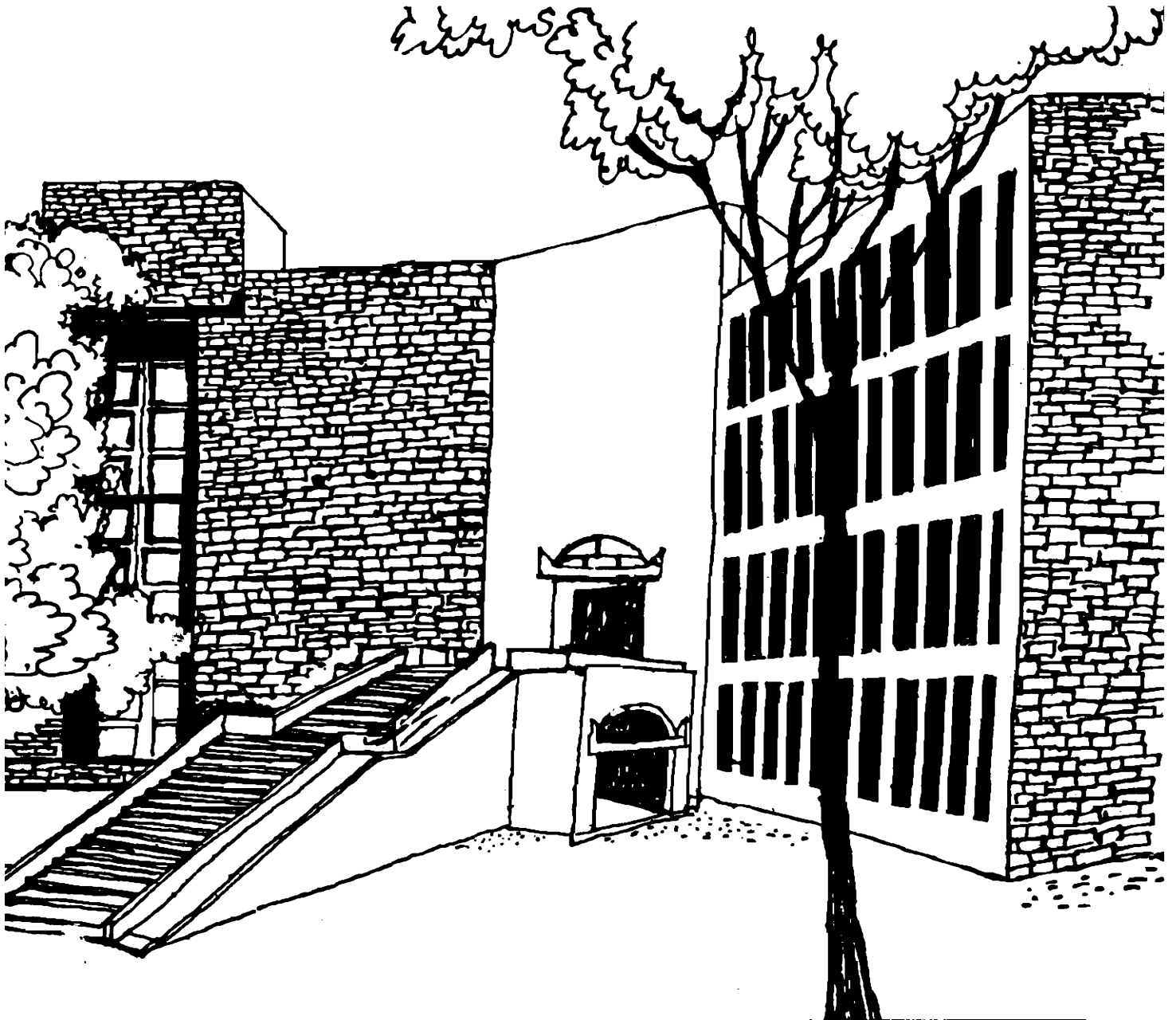




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# Working Paper



IMPACT OF COMPUTERISATION  
IN INDIAN RAILWAYS

By

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## IMPACT OF COMPUTERISATION ON INDIAN RAILWAYS

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### ABSTRACT

Indian Railways was one of the first few government departments to introduce computers in the country. Computerisation on Indian Railways started in the late 60s with the induction of IBM 1401s in the nine zonal railways, three production units, and the Railway Board. Many applications were computerised such as Passenger Revenue and Goods Accounting, Financial Management, Inventory, Operating Statistics etc. While these systems proved to be beneficial to the Railways, they were soon found to be inadequate to cater to the increasing requirements. But it was only in the VII th plan period from 1985-90 when these IBM 1401s were replaced with third and fourth generation computer systems. Computerisation in the production units and the zonal railways were strengthened, and computers were introduced in the divisions, workshops and stores. Also, many new areas for computerisation such as Passenger Reservation System (PRS), Freight Operations Information System (FOIS) etc were initiated. These developments are now beginning to show impacts on both the Railway system and its users. About Rs. 240 crores were spent on computerisation in the VII th plan; requirement of funds for computerisation in the VIII th plan from 1990-1995 is projected at Rs. 880 crores .

## **1. INDIAN RAILWAYS: AN INTRODUCTION:**

Indian Railways (IR) is the second largest railway system in the world under a single management, and the largest in Asia. It covers over 100,000 track kilometres, 300 yards, 2300 goodsheds, and 700 repair shops. Its rolling stock of over 9000 locomotives, 38000 coaching vehicles, and 350,000 freight wagons is utilised for carrying 11 million passengers and 1 million ton of freight traffic daily. IR is the single largest employer in the country with a workforce of 1.6 million regular employees. An organisational Chart of IR is given in Exhibit 1.

