and so to expedite decision making in purchasing the bureaucratic structure can be reformed into corporate structure and strategic management of purchasing instead of traditional purchasing management has to be adopted as per days demand.

- l) To reduce ordering cost and lead time our government should introduce E- Procurement Regulations or law for which effectiveness and efficiency in purchasing will be achieved.
- m) In stores department it is required to set the rule of maintaining supplier purchaser relationship to avoid the risk for buying unknown materials, parts, equipments from unknown supplier for which purchaser is to seek advice for engineering judgment.

5.7.2 Human Resource Management

- a) Maintenance is dirty and un-appreciable job. People who are engaged with this job should be highly motivated. It is only possible to change the present traditional concept of human management. Railway is a labor oriented mass transport industry. Man is the main key resource of railway. Still now 25939 employees are working in BR. For effective and efficient utilization of such man power government should adopt the modern concept of HRM in BR.
- b) Though BR is a state owned government organization spread through out the country but there has been a long experience of personnel management and exist some infrastructure facilities. Government should reorganize the personnel department with recent trend of human management; provide some rules and regulation for proper working the HR management.
- c) Training academy and all work shop training units will be under the control of HRM. Management development and employees training program should be organized centrally.
- d) Managers with modern knowledge of FIRM should be posted in FIRM department and also need to be given higher salary.
- e) Provide all facilities with computer based infrastructure.

5.7.3 Budget

- a) Sufficient budget must be allotted for proper maintenance of rolling stock. Because rolling stocks are the main resources of earning. As per yearly scheduled program of

rolling stocks maintenance, budget should be prepared and sanctioned to achieve the targeted repair of the rolling stock.

- b) Finance, accounts and maintenance department should be integrated computer network to exchange information rapidly about budget preparation, expenditure and control.
- c) Accounts and Finance department should prepare yearly balance sheet of each maintenance station and to disseminate information about loss and profit among the employees.
- d) Each workshop (Maintenance station) should keep its own books for cost accounting for monthly settlement. Workshops may vary in scale and types of work each performs. The method of cost accounting, however, remains the same for all workshops regardless of their scale and types of work each perform.

5.7.4. Maintenance management

- a) Adopting the modern concept of maintenance management and change the traditional bureaucratic attitude towards participatory and learning management model. Government should introduce some policy and technique to motivate the floor level management and workers. Some incentive program like good worker award, best worker award and best suggestion award may be introduced; in this way workers can participate in the management decision making process.
- b) A master plan should be taken to improve the productivity of the workers. Coordination with FIRM, acquisition of human resource is done properly so that the present problems of overage, under qualified and unskilled worker may not arise in future.
- c) Present actually averaged (but not as per document) workers have been lost their productivity should be released from their job with full benefits. In lieu of them educated skilled manpower should be employed to face the challenge of 21st century.
- d) Flow of raw materials must be made smooth and thereby implementing effective and efficient maintenance management.

- e) Trade union leaders should be trained up properly so that they can understand effectively the ILO convention, trade unions rules and regulation and industrial laws. They must help the management to increase the efficiency of the maintenance management.
- f) Trade union leaders are to be motivated towards their duties and responsibilities.
- g) Present manpower is to be trained to enhance their skill. For this present carriage & wagon training section should be strengthen by introducing modern facilities and infrastructure.
- h) S&P section of maintenance management of rolling stock should be properly staffed and they should standardize and simplifies the maintenance work and facilities. They must help by transfer the information of locomotive maintenance schedule program to up date the BRASS program in inventory control cell. Necessary information's, includes yearly schedule program to be collected by maintenance department from ICC. But this computerized program was found not in up-to-date. By standardization, work shops can move toward more production to attain the economies of scale.
- i) Monitoring and control can be increased so that no worker can neglect their assigned job and management is to be prompt enough to take disciplinary action against the workers who are reluctant to their job or neglect their jobs.
- j) Management should conducted work measurement survey and time-motion study time to time to identify the performance of an average worker.
- k) Facilitates the rolling stock maintenance station by providing modern machinery, equipments and infrastructure due to decreasing the inspection/maintenance time. For the simplest fact that rolling stock undergoing inspection must be taken out of service, essential that inspection time should be as short as possible. Also rolling stock is quite large, thus requiring large facilities in which to maintain it. If the inspection time is long, the number of such facilities necessary will increase as the amount of rolling stock in work shop increases.
- l) In order to shorten inspection time spare parts circulation system should be adopted. Careful examination of various activities arid the corrections between these activities should be conducted. It has been experienced that some activities, such as component

inspection take longer time than others. So step should be taken to replace component that is adopt spare parts circulation system.

