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EVALUATION OF TELECOMMUNICATIONS
AND RELATED SIGNALLING PROJECT OF
PAKISTAN RAILWAYS

NTRC-158

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EXECUTIVE SUMMARY

The efficiency of Railway operation is based inter-alia on the modernised telecommunication facilities, providing free flow of traffic and communication links between Railway operation, management and the customers.

Pakistan Railways, at the time of independence, inherited rudimentary communication system which was operated through overhead wire lines leased from the T&T Department. With the passage of time and growing traffic, the system became obsolete and its performance deteriorated. As a consequence the train control territory of the circuits was reduced from 320 kms to 200 kms. To improve the system, a project namely Telecommunication and Related Signalling was approved by ECNEC in 1979 at a cost of Rs. 378.0 million (FEC Rs. 217 million). Subsequently, due to change in scope and rise in tender prices, the project was revised to cost Rs.801.423 million (FEC:Rs.427.634 million) and was approved by ECNEC in April, 1983. The project was completed in June, 1988 after incurring an expenditure of Rs. 1044.277 million with FEC of Rs. 593.449 million.

The project envisaged replacement of T&T lines with microwave system on main line between Karachi - Rawalpindi via Faisalabad and on some sections of branch lines; UHF links on 281 stations; VHF sets in 500 locomotives and installation of 18 automataic telephone exchanges.

It was anticipated that the project would increase traffic handling capacity by 1.294 Billion Ton Kms for goods and 0.73 Billion Passenger Kms for passenger by 1987-88. Other operational improvements envisaged were (a) increase in speed (b) enhancement of safety (c) better locomotive utilization (d) reduction in wagon turn around time & (e) general improvement in Management Information System (MIS). The project had a Benefit Cost Ratio (BCR) of 2.9:1 and Internal Rate of Return (IRR) of 32.5%.

The new telecommunication network has been fully operational since 1987-88. An attempt has been made by the NTRC to evaluate the project in terms of economic benefits, other operational improvements and the system's performance. The study does not include technical aspects of the project. On the basis of data obtained from Pakistan Railway Headquarters through a questionnaire and also of the information collected through the interviews with the locomotive drivers and station masters of small stations, the major findings of the study are highlighted below:-

- i) The traffic benefits envisaged were not achieved. In actuality, the overall goods traffic declined by 11%

per annum from 8.03 BTKms in 1987-88 to 5.71 BTKms in 1990-91. The passenger traffic increased slightly at a rate of 2.4 percent per annum during the same period which could not be attributed entirely to the project.

- ii) The increase in speed anticipated with the improved telecommunication facilities did not materialize. The speed of the goods train remained as was before the project i.e. 18-20 kms per hour while the passenger trains run on the basis of fixed speed and schedule.
- iii) Instead of any improvements, the safety on the entire Railway system deteriorated as the number of accidents increased from 120 in 1984-85 to 137 in 1987-88.
- iv) The project did not result in improving the utilization and availability of locomotive. The use of diesel locomotive in terms of hours worked per day per engine remained unchanged at 15 whilst the locomotive availability declined from 85% in 1987-88 to 79% in 1990-91.
- v) A reduction of 4 days in wagon turn around time (from 19.5 days in 1984-85 to 15.5 days in 1987-88) was achieved immediately after completion of the project. This accomplishment was shortlived as the turn around time again increased to 16.5 days in 1990-91.
- vi) The project has still not been fully implemented. The signalling component has not been completed and the Line Clear Messages for the movement of trains are still being conveyed through old T&T lines.
- vii) The facilities provided under the project remained unutilized as the scheme for MIS has not been implemented so far.
- viii) There is no communication link provided between locomotive driver and the guard of the train which is a serious bottleneck in the train operation.
- ix) No proper training was given to the locomotive drivers and station masters about the operation and utility of the system.
- x) The maintenance facilities, availability of spares, air-conditioning and vehicles lag far behind the actual requirements which results in the frequent malfunctioning of the system.

- xi) Savings of Rs. 2.0 million on account of closure of 3 sub control offices, 25 crossing stations and rental of Rs. 15.5 million paid to T&T for using their overhead lines were not achieved so far as these facilities are still being used by the Railway.
- xii) The project resulted in improving the overall punctuality by 3.1% which increased from 87.6% in 1984-85 to 90.7% in 1987-88. The improvement in the punctuality of goods trains was more than that of passenger train (10% as against 2.7%) during the same period.
- xiii) The decline in traffic rendered the project hardly viable. However, based on the Railway's assumption, that system did result in improving the operational efficiency, economic analysis carried out on actual traffic yields BCR of the project at 0.92:1 and IRR at 11.03%.

Conclusions

- i) The project was well conceived but not properly planned and designed as the major changes in scope of work took place during implementation resulting in a substantial delay of 10 years in its completion.
- ii) The project did not suffer from the scarcity of funds during its implementation.
- iii) Benefits of the project were grossly over-estimated, perhaps to secure its approval by the competent authority.
- iv) Economic analysis led to conclude that the project cannot be considered sustainable.

Recommendations

- i) Tangible benefits (if any) drawn from the project may be clearly spelled out in quantitative terms and on scientific basis with the help of realistic assumptions so as to avoid over-estimation.

- ii) Impedements in the way of completing the signalling components of the project may be eliminated so as to achieve increase in speed, sectional capacity and improved safety.
- iii) Efforts may be made to initiate the work on the MIS project, computerized seat reservation and wagon control etc. so as to utilize the facilities provided under the project to maximum extent possible.
- iv) Proper facilities such as vehicles, air-conditioning and spares for maintenance may be provided for the efficient functioning of telecommunication system.
- v) With the new telecommunication network, the Railway may produce timely and more accurate data needed to improve the efficiency of its costing cell and modernise its accounting system.

CHAPTER - 1

INTRODUCTION

Transportation has become a basic necessity in the modernised world. It is an important contributing factor in the economic development. The business/commercial activities largely depend upon the efficient transport facilities, particularly of Rail transport. Though, the development of all means of transportation available in the country is imperative for growing economy but the Railway being the mass carrier of men and material, needs to be developed in advance, perhaps one step ahead of the economic expansion/development. Railway's operation, characterizing specialized technical, administrative, and commercial skill is based on modernization/development of track, locomotive rolling stock and improved signalling and telecommunication system. These facilities constitute essential components of the Railway Plans and Programmes.