**2. COMPUTERISATION ON IR :** Indian Railways was one of the first few government departments to introduce computers in the country. Computerisation on Indian Railways started in the late 60s with the induction of IBM 1401s in the nine zonal railways, three production units at ICF, DLW, and CLW, and the Railway Board. Many applications were computerised such as Passenger Revenue and Goods Accounting, Financial Management, Inventory, Operating Statistics etc. These systems were soon found to be inadequate to cater to the increasing requirements, mainly due to the limitations of the second generation hardware and software. Accordingly, a task force was constituted by the Ministry of Railways, Government Of India in January 1977 to formulate a perspective plan for computerisation on IR [2]. But, IR had to be content with the IBM 1401s till the mid 1980s as can be seen from Table 1 on investment profiles of IR.

TABLE 1  
INVESTMENT PROFILE

Items	4th plan 69-74	5th plan 74-78	Rolling plan 78-80	6th plan 80-85	7th plan 85-90 (Est)	8th plan 90-95 (Target)
Rolling St. Wks & Sheds	41.1	51.3	42.2	35.2	32.5	32.0
Mach. Plnat	1.4	2.8	4.0	6.1	7.1	5.3
Track Renw	1.5	2.8	1.1	3.1	1.6	3.0
Bridge Wks	11.1	9.6	9.5	16.9	21.0	17.5
Traf. Fac	1.9	2.1	1.7	1.4	1.7	1.7
Sig, Safety	15.8	14.8	13.1	11.8	11.1	12.3
COMPUTERS	4.3	3.7	3.1	2.3	2.7	5.1
Electrifi.	0.0	0.0	0.0	0.0	1.2	2.1
Other Elec	4.9	5.2	3.4	6.4	5.6	3.4
New Lines	1.3	1.1	1.0	0.7	1.1	1.4
Staff Welf.	4.7	5.3	6.0	4.9	5.1	7.0
Staff Qtrs.	4.7	3.5	3.9	2.4	2.7	4.8
Other Wks. & Amenities						
Rly. Research	*	*	*	0.0	0.2	0.6
Inventories	*	*	*	3.2	2.4	1.5
Inv. in PSUs	*	*	*	0.0	1.5	1.2
MTP	*	*	*	4.3	2.7	1.1
Others	7.3	4.2	11.0	1.3	*	*
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
Outlay for Railways	934	1523	1185	6585	12334	
Total plan Outlay	15779	28991	24251	97500	180000	
Expenditure on Railways % total plan expenditure	5.92	5.97	4.9	5.23	6.9	

\* Data not available

Source: 1. Indian Railways Corporate Plan 1985-2000.  
2. VIII Five Year Plan, 1990-95, Report of the Working Group on Railway Programmes, Indian Railways, June 1989. p.13 for VII Plan data.