- m)** Workshop management should improve various internal facilities in order to enable effective management. These are given bellow: **a)** Mechanization of the work, **b)** improvement of body painting, **c)** Execution of various countermeasures to the air and water pollution.

- n)** Central locomotive workshop at parbatipur was established for the general overhauling of locomotives with a view to regular maintenance arid procedures to increase the quality decrease the cost of maintenance. As well as increase the reliability and availability of locomotive. But BR has been failed to utilize the capacity of CLW. Out turn of CLW in 2009-2010 was 18 numbers, 2010-2011 was 25 numbers, 2011-2012 was 27 numbers and 2012-2013 was 16 numbers. But its capacity is 48 numbers of locomotives per year to be repaired. So government should be provided proper facilities to fully utilize the capacity of CLW.

- o)** There are some recent trends to be incorporated to enhance the effectiveness and efficiency of operation and maintenance management such as strategic operation, TQM, flexibility, time reduction, technology, re-engineering, environmental issues, and corporate down sizing.

- p)** Step should be taken to development of managerial skill and attitudes, timely decision-making, planning, control and accountability skill to adopt with the system of MIS.

- q)** Maintenance stations capacity must be reassessed as per their present holding of rolling stock arid increased their facilities so that they can able to maintain the actual number of rolling stock which is required to be maintain every year. As per example PHT diesel work shop capacity is to maintain 51 numbers of locomotives but its present requirement as per holding near about 70 numbers. So every year a great number of locomotives remain unscheduled resulted increased overdue maintenance and reduced availability.

5.7.5. Inventory control

- a)** Inventory control system for locomotive spare parts and components is computerized inventory control. There is a separate inventory control cell, which is dynamic, and got better result than traditional one, which are not for others rolling stocks spare parts. So BR should expand strengthening the present ICC capacity to control the all material by computerized system like BRSS program.

- b)** The present and future computerized inventory control system must be integrated with the maintenance department to overcome from obsolescence of over stock, running short of capital available, chains in production schedule.

- c)** With the passes of time the EOQ should be recomputed, safety stock should be reconsidered and the computer model used in control process should be reprogrammed.

- d)** Link stores depot should be careful and concise about promptly data entry and placed order for procurement in proper quantity and proper time.

- e)** Computerized expertise people should be placed in ICC and its link depots.

CHAPTER SIX

STRENGTH & WEAKNESS OF ROLLING STOCK OF BANGLADESH RAILWAY

6.1 Introduction

Maintenance management of rolling stock depends on supply of rolling stock, supply of spare parts, inventory control, and budget allocation. In the light of the interdependence among them, maintenance management of rolling stock can be modeled as technically integrated logistical management. It comprises in logistical operation and co-ordination. Logistical operation include maintenance operation, material management, purchasing management, internal inventory transfer whereas logistical co-ordination deals with rolling stock availability forecasting, order processing, procurement of spare parts, manpower develop, quality control and coordination with operation department. Rolling stocks heavy repair is done in work shop and light repair is done in loco shed and depots. But operation department is the owner of rolling stocks. They send rolling stocks in work shops, depots and loco sheds for repair. This is why Maintenance management of rolling stock is termed as a technically integrated logistical management.

6.2 Constraints and Weakness

- Lack of qualified, skilled and motivated workers.
- Underutilization of the central locomotive workshops.
- Under capacity of other workshops, sheds& depots.
- Lack of modernization of maintenance management in BR.
- Employees are not properly trained.
- Coordination between maintenance management and operation department is inadequate.
- Deficit in budget allocation.
- Want of proper information system.
- Maintenance facilities are insufficient and old to face the requirement of maintenance of modern rolling stocks.