Pakistan Railway represents country's single largest and cheap mode of the transportation system. It has 8775 route-kms of track. About 38% of the network is commercially viable of which 1200 kms traverse along the North - South main line between Peshawar-Karachi connecting important agricultural and commercial cities and towns. 75% of Rail passenger and freight traffic flows through this route. Railway remained dominant in the transport sector till the end of Third Five Year Plan (1965-70). This was due to the fact that it enjoyed monopoly situation because of lack of proper road infrastructure. Moreover, adequate funds were provided to Railway at that time to undertake their development programmes/plans.

1.1 Communications Facilities Before the Project

Telecommunications form a vital part of Railway operations, providing free flow of traffic and communication link between Railway operations, management and the customers. At the time of the Independence, Pakistan Railways started off with an antiquated communication system which was perhaps considered adequate at that time to meet the meagre requirements of Railway. The need to improve the telecommunication facilities arose with the growing Rail traffic and expansion of Railway operation throughout the length and breadth of the country but nothing substantial could be done because the development efforts were mainly concentrated on the replacement and modernization of overage assets such as track, locomotives rolling stock, coaches etc. The back log of these assets was so large that process is

still going on. In later years, complementary telecommunication facilities were provided on various sections to cope with the augmented capacity achieved through increased investments in locomotives, track etc. The facilities included installation of U.H.F./V.H.F. radio circuits, extension of train control circuits, etc. on certain sections. Almost all type of circuits were operated through overhead wire lines, leased and maintained by the T&T Department. With the passage of time, the copper wires became obsolete and instances of theft increased manifold. In addition, because of high winds and climatic conditions, there were complaints of their frequent break down. Also due to lack of maintenance and replacement the performance of circuits deteriorated rapidly. As a result the train control territory of the circuits was reduced from 320 kms to 200 kms and serious train delays used to occur almost every day.

For the improvement of the system Railways continued to make stop gap arrangements by providing communication links with wayside stations and teleprinters links and manual exchanges in all the Railway's Divisions, central control offices and yards. However, these piece meal efforts were not proved fruitful in improving the traffic handling capacity and it was no longer possible to further augment the facilities already provided. The Railway, therefore decided to go for a telecommunication system of their own operated independently of the T&T Department.

A feasibility study to examine the Railway requirements for a comprehensive telecommunication system was carried out by World Bank Consultants who after considering different technologies/options, recommended backbone microwave system together with the related signalling improvement for the Railways.

1.2 The Project Profile and Scope

Following the recommendations of the World Bank Consultants, a project, namely Telecommunication and Related Signalling prepared in 1977 was approved by the ECNEC in September, 1979 at an estimated cost of Rs. 378.0 million including an FEC of Rs.217.0 million. The International tenders were invited in August, 1979 and contract was awarded to M/s Kentron Inc. of USA in May, 1980. Due to increase/change in scope together with the increased tender prices, the project had to be revised and cost increased to Rs.801.423 million with an FEC of Rs.427.634 million which was approved by ECNEC in April, 1983. The scope and progress of the project may be seen at Annex-II.

1.3 Benefits of the Project

It was stipulated in the PC-I that with the implementation of the project, Railways would be able to provide quick transmission of information about train, wagon movement and links for streamlining the inter-communications between all stations including wayside stations enroute and yards to improve the over all efficiency of train operations. This would help achieve the following benefits:

1.3.1 Quantitative Benefits

- a) Increase in Traffic: Prior to the implementation of the project, the frequent break down of communications was a cause of train detention resulting in increased operational time and reducing transportation capacity. The handling capacity estimated to be impaired further by 8% for goods traffic and 4% for passenger traffic in case telecommunication facilities (as proposed in the project) were not provided. The projected traffic with and without the execution of the project worked out in the PC-I as under:

Year	Goods Traffic Forecast (Billion Ton Km)			Passenger Traffic Forecast Billion Passenger KM		
	With Project	Without Project	Total Diff.	With Project	Without Project	Total Diff.
1982-83	12.663	11.650	1.013	15.446	14.828	0.618
1983-84	13.295	12.231	1.064	15.910	15.274	0.636
1984-85	13.960	12.843	1.117	16.708	16.04	0.668
1985-86	14.658	13.485	1.173	17.208	16.52	0.688
1986-87	15.392	14.160	1.232	17.723	17.014	0.709
1987-88	16.174	14.88	1.294	18.254	17.524	0.730
1988-89	16.986	15.627	1.359	18.801	18.049	0.752
1989-90	17.786	16.363	1.423	19.364	18.589	0.775
1990-91	18.548	17.064	1.484	19.847	19.053	0.794
1991-92	19.285	17.742	1.543	20.343	19.529	0.814

- b) Increase in Revenues & Savings: As a result of improvement in handling capacity, the revenues were expected to increase with the additional traffic. In addition, as stipulated in the PC-I, with the provision of microwave system owned by Railway, the rental of overhead lines paid to T&T would be saved. Also saving

in staff salaries on account of closing down of 3 sub control offices and 25 crossing stations was expected. The figures of revenues and savings indicated in the PC-I as under:-

(Rs. Million)

	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
1) Monetary gain due to additional										
- Goods traffic (Million Rs.)	207.66	218.12	240.15	252.19	278.43	292.44	322.08	337.25	369.5	384.20
- Passg. traffic (Million Rs.)	42.64	43.88	48.76	50.22	53.88	55.48	60.16	62.0	66.7	68.37
Total gain (Million Rs.)	250.3	262.0	288.91	302.41	332.31	347.92	382.24	399.25	436.2	452.57
2) Net gain 80% due to the project.	200.24	209.6	231.13	241.93	265.85	278.34	305.79	319.4	348.96	362.06
3) Saving in salary on account of closing offices & stations	1.85	1.86	1.87	1.88	1.99	2.00	2.00	2.00	2.00	2.00
Saving in rental of over head wire telephone bill paid to the T&T Dept.	13.00	13.5	14.0	14.5	15.00	15.50	16.50	16.5	17.00	17.5
Total earning	200.24	209.6	231.13	241.93	265.85	278.34	305.79	319.4	348.96	362.06
Total savings	14.85	15.36	15.87	16.38	16.99	17.5	18.00	18.5	19.0	19.5
Total benefit	215.09	224.96	247.0	258.31	282.84	295.84	323.79	337.9	367.96	381.56

increase in revenues & savings in handling & revenue was expected & indicated in the PC-I with the provision of an overhead system owned by railway. The total of overhead system owned by railway was Rs. 10.00 million.

c) Improvement in Overall of Train Operations: The other tangible benefits expected to be derived from the project given in the PC-I but not quantified are as under:

- Saving in turn around time
- Elimination in delays/detentions
- Increase in speed
- Improvement in punctuality
- Improvement in availability of locomotives, coaches etc.
- Improvement in overall safety
- Decrease in accidents
- Economy in utilization of the staff
- Reduction in handling cost