Rapid technological developments prompted the national planners to prioritise "technology upgradation" in formulating India's VII th five year plan for the period 1985-90. During this period, all the IBM 1401s were replaced with third and fourth generation computer systems. Computerisation in the production units, zonal railways, divisions, workshops and stores were considerably strengthened. Many new areas for computerization such as Passenger Reservation System (PRS), Freight Operations Information System (FOIS) etc were initiated. About Rs.240 crores were spent on computerisation in the VII th plan as can be seen from Table 2. Requirement of funds for computerisation in the VIII th plan from 1990-1995 is projected at Rs. 880 crores [3].

TABLE 2

Computerisation on Indian Railways : VII th PLAN 1985-90  
(Cost in Rs. Crores)

	Total Number of units	Units so far comp- uterised ( VII th Plan)	Cost of compute- rization
1. Pass Reservation System		9	114.00
2. Freight Op. Inf. System			64.00
3. Zonal computers	9	9	14.50
4. Divisions	56	27	13.50
5. Production units		5	9.00
6. Workshops	42	14	8.40
7. Stores	198	27	3.00
8. Others: Railway Board , RDSO, Training centres, Loco sheds, C&W depots, Administrative offices			13.60
<b>Total</b>			<b>240.00</b>
=====			

Source: VIII th Five Year Plan Report [3]

## 2.1. Passenger Reservation System :

A major area of positive change in management system, culture, and method of work has been the computerisation of the passenger reservation system (PRS). Designed and developed totally indigenously, it has revolutionised the reservation system on IR.

Indian Railways handles about 350,000 reservations (berths/seats) per day at over 200 stations. The reservation load at individual stations varies from as low as 100 per day to as high as 50,000 per day. According to the corporate plan projections, the reservation load on IR is expected to be more than 600,000 per day by the year 2000 AD.

Computerisation of PRS was introduced on Indian Railways in 1985 with the commissioning of the pilot project in Delhi for Northern Railway. The complete system went into operation in May 1986. This facility was soon extended to the other three metropolitan cities namely Bombay, Calcutta, and Madras. At present, computerised system of passenger reservations is also available at Secunderabad, Ahmedabad, Bangalore, Bhopal and Lucknow. Computerisation in nine more centres is likely to be completed in the year 1990-91. With this, more than 65% of the reservation load on IR would be computerised. Projections for the VIII th plan include extending the computerised PRS to cover all stations handling a reservation load of at least 1000 per day, thereby accounting for nearly 85% of the total load on reservations.

So far, an amount of Rs. 114 crores has been incurred in the PRS computerisation programme, and another Rs. 35 crores would be incurred by the end of 1990-91. And PRS has proved beneficial both to the passengers and the railways.

Benefits to the passengers are many. By setting up reservation offices at remote locations, the railways have made reservation facilities available closer to the customers' door, thereby saving their transit time and travel costs. Further, all the computer terminal based counters are universal, ie passengers can make reservations (onward and return) by any train, class or date at any counter, thereby making it easy for passengers to schedule their trips with more certainty. By opening a large number of reservation counters, the average queue length at the counters has significantly reduced leading to a reduction in the waiting time of passengers. For example, with computerised PRS in Delhi, the average queue length at any counter is of the order of 10-12 passengers and average delay in servicing a passenger is of the order of 35-40 minutes [4]. Another facility available to the passengers is the Reservation Availability Position Information Display (RAPID) system. This system displays the reservation availability for all superfast, mail and express trains for the next 28 days for all classes and has facilitated the passengers' travel planning immensely. The RAPID system is currently working in Delhi and is expected to be introduced in many other PRS centres soon. Its unique feature is that teletext broadcast is used to provide the display and hence any home or office in Delhi equipped with TV and a teletext decoder can also receive all the reservation information on its TV set.