- Lack of shipping alternatives.
- Less availability of rolling stocks.
- Inadequate numbers of materials handling equipment for internal materials transfer.
- Absence of analysis of multimode transport system to find the most economic mode of transport (auxiliary users coordinated transportation, piggy back, fishy back, train ship and air truck, line-haul, trailer on flat car (TOFC), container on flat car service (COFC), package services, common consumer rate structures such as classification and class rate, minimum charge, arbitrary assessment, exception rate, commodity rates, special rates and service, freight all kind (FAK), local, joint, proportional and combination rates, transit privileges, diversion and re-consignment, demurrage and detention, ancillary or accessorial charges, (environmental, special equipment charges).
- Lack of transportation administration and traffic research; Traffic administration - Freight classification rates, equipment schedules, documentation, freight bill, tracing and expending, auditing claim administration, transport service research and logistical system research.
- Absence of analysis of relationship of performance cycle, average inventory analysis and analysis of EOQ complication.
- Analysis of package in movement and storage, protective packing (Physical environment, element environment, material handling, automated/manual handling).
- Warehousing evaluation (Transfer, selection, shipping).
- Absence of alternative maintenance by private/public organization or by outside the country.
- Comparative benefits from other competitors.
- Absence of measurement standards.
- No analysis of total logistical cost.

6.2.1 Strategies to Overcome Constraints and Weakness:

i. The characteristics of different mode of transports are given below in table 6.1:

Operating Characteristics	Transportation mode				
	Rail	Highway	water	pipeline	air
Speed	3	2	4	5	1
Availability	2	1	4	5	3
Dependability	3	2	4	1	5
Capability	2	3	1	5	4
Frequency	4	2	5	1	3

Table 6.1 Operating Characteristics of Transportation mode

In terms of availability and capacity railway ranks second. Railway is to use its own service but since its speed ranks 3 and availability ranks 2nd, it cannot reduce the transportation time thereby influencing delivery period. So, the crucial part in the reduction in delivery period is not attended. Rolling stock turn over time should be reduced. So, government should give Railway the authority to transport goods by evaluating alternative mode of transport depending on the circumstances.

- ii. Traffic department does not make wagons available for transportation of goods for which internal transport outbound transportation are delayed causing stock out cost and maintenance of rolling stock delayed which is very dangerous for an organization and so the wagons for carrying railway goods should be made available.
- iii. Modern material handling equipments are to be procured to reduce the internal transfer time so as to reduce stock-out cost.
- iv. By analysis of multimode transport alternatives, introducing traffic administration the transportation cost can be minimized and for such purpose a research cell is to be established.

- v. By introducing regular storage alternatives, measurement standards and analysis of total logistic cost can be minimized and as a result the maintenance cost shall be minimized.

6.3 Internal transfer

Transports of goods are delayed for which material do not reach the workshop in time causing delay in out turn of rolling stock and thus logistical management is not effective.

6.4 Efficiency

Delay in transporting railway materials causes stock-out cost and materials are transported not at the minimum cost method but at the traditional cost method. So the logistic management is not efficient in Bangladesh Railway.

6.5 Information, Visibility, Collaboration, and Communication for railway maintenance teams

With work sites and equipment in multiple locations, countless trains to keep running and complex IT systems to navigate, many railway maintenance groups find it difficult to stay on track. Railway maintenance operations must improve in four main areas; speed, accuracy, visibility, and collaboration. Key to making these improvements is more efficient distribution of project data and better management of master data across large IT landscapes. But that's easy to than to do. Hindering those improvements is the fact that many railway companies IT systems don't provide real-time access to project status and master maintenance data. Maintenance technicians receive orders and record project details on paper and enter results into IT systems manually when tasks are completed. With this cumbersome, time consuming process, many errors occur and speed and accuracy are impossible to achieve. In many railway companies, maintenance workers lack visibility into the overall maintenance process. Without an overall view, it's difficult to control the process, make sound decisions, and collaborate effectively.