1.3.2 Non-quantifiable Results of the Project

It was anticipated in the PC-I that the new telecommunication system would result in the improvement of the following functions of Railway:-

- i) To move staff, locomotives and rolling stock to the right place at the right time, to regulate train operation and to communicate with station/control offices during breakdowns/difficulties.
- ii) To assist in freight work by providing advance information about wagon destinations and freight train formation to Marshalling yards.
- iii) To exercise economy in the utilization of staff, motive power, rolling stock and other facilities.
- iv) To provide information to passenger enquiries as well as other user of Railway.
- v) To establish an effective administrative control over train operation on main line by Divisional & Railway Headquarters.
- vi) To provide direct dialling and rapid communications facilities between management at Islamabad and Head Office at Lahore, Divisional and Sub Divisional Offices etc.
- vii) To develop a base for the computerized wagon control, automatic wagon identification and seat reservation.

CHAPTER - II
PERFORMANCE EVALUATION

2.1 Description of the Study

The Telecommunication and Related Signalling project was completed by the Railway and the system had become fully operational in the year 1987-88. Under the project back bone microwave system was installed. The Railway believed that project on completion would bring about substantial improvement in train operation. Also the improvement in telecommunication was essential for full realisation of benefits of other Railway projects. Keeping this in view, it is considered worthwhile to carry out the post project evaluation. A study is, therefore, prepared to undertake performance evaluation of the new telecommunication system installed on main line and on some sections of branch lines by the Railways. The scope of evaluation is limited only to the analysis of economic aspects of the project including the achievement of targets/benefits estimated in the approved PC-I. Hence, this is not a technical evaluation as it does not go into engineering technicalities of the system or identify the flaws in the execution of the project.

2.1.1 Objectives

The specific objective of the study is to evaluate the significant contribution of the project towards the achievement of the traffic targets and other operational/administrative benefits as stipulated in the PC-I and indicated at para 1.3 above respectively. It may be clarified that the sole purpose of this research is to identify the deficiencies in the planning of a particular project with a view of further improvement.

2.1.2 Methodology

For the collection of the relevant data pertaining to quantitative targets and non-quantifiable benefits, a questionnaire has been prepared which may be seen at Annexure-I. The questionnaire was designed in such a way so that the contribution of the new telecommunication network could be specifically assessed by comparing the targets before and after the project. In addition, information about the achievements of the project and further clarifications on the data were also obtained from the concerned officials of the Railways including Chief Engineer (Telecom), Chief Engineer (Signalling), Additional General Manager (Engineering), the Dy. Chief Engineer (Telecom)

and Divisional Telecom Engineers (Lahore & Rawalpindi). As per decision of Research Advisory Committee of NTRC, the interviews of locomotive drivers and station masters of small unknown stations were also conducted to assess the system's performance and utilization.

2.2 Financial/Physical Achievements of the Project

Before discussing the results of the analysis of data, a brief resume of the investment made on the project and the achievements thereon are described below.

The revised project was approved by ECNEC in April, 1983 at a cost of Rs.801.423 million with an FEC of Rs.427.634 million. The expenditure stood at Rs.1044.227 million with an FEC of Rs.593.449 million. This also included Rs.229.543 million received as compensation received from M/s LTV due to abandonment of the project. The excess over the approved cost is 30% while that of FEC is 39%. In physical terms, the telecommunication network was completed and commissioned in June, 1988. The progress made under the project may be seen at Annexure-II.

It is pertinent to point out that it took Railway about 10 years to complete the project. The details of processing the project in chronological order are indicated at Annexure-III. The ADP allocations, for the project, funds released and expenditure incurred are illustrated in Annexure-IV. It is evident that the funds released during the period 1980-81 to 1984-85, which were more than the ADP allocations were not fully utilized. This implied that project did not suffer from scarcity of funds during implementation.

2.3 Evaluation of the Benefits

The data provided by the Railway on the questionnaire may be seen at Annexure-I. It is evident that Railway did not provide the relevant information in accordance with the columns namely "before and after the project" of the questionnaire. Instead, the year-wise figures from 1984-85 to 1988-89 have been indicated. However, during discussion with the concerned Railway officials, it was clarified that the system has been in operation since June, 1988. The figures prior to 1987-88 may be taken as "without project". The other shortcoming appeared in the data is that the overall figures of traffic, revenues/savings etc. have been provided and the impact of the project in improving the handling capacity as reflected in the PC-I has not been quantified. Nor has the saving in time in terms of train hours saved as a result of the project been estimated.

Notwithstanding these inadequacies, the analysis have been carried out for each of the operating parameters as explained in the following paragraphs:-

a) Traffic

In the PC-I, Railways credited the project with the increase in traffic handling capacity by 8% per annum for goods and 4% per annum for passenger. This was based on the elimination of train's detentions and delays and improvement of locomotive and wagon's availability. The overall Rail goods and the passenger traffic were projected to grow at a rate of 5% and 3% per annum respectively during 1982-88. The actual achievement and the projections are as under:-

Year	Goods Traffic BTKm Projection	Actual	%age In- crease/ decrease	Passg. Traffic BPKm Projec.	Actual	%age In- crease/ decrease
1978-79	10.5	9.4	-10.5	13.8	16.7	21.4
1982-83	12.663	7.32	-42.2	15.45	18.03	16.7
1983-84	13.29	7.38	-44.5	15.91	18.29	15.0
1984-85	13.960	7.20	-48.4	16.71	17.81	6.6
1985-86	14.66	8.27	-43.6	17.21	16.85	-2.1
1986-87	15.39	7.82	-49.2	17.72	16.92	-4.5
1987-88	16.17	8.03	-50.3	18.25	18.54	1.6
1988-89	16.99	8.36	-50.8	18.80	19.73	4.9
1989-90	17.79	7.23	-59.4	19.36	20.37	5.2
1990-91	18.55	5.71	-69.2	19.85	19.96	0.6

Source: Pakistan Railway Year Book 1990-91.

The overall traffic for goods dropped down substantially to all time lowest figure of 5.71 billion TKm in 1990-91 indicating achievement even less than one-third of the projections. In 1978-79, prior to project Railways handled

9.4 BTKm; the maximum achievement so far. The above figures revealed that nevertheless the goods traffic continued to decline, it had registered a slight increase at a rate of 2% per annum between 1982-83 and 1988-89. It may be noted that increase more than the growth was picked up a little immediately after commissioning of the project in 1987-88. Thereafter the growth was not sustained as the decrease was 11% per annum during the period from 1987-88 to 1990-91 which is more than anticipated in the PC-I. Apparently, it looked as if the 2% growth may be due to the new telecommunication system. However, according to Railway the share of improved telecommunication facilities cannot be quantified as the increase in traffic is largely dependent upon the other projects relating with improvement in infrastructure facilities, such as track, motive power, coaches and wagons etc.