Benefits to the railway management have come from increased staff productivity, improved railway customer relationships etc. Staff productivity has increased as a result of simplified procedures, eliminating unwieldy registers, and providing better working conditions thereby reducing the service time, scope for human error etc. Also, the total workload has been distributed across all counters by abolishing the existing practice of dedicating trains and classes to each counter. There has also been a reduction in the workload at ticket printing press, traffic accounts office etc. All these developments have led to a reduction in the clerical workforce and an induction of more technical staff for maintaining the hardware and software. It has not been possible to completely quantify all the savings but the savings are clearly visible. A detailed cost analysis done for Delhi [5] showed that the cost of computerized reservation systems in Delhi is Rs.2.03 per berth/seat as compared to Rs.2.21 in the manual system. However, due to additional facilities now provided such as airconditioning of passenger halls and setting up of new reservation offices in different parts of the city, the cost per berth/seat has gone to Rs.2.60. This cost will reduce over the years as the volume of reservations will increase without incurring any appreciable input costs.

In September 1990, the Department of Electronics conducted a study on the effects of Computerised PRS(CPRS). The study group focussed its efforts in examining the impact of CPRS in Delhi area and their conclusions are summarised below [9].

Advantages of CPRS include (i) Rs 13.5 crores from saving 91 man hours of users time annually, (ii) Rs 1.37 crores as the distance travelled by passengers to reach a reservation counter decreased from 14.9 Kms to 11.6 Kms, (iii) A 40% increase in daily transactions, (iv) No increase in front-end staff in spite of increased passenger traffic, (v) Better utilisation of train capacity, (vi) Higher staff productivity etc.

On the negative side, the study has found that there are differences in the productivity of various counters. Health hazards like eye strains resulting from working with computer terminals have also been identified.

The computerisation of PRS involved development and implementation of a totally indigenous on-line, real-time system. Software development was done by CMC (earlier called the Computer Maintenance Corporation), a Government Of India undertaking in close consultation with the IR officers. The implementation programme of PRS has been mostly successful. This facility has been very highly appreciated by the public. However, its full potential has not been exploited yet: the PRS data base is being used primarily for monitoring and control, and not so much for planning passenger traffic.

## **2.2 Freight Operations Information System :**

Freight traffic on Indian Railways has been increasing at an alarming rate; from 93 million tonnes (originating) in 1950-51 to 221 million tonnes in 1980-81, to 340 million tonnes by 1989-90,

and is estimated to be around 450 million tonnes by the year 1994-95. Also, the freight traffic accounts for more than 75 per cent of the total revenue on Indian Railways. The need for a computer based system for management of freight operations has been felt for quite some time.

The decision to set up a computerised system was taken by the Government in 1982 and called it the Freight Operations Information Systems (FOIS). The proposed computer system of FOIS consists of a 2-tier architecture: i) a central system to process information relating to moving assets such as wagons, trains, locomotives, etc and ii) seven zonal systems to process information relating to the activity centres, such as yards, good sheds, locomotive maintenance yards etc. It is estimated that there will be about 2700 terminals distributed across all the zonal railways to capture wagon particulars in real time.

The task of designing and developing the FOIS is entrusted with the Centre for Railway Information Systems (CRIS), New Delhi. The software, TRACS (Traffic Reporting and Control Systems) which is currently in use on Canadian National Railways has been accepted as the basic model for FOIS. CRIS is currently engaged in modifying and enhancing TRACS to suit the freight movements on IR. Development and simulation centre for software development and modification has already been set up and work of providing telecom links on Northern Railway has been initiated. The pilot project on FOIS for Northern Railway is expected to be completed by 1996 at a cost of approximately Rs.400 crores. When fully implemented in all zonal railways, the system is expected to

bring the rail users closer to the railway system. It is anticipated that FOIS will gradually improve the reliability, efficiency and effectiveness of the management of freight operations on Indian Railways. According to an estimate [6], the project is expected to give a return of 15% on account of savings of wagons and locomotives .

### **2.3 Zonal Computerisation**

Zonal Railways are the basic units for management planning and control on Indian Railways. Computerization on Indian Railways started in the late 60's by installing IBM 1401s at the zonal railway headquarters. These systems were in operation for almost 15 years, even though they were found to be inadequate to cater to the increasing requirements. Finally, in the late 80s , all the IBM 1401s were replaced with third and fourth generation computer systems (ECIL's TDC 332 and ICIM-6060) at a cost of approximately 14.5 crores. At present the major application areas are the following:

(i) **Materials Management Systems:** Railway network gets its material requirements through 199 stores depots stocking over 300,000 items. Annual issues from stores depots amount to almost Rs. 2500 crores.