6.6 Improved Planning, Accuracy, and Efficiency

SAP for Railways delivers the following benefits for maintenance teams:

- **Well-organized maintenance processes.** Organized processes are faster, more flexible, and cost effective.
- **Saves time and maximizes site safety.** The right people and the right equipment are at the site on time to perform maintenance.

- **Improved collaboration between workers.** SAP Net Weaver provides consistent master data and enables timely information exchange between maintenance and operations.
- **Better maintenance planning.** SAP Service and Asset Management predict what repairs will be needed and what parts should be ordered.
- **Better decision making.** SAP solutions for mobile business give workers quick access to accurate, up-to-the-minute data that leads to better decisions.
- **Efficient mobile maintenance processes.** SAP, RFID technology provides fast, accurate data entry.
- **Lower costs.** Streamlined business processes and reduced downtime of technical systems keep costs down.
- **Increased customer satisfaction.** More efficient business processes lead to better customer service.
- **Excellent track maintenance.** Track availability is maximized by placing the right resources on site with the right equipment for repairs.
- **Improved communication.** Real-time communication with repair and maintenance teams optimizes task scheduling and response to urgent repair request.

6.7 Impact of efficiency and effectiveness of Rolling Stock maintenance in Bangladesh Railway

In chapter three, four, five and six examining effectiveness, assessing efficiency and screening out constraints and weakness of existing Maintenance management of rolling stock in Bangladesh railway have been discussed and explain in detail. From this discussion, modeling and relationship the impact of ineffective and inefficient Maintenance Management of Rolling stock has been addressed in the following manner.

- i. The market share of passenger and freight of Bangladesh Railway is declining day by day. There are some causes for declining market share. One of them is ineffective & inefficient maintenance management. Since all the interrelated departments are not functioning properly and are associated with constrains and weaknesses, the objectives of maintenance of rolling stock in schedule time with proper quality is not achieved as a result reliability and availability of rolling stock declined which reduced the passenger and goods carrying capacity of railway causes declining of market share of BR.

- ii. Lower market share from 30% in 1982 and 20% in 1986 to 10 in recent year causing lower revenue leading to a lack of material supply, maintenance and investments causing poor services and further contributing to reduce revenue just like a vicious poverty cycle.
- iii. Due to continuous declination in revenue BR faces some challenges such as low efficiency, poor service quality, political interference, aging fleet and
- iv. Congested network on major sections such as Dhaka, Chittagong and western section to India. Bangladesh railway has many natural advantages over other modes of transport. Railway consumes less fuel than road cause less pollution and takes less space than road compared to carry same amount of load. Railway has competitive advantages over road transport such as mass communication, safe and lower fare structure. But less availability of rolling stocks, inferior quality of maintenance is one of the causes of face BR uneven competition from road transport. Besides, government is running railway as social, economic and utility arm of the government by paying a good amount of public service obligation (PSO) and welfare grant. In spite of such PSO and grant in the fiscal year 2012-2013 Bangladesh Railway has incurred net operating loss Tk. 633.05 crore the portion of which is caused by unsatisfactory level of availability and at the industry level quality maintenance of rolling stocks due to ineffective and inefficient other supported and related management.
- v. Due to want of proper maintenance road failure of rolling stock has been occurred, hampered punctual train operation. Sudden under repair, more maintenance timing in maintenance station, improper material are other causes of less availability and reliability resulted less punctuality of passenger train running. Punctuality of passenger trains is given table 6.2 below:

Table 6.2 Punctuality of passenger trains

Types of train	Punctuality BG	Punctuality MG
Intercity	82.2 %	51.1 %
Mail & Express	77.8 %	49.7 %
Local	76.1 %	82.0 %

Because of not attaining satisfactory level of punctuality passenger is being diverted to road transport causing declining in market share.