On the contrary, in the PC-I, the additional traffic generated with the project was clearly discernable as indicated at page 3 of this study. Either the Railway was unable to quantify the improvement in traffic due to the project or the projected increase has not materialized. It has been explained by the Railway that benefits can not be quantified and apportioned to one project only due to the multifarious disciplines/activities involved in the Railway Operational efficiency. The Railway's viewpoint do not hold good as the project of telecommunication formed the part of the 10th Railways project of the World Bank alongwith the other projects such as Rehabilitation of track and improvement of locomotives, coaches, wagons, marshalling yards, etc. Evidently, a package of projects was proposed to enable the Railways to redeem its performance. This could not be materialized as the huge investment made on the telecommunication project together with other schemes was not capitalized properly principally due to substantial delay occurred in their execution particularly in the telecommunication project. The delay resulted in the cost overrun due to increased tender price and change in scope/design and the abandoning of the project by the contractor (These factors are beyond the scope of this study and have not been analysed). Hence the projected target of this project and those expected from other complementary projects were not achieved.

Another important factor responsible for the goods traffic decline is the decrease in handling transport capacity. It was explained in the PC-I that in the absence of an efficient telecommunications system, the freight trains operation suffered a lot because of the high priority assigned to passenger trains. It was estimated that with the improved telecommunications, the delays/detentions of passenger trains would

be eliminated enabling the freight trains to run through without any fear of being detained because of passenger train. As a result the transport capacity for goods traffic would be improved by 8% and passenger traffic by 4%. Unlike to this, the actual passenger traffic remained almost stagnant during 1982-88 and thereafter increased at a rate of 2.4% per annum during 1987-91 which cannot be attributed entirely to the project because of the preference/priority given to passenger services. This argument is further corroborated by the fact that increase in passenger traffic in later years after completion of project has not impinged on the transport capacity, as assumed in the PC-I, which is also evident from the declining trend of the goods traffic.

b) Increase in Speed

The speed of the trains depend among other factors upon the efficient signalling system. It was also proposed in the project to integrate the signalling component of the project with U.H.F. system between stations by providing interface. This component of the project has not been commissioned and the Line Clear Messages for the train working are currently being conveyed through old Siemens system operated on T&T lines. There is, therefore, no impact of the project on the speed of the trains. The passenger trains run on fixed speed on time basis whilst average speed of all goods trains (including through goods trains) is 18-20 kms per hour as was before the project.

c) Improvement in Punctuality

An improvement of 3.1% in the overall punctuality of train achieved with the commissioning of project in 1987-88. The punctuality of goods train was improved by about 10% (from 77.5% in 1984-85 to 87.2% in 1987-88) and that of passenger trains by 2.7%. This was attributed to the facilities provided under the project for the quick transmission of information pertaining to whereabouts of trains, elimination of detentions (though not quantified) and timely movement of staff, locomotives, wagons etc. However, the punctuality of goods trains has been dropped to 84.5% in 1988-89 and that of passenger trains from 91.1% to 88.2% during the same period. The deterioration in the punctuality within one year of commissioning of the project seems to be due to inter-alia the malfunctioning of the system mainly caused due to lack of maintenance/spares.

d) Improvement in Utilization of Motive Power & Staff

It was ascertained that project on completion would result in the better utilization of locomotive and also in the

economical use of staff. The use of locomotive in terms of hours worked per day per engine (Diesel) remained in the range of 14-16 hours as was before the project whilst the locomotive availability was declined from 85% in 1987-88 to 79% in 1990-91 which implied that percentage of ineffective locomotives had been increasing since the inception of the project. In so far the economy in the utilization of staff, there is no significant change occurred as a result of the project.

On one hand the Railway is still paying the T&T for using the over head lines. Nor has the 3 sub-control offices and 25 crossing stations been closed as proposed in the PC-I. On the other, additional staff for the maintenance/operation of the telecommunication system was also recruited as per PC-I. Thus the Railway at present is subjected to bear both the expenses on its telecommunication system.

e) Improvement in Wagon Turn Around Time

The data provided by Railways reveal that turn around time of wagon was reduced from 19.5 days in 1984-85 to 15.5 days in 1987-88. A reduction of four days may possibly be due to the project which facilitated advance information on wagon destinations and make up of freight trains to Marshalling yard. It may be noted that Railway ascertained in the original PC-I that with the commissioning of new telecommunications system, the transport handling capacity would increase with out physically increasing the other equipment, which would result in improved wagon turn around time and better availability of locomotives. These benefits were not realized owing to the deterioration in the Railway handling capacity.

Moreover, in order to streamline the wagon operation through computerized wagon identification & control, the scheme for Management Information System (MIS) was then proposed to be implemented after completion of the telecommunication system for which the base facilities have already been provided in project. The MIS project is yet to be initiated and the facilities provided for this purpose remain un-utilized.

f) Improvement in Overall Safety

The safety on the entire Railway network has deteriorated. The project has also not contributed towards the improvement in the safety as evident from the number of accidents increased from 120 in 1984-85 to 137 in 1987-88.

g) Increase in line capacity

The increase in line capacity of the scheme is largely related with the speed of trains and signalling system. The improved and efficient signalling system enables the trains to run at a fast speed. As pointed out earlier that the signalling included in the project relating to automatic block and tokenless block instruments was not commissioned so far. At present, as before the project, the train working is being carried out with help of the old T&T system. Due to this deficiency of the project, the trains move with the required sectional speed and thus impeding the line capacity.

h) Increase in Revenues/Savings

The monetary gain as worked out in the PC-I due to additional traffic to be generated with the implementation of the project has not been materialized because of the decline in the goods traffic which is the main source of Railway's earning. Moreover, the Railway did not quantify the contribution of the project towards the increase in passenger traffic and the revenues earned thereon. The savings on account of closure of control/sub offices and surrender of T&T lines have not been affected because the offices and T&T lines are still under operation of the Railway.

The Railway indicated that the benefits pertaining to additional monetary gain cannot be quantified due to multifarious discipline and also due to lack of any method whereby benefits/losses can be assigned to a particular discipline. This does not hold good and is totally in contradiction to what has been indicated in the PC-I in this regard. This leads to a simple conclusion that benefits were over-estimated in the PC-I in order to get the project approved by the competent authority.