Computerisation of the materials management system was one of the first activities under the zonal computerisation programmes in the late 60's. Railways had traditionally maintained account of their materials on manual systems. The efficiency of stores keeping as far as the inventories are concerned is generally

judged from the levels of stocks maintained per unit of issue material. Prior to computerization, this turn over ratio was of the order of 60% i.e., for every Rs.100 worth of materials issued, the railways had a year-end inventory worth Rs.60. This ratio dropped substantially to 39% in 1974-75 and to 23% in 1987-88 [7].

Initially the system got off well due to all round monitoring, but over a period of time it has developed some problems. The computerised reports brought out every month on stock status reveal discrepancies with the physical stock in the depots. For example, the percentage of total discrepancies (both surplus and deficiencies taken together) to total stores transactions (receipts and issues during the year) was 3.2% in 1985-86 [8]. Many of the reasons for such discrepancies have been attributed to the centralized processing of a large number of transactions. Annual issue from stores depots have gone up from Rs. 266 crores in 1968-69 to Rs. 2340 in 1987-88. Accordingly, the top railway management decided a few years ago to equip the stores depots with PCs/Minis so that the day to day transactions can be recorded at the depot level itself for better monitoring, planning and control.

(ii) Freight Accounting Systems: Computerizing the freight accounting systems has proved beneficial to the railways in many ways. The systems caters to apportionment of earnings, NTKMs (Net Ton Kilometres), etc. for individual zonal railways. Various statistical reports for inter and intra railways commoditywise

movements are also generated by the computerized systems. Above all, the system incorporates many detailed checks to ensure that the financial accounts will be accurate and precise. Reports like ABC analysis of originating tonnage, zonewise analysis of traffic, etc serve as useful inputs for the management to take action for planning and control.

(iii) Passenger Accounting Systems: From the passenger classifications relating to the printed tickets sold at various stations, processing is done to take the correctness of fare and to develop relevant accounting statements. Statistical statements pertaining to originating and terminating traffic giving classwise details of passengers are generated by the system. Like the freight accounting system, the passenger accounting system also generates apportioned earnings between railways and other intra and inter railway statistics on passenger movement.

(iv) Financial Management Systems: The entire financial management functions of each zonal railways have been computerized. This includes revenue and capital purchases and ledgers, cash book, allocation of registers, control over expenditure statements, current accounts, and works registers. These reports are primarily meant to serve the purpose of control of expenditure at various stages and also at the preparation of the budgetary reviews.

Some of the other applications are :

- (i) Commercial Management: Passenger business performance, Goods performance, Claims statistics,
- (ii) Transportation Management: Operating performance statistics, Analysis of engine and coaching stock utilisation,
- (iii) Personnel Management: Pay roll and PF accounting .

Major benefits from zonal computerisation are on statistical compilations of huge volumes of data and on generation of a large number of reports for monitoring and control of operations. Computerisation of the materials management systems has brought down the turnover ratio from 60 per cent in 1968-69 to as low as 23 per cent in 1987-88. While the issue of materials has gone up almost 10 times in the above period, the staff strength in stores depots has increased only by 10 per cent over the same period; from 37581 in 1968-69 to 41298 in 1986-87 [3]. Similar benefits have accrued from computerising the accounting systems; though the workload has increased manifold, the staff strength has remained constant since 1967-68 [3]. Computerisation of the financial management system has made it possible to exercise better control over expenditure mainly due to the accurate and timely availability of expenditure unitwise. In short, computerisation at the zonal railways has been more or less effective in monitoring and control of operations. However, there is considerable room for utilizing these computers to support various planning activities at the zonal railway headquarters, such as minimising empty wagon movements, project monitoring, estimating the traffic commoditywise between marshalling yards, utilisation of rolling stocks - wagons, coaches and locos, etc.