- vi.** Maximum freight trains except container trains are moving non-vacuum with average speed of 20 km. This is as because of goods wagon may not be under proper maintenance as per industrial standard. So customers are being diverted to other modes of transport causing declination of market share.
- vii.** The inventory of BR is around Tk. 250 crore which is associated with maintenance, storage, insurance, obsolescence, communication, processing including material handling and packaging, update activities including receiving and data processing, manageable and capital cost. For this huge inventory capital block is Tk. 250 crore for which BR is Losing opportunity cost of investing this amount in other most important sector such as procurement of rolling stocks or development of physical infrastructure to reduce the congestion of important corridors. Again some 20% of total inventory cost i.e. Tk. 50 crore is required every fiscal year as maintenance and associated cost, which increases revenue expenditure causing adverse effect on financial infrastructure. If inventory size had been reasonable, the operating loss would have been lowered down. Since inventory is a component of Maintenance management of rolling stock, inefficient and ineffective maintenance management in BR causes this appalling adverse effect on financial infrastructure.
- viii.** Inefficient and ineffective purchasing management is a link of maintenance management, which can not contribute to significant dollar savings in revenue procurement budget of on an average TK 70 crore every fiscal year.
- ix.** Ineffective and inefficient integrated logistical management cannot contribute to cost saving, reduced inventory and improved operating efficiency.
- x.** The challenge of globalization has influenced reduction in delivery time, which reduced maintenance time of rolling stock, cost minimization and improved quality. Ineffective and inefficient maintenance management refrain BR workshops from attaining these three factors and the customers are riot given services to their satisfactory level causing the loss of market share.

CHAPTER SEVEN

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

7.1 Discussion

The key roles of the Maintenance Management of Rolling Stock include:

- Ensure all works are undertaken safely and hazards are continuously identified and addressed to provide a safe working environment.
- Maintain rolling-stock, bulk handling and loading equipment to provide an agreed level of performance, reliability and availability of equipment.
- Manage the planning and implementation of maintenance and capital upgrading relating to locomotives, wagons, bulk handling and loader and fixed asset used to maintain Rolling stock assets.
- Manage the interface between Rolling stock Services and Train Services to coordinate maintenance activities and ensure rolling stock and equipment is available to meet planned train operations and customer requirements
- Develop, implement and maintain quality maintenance processes to ensure service quality performance standards are met.
- Participate, as required, in development of strategic plans for the rolling stock, bulk handling and ship loading areas
- Ensure the department complies with Tasmanian Railway policy and procedures as directed, and to ensure compliance with the Safety Management System.
- Ensure the day to day operation of the department is managed effectively and efficiently
- Provide sound advice and input into strategic and business plans on issues associated with engineering maintenance standards, including but not limited to recommendation for capital upgrades, the acquisition of new and second-hand fleet
- Develop processes and a capability to ensure that the maintenance team seek-out, identify and implement new maintenance practices to drive continuous improvement in availability and reliability at lower unit cost .

However, for comparison a research report about **Managing Railcar Maintenance “A Primer on Practices and Improvement Opportunities for the U.S. Transit Industry “** is discussed below:

7.1.1 Managing Railcar Maintenance

The U.S. transit industry has an active service fleet of more than 20,000 railcars, which continues to grow through the expansion of existing transit rail systems and the development of new systems. The fleets of many of the largest rail transit agencies are aging, even as their expected service requirements and performance are rising. Moreover, recent reports have identified a major capital investment backlog for transit infrastructure in general and rolling stock in particular. As the single largest source of funding for railcar acquisitions, the Federal Transit Administration (FTA) has a natural interest in ensuring the cost-effective maintenance and preservation of the national transit railcar fleet.

Based on this context, FTA is supporting research identify maintenance practices that can help promote more cost-effective fleet management throughout the U.S. rail transit industry. National transit performance data show significant variation in performance and cost among transit fleets, which may imply that differences in fleet management approaches explain, in part, differences in fleet performance outcomes. This research report presents established maintenance management practices and methods together with examples of successful implementation.

This report documents standard maintenance management approaches for rail transit rolling stock and emphasizes the need for ongoing improvement efforts to sustain and raise program performance.

An effective maintenance management function, supported by a high quality performance improvement framework, is critical to successful fleet management. In interviews at diverse transit maintenance programs, management staff indicated frontline supervisors and foremen are often missing core skills and knowledge necessary for effective fleet management, including areas such as planning, performance management, and performance improvement. This research report provides a primer on the core knowledge necessary for a comprehensive understanding of railcar fleet maintenance.