2.4 Non-quantifiable Benefits

Non-quantifiable benefits, as indicated in the PC-I, relate to the movement of staff and trains and their regulation/monitoring, provision of direct links between all the stations including way-side station and Train Control Offices and Divisional Offices etc.

With the execution of the project it is possible to keep track of the information regarding the whereabouts of the trains including goods trains, wagons etc. at the stations/sections. With the direct dialling facilities the information is promptly conveyed to any station or wayside station enroute which

was not possible before the project. The microwave system installed has proved very useful particularly in Sind. Because of law and order situation there, the over head lines of T&T are either being subjected to sabotage or out of order due to want of repairs. With the new network, this problem has overcome and the trains are running particularly on branch lines with the microwave system which is the only means of communication available in that area.

The regulation of train operations, movement of staff and locomotive/vehicles are being carried out fully through the telecommunication network. However, 100% achievement in this regard seems to be optimistic and is self contradictory when compared with the relatively deteriorated performance regarding availability and utilization of locomotives etc.

One of the main components of the project was to provide telecommunications between locomotive drivers and control office during emergency. The achievement in this regard is 80% as 350 locomotives are equipped with VHF radio sets alongwith installation of 78 base stations covering all the area enroute. The importance of this facility is evident from the fact when locomotive of Tezgam was attacked with rocket in Sind, the incident was immediately reported by the driver to nearby base station through VHF radio link installed in the locomotive. For the purpose of inquiry proceedings, the project provided for tape logging of conversation between drivers train controller and station masters. This facility is not being properly utilized because of lack of interest and malfunctioning of equipment used for recording.

The telecommunication network immediately after commissioning did facilitate quick transmission of information relating to train formation and availability/utilization of wagons, locomotives etc. However, these accomplishments were shortlived as the system has been suffering from the frequent problem of malfunctioning since 1990 due to lack of maintenance facilities including spares, vehicles and air-conditioning.

2.5 Economic Analysis

Based on the increase in traffic and operational efficiency, the benefits were calculated in the PC-1. The cost benefit analysis thus carried out revealed that project was viable with Benefit Cost Ratio (BCR) at 2.9:1 and Internal Rate at 32.5%.

In actual terms, the freight traffic slumped down to 5.7 BTKm which is less than one-third of the PC-I target. As such the economic benefits were not realized as a result of the project. The project can hardly be considered viable.

Notwithstanding the fact that Railway's performance has deteriorated substantially, it contended that had the new telecommunication system not been available, the decline in operating efficiency would have been increasingly high. Considering that Railway contention may be true and some improvements might have been made in train operation with the new telecommunication facilities which was not quantified, a hypothetical exercise of the cost benefit analysis for the project has been carried out on the basis of the following:-

a) Only 5% of the goods traffic (against 8% projected in PC-I) and 4% of the passenger traffic is assumed to be generated due to the improved telecommunication facilities. Applying these percentages on actual traffic performance during 1987-88 which is taken as the base year, the traffic and revenues thus worked out are as under:-

	1987-88	1988-89	1989-90	1990-91
i) <u>Actual Total Traffic</u>				
<u>Handled</u>				
Goods traffic (MTKkm)	8,033	8,364	7,226	5,709
Passenger traffic (MPKkm)	18,542	19,732	20,373	19,964
ii) <u>Apportioned to the Project</u>				
5% Goods traffic (MTKkm)	402	418	361	285
4% Passenger " (MPKkm)	742	789	815	799
iii) <u>Revenue Share as a result of the project from</u>				
- Goods traffic (Rs. Million)	110.15	118.29	116.60	116.85
- Passenger traffic (Rs. Million)	69.75	73.79	78.45	94.28
<u>Total Rs. Million:</u>	180.25	192.08	195.05	211.73

*

Calculated on the basis of the rate per kilometer for the successive years given in Railway year book 1990-91.

- b) Overall life of the different equipment/components of the project is taken in the range of 10-30 years as reflected in the PC-I.
- c) Revenue beyond 1990-91 is assumed to be increased by about 5% as adopted in the PC-I.
- d) The savings on account of closure of T&T control offices and rental paid to T&T have not been materialized as indicated by the Railway on the questionnaire at Annexure I.

Based on the above assumptions the detailed analysis carried out is given in Annexure-V. The results are summarized as under:

-	Net present value at 12% discount rate (Rs.Million) ... (-)	59.96
-	Benefit cost ratio at 12% discount rate	0.9:1
-	Internal Rate of Return	11.03%

The above results lead to conclude that the project cannot be considered sustainable with as low rate of return as 11.03%.

2.6 Interviews with Locomotive Drivers & Station Masters of Small Stations:

The performance of the telecommunication system was also assessed by taking opinion of the train operating staff such as locomotive drivers and Station Masters of small unknown stations. This opinion survey has been conducted in Lahore and Rawalpindi Divisions of the Railway. The interviews could not be obtained from the staff belonging to Sukkur and Karachi Division because of law & order situation. In all 10 persons were interviewed with break up as under:-

	<u>Locomotive Drivers</u>	<u>Station Masters</u>	<u>Total</u>
Lahore Divisions	3	4	7
Rawalpindi Division	2	1	3
Total:	<u>5</u>	<u>5</u>	<u>10</u>

These interviews were arranged by the Railway Headquarters Lahore.

Under the project, the locomotives were equipped with radio set providing direct communications with the train controller and station masters of base station where VHF equipment is installed. As such the questions to the locomotive drivers mainly related to the requirement and performance of this facility. The excerpts of the opinion expressed by the locomotive drivers are produced as under.

All the 5 locomotive drivers ruled out the impression that the installation of VHF equipment/radio sets in the locomotive was a fancy proposition and regarded it as a genuine necessity providing prompt communications between drivers and control office which was not possible before the project. The system has resulted in reducing train detention time which was not quantified by the Railway. The general complaint of the drivers pertained to the non responsiveness of the concerned control office when called by them. One of the drivers indicated that he had been able to receive reply from control only once ever since the system became operational. In the beginning just after completion, the new telecommunication network worked alright but this accomplishment was shortlived as the system has been suffering from faults since 1990 because of lack of maintenance and repairs problem.

No proper training was imparted for operating the radio sets. However, at the time of introduction of the system verbal instructions about the operations of the knobs/buttons were given to the drivers. Presently there is no regular/permanent system of training.

The drivers pointed out a serious deficiency in the system. At present there is no communication facilities exists between drivers and the guard of the train. As such they are unable to make contact with each other while train is moving. This poses sometimes serious bottleneck in the train operation.