## 2.4 Divisional Computerisation

Divisions are the basic operating units on Indian Railways. Computerisation at the divisional level started only a few years ago. The main objective of divisional computerisation is to assist the divisional managers to closely monitor and control the actual operations. Towards this, mini computer systems are being installed on divisions in a phased manner. So far about 18 divisions (2 divisions per zone) have been equipped with mini computers. Additional 9 divisions are expected to be covered this year.

The total cost of divisional computerisation has been approximately Rs.13.5 crores so far. The task of identifying computer applications and software development has been completely entrusted to the individual divisions, unlike the zonal railways which have more or less standardised their computer applications. As a result, each division has selected its own priority areas for computerisation. A few such areas are given below.

**Engine failure analysis:** This system provides information on loco failures in various formats. The input sources for this application are the daily line and shed reports. Reports on locowise failures, equipmentwise failures, sectionwise failures, type defect failures etc. are frequently generated. These reports highlight the mode of defects, equipments prone to failures, sections where more failures are being noticed, equipments with bad history, evaluations of the effect of various



modifications and improvements carried out etc. These reports are helpful in performance analysis in various permutations and combinations. The implementation of this application has enabled the divisions to immediately identify the trends of failures for a particular type of loco, equipment, or section to analyse the cause of failure and take corrective actions.

**Signal failure analysis:** This system helps to monitor signal failures. This application takes care of stationwise, causewise gearwise analysis of signal failures. This has facilitated quicker and more accurate decision making and also helped in taking prompt corrective action resulting in increased reliability of equipments.

**Earnings from Train Ticket Examiners:** This system helps to monitor the performance of train ticket examiners (TTE) in respect of monthly earnings. With the help of this package, it has been possible to generate reports on individual TTE earnings from each station, stationwise summary of earnings from all TTEs, division summary of total earnings from all TTEs etc. Initial impact of implementing this system has been very encouraging with the earnings from ticket checkings showing an increase. One division reported an increase of about Rs. 600000 per month during the year 1988-89 when the system was implemented.

Other areas of computer applications are (i) Payroll and PF accounting, (ii) monitoring track maintenance, (iii) fuel analysis for each type of locomotive over each type of section, (iv) inter railway financial adjustment statements of

expenditure on fuel, cost of maintenance of locomotives and coaches, (v) recovery of electricity charges from private parties operating stalls in the railway territories such as platforms and stations, (vi) public complaints analysis, etc.

## 2.5. Production Units.

Computerisation at the three main production units namely the Integral Coach Factory (ICF) at Perambur, Chitaranjan Locomotive Works (CLW) at Chitaranjan, and the Diesel Locomotive Works (DLW) at Varanasi started in the late 60's on IBM 1401s. However these computers were replaced by third and fourth generation mainframe computers during the VII th plan period. Also, mini computer systems have been installed in the Wheel & Axle Plant at Bangalore and the Rail Coach Factory at Kapurthala. The total cost of computerisation in the production units is approximately Rs 9 crores.

Starting with traditional accounting areas, several MIS applications have been developed in the areas of production management, materials management, financial management and personnel management. Among the three main production units mentioned above, ICF has taken the lead over DLW and CLW in computerising their activities. Of special significance is the Integrated Production Planning and Control (IPPC) system at ICF where production management and control is integrated with stores control using the ICL software OMAC (Online Manufacturing Accounting Control). Central to IPPC is a Manufacturing Data Base (MDB) which consists of an engineering database, an

operations database and a workcentre database. The engineering database contains all the information on all types of coaches (approx. 150 types) including bill of materials, engineering drawings etc. and is integrated with the stores control. It is therefore possible to forecast, one year in advance, all the materials required for next year's production, monitor the supply of the required materials, identify the critical items and initiate corrective actions well before the production cycle begins. The operations data base consists of information on all types of operations (approx. 20 major types) such as fitting, welding, forging etc. and their sub operations. The workcentre database contains all the information on more than 1000 machines installed in the 60 production and service shops of ICF. The MDB provides facilities to inquire into part details, structure details, and operations details besides producing batch reports on exploded list of components, machinery and plant list, list of items planned at a given workcentre, maintenance schedules etc. In short, the IPPC system has greatly facilitated the planning and execution of the production process at ICF. Today, ICF is one of the largest coach building units in Asia with an annual production capacity of 1000 coaches.