A central focus of the study was the need to have in place an ongoing performance improvement function to confront emerging challenges and exploit opportunities to sustain and improve fleet performance. The research report focuses on two widely-recognized and complementary performance improvement frameworks: Reliability-Centered

Maintenance, which, broadly speaking, addresses the effectiveness of maintenance carried out, and Total Productive Maintenance, which addresses maintenance quality and efficiency. This report also addresses standard practices, common issues, and potential improvement methods in maintenance strategy, planning, performance measurement, procurement, information systems, and materials management.

The research conducted documents standard maintenance management approaches for rail transit rolling stock. It is intended to be a practical resource for experienced but especially new managers in fleet management and related areas who are not necessarily familiar with specific aspects of fleet management or who are looking for new performance improvement opportunities and approaches. With no single existing resource for railcar maintenance management, the report addresses an important gap in the existing transit management literature and provides an important baseline of practice for the industry build upon.

The report also emphasizes the need for ongoing improvement efforts to sustain and raise program performance—for example, to improve reliability and customer experience and reduce fleet lifecycle costs. The improvement methods presented in the report provide managers at all levels tools to respond to the steady stream of challenges a fleet maintenance program confronts. Moreover, the report provides frameworks to help readers diagnose negative maintenance syndromes and a vision of a highly-functioning fleet maintenance program.

7.1.2 Problems of inefficiency and ineffectiveness of maintenance management in Bangladesh Railway

Cause of inefficiency and ineffectiveness of maintenance management, Constraints and weakness in Bangladesh Railway discussed respectively in chapter 3, 4, 5 & 6. The problems are given below in a summarized format:

- i.** BR has to keep up traditional transportation environment. The traditional approach of waiting for traffic to come to the railway. This traditional mentality infected all the employees including the maintenance workers, supervisors and officers.
- ii.** Lack of management styles and procedures to meet changing circumstances. Old and well established techniques used in maintenance operation and accounting.

- iii.** Maximum maintenance workshop, shed, and depots are old, under capacity and ill equipped, 80% of the maintenance equipment is average and the work operate at about 65 % efficiency.
- iv.** Lack of modern management skilled employees, modern equipment and not use modern technology to management practice and also in maintenance.
- v.** Another vital problem of maintenance management of BR is untrained and under-motivated labor force.
- vi.** Personnel management is not up to date, less application of modern concept of human resource management though Bangladesh Railway is a labor oriented organization.
- vii.** Skilled manpower at all management is moderately absent, such as supervisory and staff levels.
- viii.** Inadequate supply of material that is inefficient and ineffective material management and inventory control management.
- ix.** Lack of proper safety management.
- x.** Under utilization of Central locomotive workshop result declining availability and reliability of locomotive.
- xi.** Inefficient financial management and inadequate budget allocation for purchasing material and maintenance of rolling stock.
- xii.** Absence of market oriented Management practice. Maintenance management has been not facing any out side competition.
- xiii.** Poor management control over worker, inadequate accountability and poor quality control resulted less productivity.
- xiv.** Inadequate training of labor union leaders, tendency to unnecessary and illegal intervention of all management work.

7.2 Conclusion

Maintenance management of rolling stock in BR is a wide range of multidimensional work involvement throughout Bangladesh railway and also integrated with other link management. It is difficult to plan the deployment of such a system and to evaluate its effectiveness and efficiency. It is just like a chain connecting one link to the next, and a management implementation can proceed similarly. Each added link brings more efficiency. When all of the links are in right place, and when the man, machine, technology, information, goods and finance flow properly, the benefits are enormous. This is truly a case in which the whole is greater than the sum of its parts.

Again the articles, journals, subject matter, books and literature on rolling stock maintenance management written by different author/authoress, professionals are absolutely based on business oriented organization with 100 % commercialization. But BR is a state owned organization with a view to rendering utility and social services to the people. BR is guided by government rules and regulations. It has got some limitations to implement all links in all respect between the major components of maintenance management of rolling stock.

BR is not empowered to formulate strategy based on competitive advantages and to implement the strategy to bring effectiveness and efficiency in rolling stock maintenance management without prior approval of government. So, the extent of maintenance management to which it is applicable in BR has been discussed.