The drivers were unable to quote any example whereby accidents could be averted due to this system. However, a driver of Rawalpindi Division while travelling in Sukkur Division had a different experience. He informed that he received a message through VHF system from controller well in time and accident was thus averted at Rohri.

The problem of theft of the radio sets installed in the loco motives occurred immediately after completion of the project. At present an arrangement has been made whereby drivers of the locomotive is responsible for taking/handing over the radio sets from/to the shed staff before/after the journey. Apparently this procedure is working alright. However, most of the time the microwave staff deputed in the shed for handing/taking over the equipment is either not available or non-cooperative. As such the proper control of theft of this equipment cannot be exercised.

The station masters of the following small/unknown stations were interviewed:

- Kala Shah Kakoo
- Shahdra Bagh
- Lohi Bheer

Two station masters each at Kala Shah Kakoo and Shahdra Bagh were available for the interview. The questions were related to the performance and utilization of the system. All the five station masters were of the view that train working (relating to proceed/approach) is currently being performed on Siemens system operated on T&T lines.

Regarding the utilization of the microwave system, the misuse of the telephones are reported by the station masters. The stations masters did not experience any improvement in the operating conditions; such as increase in traffic, speed etc. as a result of the project. Yet, they are appreciative of the system's advantage relating to the reporting of the incidents in emergency or of locomotive failure. However, the information regarding the numbers of such incidents reported through the use of telecommunication network was not provided. The Kala Shah Kakoo Station Master regarded the transmission of timely information as a great merit of the system which helped in streamlining the oil/chemical traffic but he was not able to quantify the revenue share of the project on this account.

The station masters were not given any training about the operation and the utility of the system, which should have been imparted at the time of introduction of the system.

The station masters are also aware of the adverse affect of the dust and hot temperature on the functioning of the system. Due to this problem, the system remains faulty most of the time in summer as the equipment installed on the stations is

very sensitive and vulnerable to extreme weather and dust. No arrangements have been made to protect the system from these hazards.

Generally the Station Masters do not seem to be in favour of the new microwave system. They considered the old Siemens system working on T&T lines is better than the new telecommunication system as the former ensures safety, simple to operate and maintain while the later is fallible and thus at present has very low utility. In their opinion, microwave system may prove fruitful when computerized seat reservation system on the patterns of PIA would be initiated in future.

CHAPTER - III

CONCLUSIONS AND RECOMMENDATIONS

On the basis of the economic analysis and the performance evaluation carried out as well as the interviews conducted with the end users of the facilities, the conclusions and recommendations drawn from the study are as under:

Conclusions

- i) The project was well conceived but not well planned and designed as the major changes in scope of work took place during implementation resulting in a substantial delay of about 10 years in its implementation.
- ii) The project did not suffer from the scarcity of funds during implementation.
- iii) Benefits of the project were grossly over-estimated, perhaps to secure the approval of the project by the competent authority. The economic analysis was based on the assumptions which did not come true.
- iv) It was concluded in the PC-I that there were frequent breakdown of the old telecommunication system prior to the project which caused delays/detentions of the passenger train resulting in increase in operational time and impairing the capacity. Even with new efficient telecommunication network, the traffic handling capacity for goods continued to decline suggesting that no change occurred in the policy of giving priority to passenger train movement. The net result is the loss of freight traffic.
- v) The economic analysis carried out in the study led to conclude that the project cannot be considered sustainable/viable.
- vi) The tape logging facilities provided for recording conversation between locomotive drivers, controller and station masters, if utilized properly to the maximum extent, can serve as "Black Box" in inquiry proceedings.

vii) The facilities of improved communication have not been capitalized by Railway marketing for the stimulation of business which can be enhanced by pursuing policies and practices more vigorously for the available freight traffic. The Railway thus can compete with private truckers more aggressively as the latter do not own such facilities.

viii) In addition to above, there is a lack of co-ordination between the train operating staff (locomotive drivers station masters etc.) and the telecommunication maintenance staff. It appears that they do not co-operate with each other. The station masters (though 5 in number) seem to be biased toward the telecommunication system. Such a situation may not be conducive for the efficient utilization/operation of the telecommunication network.

Recommendations

The recommendations of the study are as under:

- i) Projects need to be based on sound and realistic planning taking into account (a) the existing and future requirements of the outcome (b) investments (c) the costing of the key inputs and (d) the likely effects of the project on the overall system and the national economy.
- ii) Tangible benefits (if any) drawn for the project may be clearly quantified and worked out on scientific basis with the help of realistic assumptions. The benefits thus estimated should be economically analysed by comparing different alternatives and cost effective solution.
- iii) Impediments in the way of completing the signalling components of the project may be eliminated so as to achieve increase in speed, sectional capacity and improved safety.
- iv) With the new telecommunication network, the Railway may improve the utilization of its rolling stock, motive power and the staff. The policy of giving preference to passenger trains also needs to be reviewed/changed.

- v) Realizing the importance and role of modernized telecommunication system, the staff may be made to adjust themselves to the changing environment and develop business oriented approach to gain the freight traffic lost by the Railway.
- vi) Available surplus capacity of telecommunication network may be given on lease to private sector. Also metering/billing of the trunk calls may be introduced. The funds thus generated may be placed at the disposal of the Railway telecommunication department to make the project self sustaining.
- vii) Railway may explore the possibility to convert its present telecommunication department into semi-autonomous organization or to run it on the pattern of proposal for converting its manufacturing units into autonomous Corporation or RAILCOP etc.
- viii) With the new telecommunication network, the Railway may produce timely and more accurate data needed to improve the efficiency of its costing cell and modernise its accounting system.
- ix) Efforts may be made to initiate the work on the MIS project, computerized seat reservation and wagon control etc. so as to utilize the facilities provided under the project to maximum extent possible.
- x) Communication facilities between the guard of the trains and locomotive drivers need to be provided for the smooth and safe running of the train.
- xi) Proper facilities such as vehicles, air-conditioning and spares for maintenance may be provided for the efficient functioning of telecommunication system.

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ANNEXURES

**QUESTIONNAIRE FOR THE STUDY OF EVALUATION OF
TELECOMMUNICATION & RELATED SIGNALLING PROJECT
OF PAKISTAN RAILWAYS**

PART-I: QUANTIFIABLE BENEFITS AS A RESULT OF PROJECT.