## **2.6 Workshops.**

Computerisation of repair workshops on Indian Railways was initiated in 1988. Fourteen major workshops were selected for computerisation in the first phase. These workshops were provided with mini and micro computer systems. The total expenditure incurred so far on these workshops is approximately Rs.8.4 crores.

Production Planning and Control, Materials Management, Plant and Machinery Maintenance, Rolling Stock Maintenance, Financial Management, Personnel Management, and Workshop Payroll are a few areas taken up for computerisation in these workshops. These applications are at different stages of development and implementation in each of the workshops.

Benefits from the above computer applications realised by a few workshops are (i) Increased productivity, (ii) Reduction in the inventory cost, (iii) Reduction in the cycle time for repairs to rolling stock, (iv) Increased reliability of rolling stock, (v) Improved industrial relations, etc.

An attempt has been made by one of the workshops to quantify the benefits from computerisation. It is estimated that total benefits would amount to approximately Rs.50 lakhs per annum on successful implementation of all the computer applications. In addition to the annual savings mentioned above, a one time saving of approximately Rs.4.0 crores is also expected resulting from reduction in inventory, reduction in the cycle time for repair, etc.

## 2.7 Stores Depots.

As mentioned earlier in the section on zonal computerisation, steps have already been taken to decentralise stores accounting at the store depot levels. Accordingly, stores depots computerisation was initiated around 1988 in a few major depots. By now, about 27 stores depots have been provided with PCs to

facilitate their transaction processing activity. These stores have computerised their stock ledgers and receipts, which account for nearly 80% of the total processing load.

A typical major store depot on Indian Railways handles about 2000 stock items and processes about 12000 indents/requisition slips, 9000 issue vouchers, and 200 receipt notes every month to cater to the demands from about 2000 consignees such as workshops, carriage & Wagon depots etc. Purchase orders (about 1700 per year) are processed at the zonal computer centre, and sent to the stores depots for follow-up actions.

Total cost of stores computerisation is Rs.3 crores so far. Benefits from computerisation reported by a few stores are very encouraging. With computerised monitoring and control, it has been possible to bring down the turnover ratio at these stores. One major store has brought down its turnover ratio from 18.4% before computerisation to 17.2% after computerisation, which amounts to a reduction of Rs.1.8 million in its inventory holding. Another significant benefit from computerisation has been an increase in the service level to customers by processing their demands quickly. In the manual system, the total time required from the receipt of indents to the actual issues was about 20-30 days; this involves registering the demands in the appropriate ledger, deciding on the quantity to be allotted, generating the issue vouchers and intimating the wards for actual issues to be made. After computerisation, all these activities are carried out in 1-2 days. Also computerisation has helped the controller of stores to take "allocation decisions" more

rationally based on data and minimize the number of complaints from customers. Frequent monitoring of purchase orders has helped to identify defaulting vendors and take corrective actions as well as to chase the purchase orders more effectively. Staff strength has remained almost the same so far. Also, processing of transactions in the depots has almost eliminated their validation in the zonal computer centre saving enormous time and cost. Above all, computerised stock accounting has minimized the discrepancies between the actual stock and the reported stock in these depots.

## **2.8 Other Computer Applications**

Another important application is monitoring the movement of freight wagons in IR, done at the Railway Board's computer centre in New Delhi. This system maintains a complete record of the entire fleet of all the broad gauge and metre gauge goods stock on Indian Railways. This database is also used extensively for a variety of statistical applications to analyse and report various freight statistics for each zonal railway. Computer systems are also used extensively for research and development at RDSO in Lucknow and in the training institutions. Above all, more than 150 PC/micro computers have been installed in various offices in the Indian Railways to facilitate office automation.

### 3. CONCLUSION

Computerisation on Indian Railways has been gaining momentum since the mid 80s. The computerised PRS which is today handling about 55% of the total reservation load in IR, has already created a significant impact on both the railways and its consumers. The FOIS, when completed would significantly improve the management of freight operations. Computerisation in divisions, stores, workshops, etc. would greatly facilitate the monitoring and control of operations. More emphasis needs to be given to strengthen computer applications in the areas of management planning and strategic planning in Indian Railways.

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**Exhibit 1**

**An Organisational Chart of Indian Railways**