However, for every organization be it government or private its goal should be stream lining its Maintenance management of rolling stock to such an extent that it “replaces its maintenance, purchase, human resource, and inventory management with information i.e. supportive with information and telecommunication technology” to make it effective and efficient toward improving the organizational performance.

After careful analysis of the constraints, opportunities and limitations of maintenance system in BR the following conclusions were reached: Maintenance Management of Rolling stock in Bangladesh railway is not effective and efficient. Maintenance management of rolling stock is not well trained and equipped to face the challenge of 21st century.

7.3 Recommendations

In consideration of causes of ineffectiveness and inefficiency in maintenance management of rolling stock, impact assessment and constraints and weaknesses discussed respectively in chapters 2, 3, 4, 5 & 6 the recommendations are laid down to make maintenance management of rolling stock effective and efficient.

- i.** The existing bureaucratic structure between the links of maintenance management should be reformed into corporate structure by delegating authority and de-concentration of power to the managers involved in maintenance management of rolling stock so that they can make decision quickly as regards links of maintenance management of rolling stock. Backward and forward integration i.e. vertical integration should be strengthened to make maintenance management of rolling stock effective.
- ii.** Management must develop good lower, middle and senior management, in both technical and financial fields and also must raise morale at all levels to increase productivity in maintenance. Capacity building of human resource involved in maintenance management in order to facilitate them to formulate maintenance management strategy and effective and efficient implementation thereof with necessary feedback. BR must be ensuring the key factor high quality is the expertise and experience of workers. It is uncomplaining engineers who can extract the highest performance from advanced machines. So such expert, experienced and flexible engineers should support BR.
- iii.** Computer application must be introduced between all links of maintenance management of rolling stock, which can be converted into information resources, stock-out cost can be minimized, and rolling stock availability can be maximized. 80% of railway materials are procured from abroad, supply fails delivery delayed and consequently effective and efficiency of maintenance management fails. This is because of poor order quantity or sometimes-spare are declared obsolete by the suppliers. To solve maintenance problems BR should redirected their efforts toward a method of maintenance that can be done with minimum manpower cost. Specially, BR should develop efficient diagnostics to analyze the status of equipment; introduce maintenance-free facilities and materials must be studied the causes of deteriorations of facilities and should be proposed counter measures. BR should adopt advanced technology; standardized parts and rationalizing

maintenance plants in order to improve product quality achieve technological innovation and cut maintenance cost. BR can and should adopt the MIS as mentioned in chapter 5 previously in accordance with SAP or any other successful example taking it as a model.

- iv.** Detailed guidelines for logistical cost analysis make vs. buy, lease vs. buy, best-buy, transportation management, supplier's evaluation, suppliers management, procurement of used equipment, environmental, social and political aspect of procurement, legal aspect of purchasing and keeping inventory level should be prepared. Detailed guidelines for repair and maintenance of rolling stocks in a cost effective manner should be prepared.
- v.** Financial resources to procure adequate number and quantity of spare parts and materials handling equipments to remove constraints and weaknesses between the links of maintenance management of rolling stock. Government should support by financing and staffing to fully utilize the capacity of Central locomotive workshop, which will create great impact on increasing the reliability and availability of rolling stock. The passenger and freight cell should use effective promotional tool and share the mindset of the users of the railway to increase market share causing economic growth and investment for repair and maintenance of rolling stocks, the ultimate result of which is effectiveness and efficiency in Rolling stock maintenance management.
- vi.** The main objective of rolling stock maintenance management is to give maximum timely output by utilizing minimum resources. It is possible when productivity of manpower at the highest level and inventory level can be kept minimize. To keep minimum inventory lead time is to be reduced, for which Government and E-procurement and regulation of analysis of mode of shipping are to be established.
- vii.** Railway workshop must be committed to creation of people-oriented working environment, with a goal 'zero' accident by promoting occupational safety and health activities under "human life comes first" philosophy. This slogan: "your health and readiness make a safe and efficient work place" - will motivate the manpower and trade union leaders toward their works.

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