S.No.	I T E M S	84-85	85-86	86-87	87-88	88-89
A) <u>Operational Efficiency</u>						
1. <u>Traffic</u>						
-	Goods (BT Km)	7.202	8.270	7.820	8.033	8.364
-	Passenger (BP Km)	17.807	16.850	16.920	18.542	19.732
2. <u>Increase in Speed (Average)</u>						
- <u>Passenger Train</u>						
-	Main Line	Passenger trains run on fixed speed and time basis.				
-	Branch Line	basis.				
- <u>Goods Train</u>						
-	Diesel	18.3	18.3	18.2	19.2	19.9
-	All	17.8	17.9	18.0	19.1	19.3
3. <u>Improvement in Punctuality (%)</u>						
- <u>Goods Train</u>						
-	Total Mail/Exp. Train	77.5	85.6	84.8	87.2	84.5
-	Passenger Train	88.4	94.1	91.1	91.1	88.2
-	Overall	87.6	91.4	89.5	90.7	89.2
4. <u>Improvement in the Utilization of Motive Power & Rolling Stock</u>						
a)	Availability of Locomotives (Per Engine per day (Hrs))	15.1	15.6	14.7	15.5	15.7

Contd...P/(ii).....

(ii)

b) <u>Locomotive Productivity</u>						
- Passenger Traffic (BT Km)	7.202	8.270	7.820	8.033	8.364	
- Goods Traffic (BP Km)	17.807	16.850	16.920	18.542	19.732	
c) Wagon turn around time (days)		19.5	18.3	17.3	15.5	16.5
5. Improvement/increase in handling capacity (%)	same as under Item-I above					
6. Improvement in overall safety						
- No. of accidents	120	132	140	137	138	
7. Elimination of delays/detentions (%)	As under Item-3 above					
8. Improvement in overall operational efficiency (%)	As under Item-1,3 & 4 (c) above.					
9. Economy in the utilisation of staff						
- No. of staff engaged in traffic control/signalling	No significant change					
B) <u>Savings & Revenues (Million Rupees)</u>						
i) <u>Benefits on account of saving time</u>	!					
a). Due to increase in speed/punctuality.	! The benefits cannot be quantified as there is no way					
b). Due to elimination of delays/detention.	! to assign losses/benefits to a particular discipline.					
ii) Benefits on account of saving in wagon turn around time.	!					
iii) Saving in the handling cost of passenger and goods traffic	!					

Contd....P/(iii)....

(iii)

iv) Saving in salaries on account of closing 3 sub-control Offices & 25 crossing stations(as proposed in PC-1). ! Sub-control Office at FSLD, SMA & KOT closed. 63 persons were spared (JCD control Office will be closed shortly).

v) Saving in the payment of rental to T&T Department. ! Overhead lines not yet surrendered, however, the position of telephone bills to PTC is as under :-

12.861 15.596 15.859 11.867 14.467

vi) Monetary gain due to additional. ! The benefits cannot be quantified due to multifarious disciplines. ! It is however, worth mentioning that it would not have been possible to run trains particularly in Sind area, had the modern telecom: facilities not been provided. Moreover, the deterioration in the services was also arrested by providing new systems.

- Passenger Traffic.
- Goods Traffic.

Total benefits.-

Contd...P/(iv)...

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99

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98

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97

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(iv)

Part-II: Non-quantifiable benefits

1. How far the following objectives have been achieved as a result of the project:
- i) To move staff, motive power & vehicles to right place at right time. 100%
 - ii) To regulate train operations & monitor train movement from station to station. 100%
 - iii) To provide direct dialling facilities between all the stations and the Divisional Offices & Rlys. Hd: Qrs. 100%
 - iv) To provide telephone communication between train control offices & wayside stations (all the stations on main line & important station on Branch lines) for supervision & monitoring round the clock. 100%
 - v) To provide advance information about wagon destinations and make up of trains to marshalling yards and goods yards. The existing systems are being fully used for this purpose. However, this item relates to MIS project also.
 - vi) To provide communication between drivers & control office during break downs, accidents & other emergencies. 80%
 - vii) To provide Tape logging of conversation between controller, station masters & locomotive drivers for the purpose of inquiry proceedings. 20%
 - viii) To provide communication between gangs working on track and approaching trains & control offices. -
 - ix) To provide communication between level crossings and approaching trains & control offices. -
 - x) To provide information on enquiries from passengers & other Railway users/clients. 100%

Contd...P/(v).....

- x1) To establish development base for:
 - a) Computerised wagon control & identification.
 - b) Computerised Seat reservations.
 - c) Establishing Management Information system (MIS).
 - d) Computerised Central Traffic Control.
 - 2. Whether Telecommunication/signalling needs of the Rlys are being met adequately through the project.
 - 3. How far the facilities/systems capacity provided under the project are being utilised.
 - 4. Whether any improvement has been made in the availability of accurate data for the modernisation of Rlys accounting system.
 - 5. Whether project has resulted in the stimulation of new business activities.
 - 6. How the Telecommunication requirement of electrified section between Lahore and Khanewal are being met.
 - 7. Whether staff as well as Officers are adequately trained to operate the system.
 - 8. Indicate the bottlenecks/difficulties being faced by the Railways in operating the system.
- 100%
- Yes.
- Fully.
- Proper Telecommunication media has been provided & can be used for collecting all sorts of data.
- Yes.
- Not related as the project did not include LHR-KWL Section.
- Yes.
- Shortage of staff due to recruitment bans etc.
Procurement of spares, non-availability of adequate test instrument and road vehicles, and trained staff drainage.

SCOPE AND PROGRESS OF THE TELECOMMUNICATION AND
RELATED SIGNALLING PROJECT

ANNEXURE-II

S.No. Scope of the Project	Achievements/Progress
i) Installation of a back-bone microwave system of 960 channels capacity on main line between Karachi-Lahore-Faisalabad-Lalamusa-Rawalpindi, and on Wazirabad-Sangla Hill Sections, Sukkur-Shaheed Allah Bux - Liaqatpur Section and Spurs to Lahore, Multan and Kot Adu Sections covering a distance of 2000 kms alongwith installation of 44 microwave.	A Back bone, Microwave system of 960 channel capacity as specified, along main line between KHI-RWP and important sections of branch line between Faisalabad-Khanewal covering a distance of 2200 kms. is in operation. The Railway is using only 300 channels to meet the present requirement which can be increased to 600 channels in future.
ii) Installation of UHF links with 36 channels capacity on 281 stations enroute the project, providing block working, direct dialing, train control and deputy train control, data system, Morse (telegraph circuits) working etc.	UHF radio system is working at 263 stations. This network serves as communication links between adjacent stations and provides facilities for train operation and links with wayside stations, covering distance of about 2700 kms.
iii) Installation of 18 automatic telephone exchanges with direct dialing facilities between all the stations, Divisional offices & Railways Headquarters as well as with way side stations.	17 electronic exchanges at important stations are in operation providing direct dialing facilities between stations including wayside stations enroute and Railway Headquarters, Divisional Offices etc.
iv) Provision of VHF radio sets in 500 locomotives with 78 base stations on entire route of the Project.	350 Locomotives have been equipped with VHF radio sets to provide communications between Locomotive drivers, train control office and station masters etc.
v) Provision of automatic block signalings at stations between Hyderabad-Lodhran and electronic axle counters on the stations for block operation. On single line from Lodhran-Rawalpindi tokenless block instruments would be modified to work on UHF system.	Provision of automatic block signalling and modification to tokenless instruments to work on U.H.F. system between stations enroute and installation of electronic axle counters could not be achieved due to the technical problems.

**CHRONOLOGY OF IMPORTANT EVENTS
TELECOMMUNICATION AND RELATED SIGNALLING PROJECT**

Sl.No.	Date	Description
1.	15-4-1977	The Project was cleared by Defence Department
2.	14-6-1977	The Project was cleared by Secretary, Ministry of Communications.
3.	May, 1978	PC-I proforma submitted to Railway Board.
4.	July, 1978	PC-I submitted to Planning Division.
5.	3-3-1978	Project was approved in a ministerial meeting.
6.	7-7-1978	PC-I approved by CDWP.
7.	15-8-1979	International Tenders Floated.
8.	24-9-1979	PC-I approved by E.C.N.E.C.
9.	25-5-1980	Anticipatory approval for enhanced cost received.
10.	30-5-1980	Letter of intent issued to M/s Kentron Pakistan Inc.
11.	3-6-1980	World Bank approval received.
12.	17-7-1980	Agreement for Route Survey signed.
13.	30-10-1980	Main Agreement signed.
14.	22-12-1981	Addendum to Agreement signed.
15.	April, 1982	PC-I revised and submitted to Planning Division.
16.	13-4-1983	Revised PC-I approved by ECNEC.
17.	24-10-1983	Contract with M/s. Kentron cancelled by Railway Board.
18.	June, 1984	Tenders re-invited for balance work.
19.	21-2-1985	Contract signed with M/s. DAEWOO Corporation of Republic Korea.
20.	June, 1988	Project completed and commissioned.

"A.D.P." ALLOCATIONS FUNDS RELEASED AND ACTUAL EXPENDITURE

(Million Rupees)

Year	"A.D.P." ALLOCATION			FUNDS RELEASED			ACTUAL EXPENDITURE		
	Rupee	F.E.C	Total	Rupee	F.E.C.	Total	Rupee	F.E.C.	Total
1977-78	1.207	50.333	51.540	0.600	2.700	3.300	0.136	0.648	0.784
1978-79	2.500	5.000	7.500	2.300	4.351	6.651	1.433	-	1.433
1979-80	4.078	9.000	13.078	3.300	2.800	6.100	4.008	1.766	5.774
1980-81	41.430	89.270	130.700	79.625	102.000	181.625	67.298	98.158	165.456
1981-82	165.900	148.000	313.900	165.000	228.600	393.600	144.621	178.572	323.193
1982-83	76.670	49.330	126.000	120.947	103.613	224.560	120.941	134.535	255.476
1983-84	7.500	8.026	15.526	26.000	13.572	39.572	21.245	5.636	26.881
1984-85	2.617	0.383	3.000	4.617	0.383	5.000	0.179	-	0.179
1985-86	0.100	-	0.100	-	-	-	24.201	30.180	54.381*
1986-87	0.001	-	0.001	0.001	2.509	2.510	16.650	15.663	32.313*
1987-88	1.000	-	1.000	8.000	13.465	21.465	24.717	51.623	76.340*
1988-89	3.470	-	3.470	8.470	-	8.470	8.903	13.465	22.368
1989-90	0.500	-	0.500	6.520	-	6.520	5.815	35.253	41.068
							4.568	-	4.568
								8.015	8.015
							6.112	-	6.112
								17.426	17.426
	306.973	359.342	666.315	425.380	473.993	899.373	379.445	435.289	814.734
							71.383	158.160	229.543
Total:							450.828	593.449	1044.227

* In addition to ADP allocation, expenditure of Rs.229.543 million incurred out of the Encashed Bank Guarantees received from M/s LTV as compensation on abandonment of the project by M/s. K.P.I.

ANNEXURE - V

COST BENEFIT ANALYSIS OF THE RAILWAY'S
TELECOMMUNICATION & RELATED SIGNALLING PROJECT

Sl. NO.	YEAR	TOTAL COST	TOTAL BENEFIT	DISCOUNTED COST	DISCOUNTED BENEFIT
0	1977-78	0.78		0.78	
1	1978-79	1.44		1.27	
2	1979-80	5.77		4.60	
3	1980-81	165.46		117.81	
4	1981-82	323.19		205.55	
5	1982-83	255.48		144.86	
6	1983-84	26.88		13.63	
7	1984-85	54.56		24.66	
8	1985-86	32.31		13.05	
9	1986-87	78.85		28.46	
10	1987-88	63.44	180.25	20.43	58.04
11	1988-89	32.64	192.08	9.37	55.13
12	1989-90	48.15	195.05	12.37	50.13
13	1990-91	72.78	211.93	16.67	48.53
14	1991-92	86.78	222.94	17.79	45.70
15	1992-93	72.78	234.48	13.32	42.91
16	1993-94	76.36	246.58	12.45	40.19
17	1994-95	76.36	259.25	11.15	37.85
18	1995-96	76.36	272.53	9.93	35.43
19	1996-97	94.19	286.45	10.93	33.23
20	1997-98	80.19	301.04	8.34	31.38
21	1998-99	84.06	316.33	7.82	29.42
22	1999-0	84.06	332.36	6.98	27.59
23	2000-1	84.06	349.17	6.22	25.84
24	2001-2	100.06	366.80	6.60	24.21
25	2002-3	84.06	385.28	4.96	22.73
26	2003-4	88.20	404.66	4.67	21.45
27	2004-5	88.20	424.99	4.15	19.97
28	2005-6	88.20	446.31	3.70	18.75
29	2006-7	88.20	468.66	3.26	17.34
TOTAL :		2513.9	6097.14	745.78	685.82

Net Present Value at 12% Discount Rate = -59.96
Benefit Cost Ratio at 12% Discount Rate = 0.92:1
Internal Rate of Return = 11.03%

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POST OFFICE OFFICE OF THE SECRETARY
GENERAL INVESTIGATION AND CONTROL DIVISION

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