Pakistan

Locomotive Manufacturing Factory Project

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Field Survey: September 2004

1. Project Profile and Japan's ODA Loan

Regional map of the project site

Risalpur Locomotive Manufacturing Factory

1.1 Background

Pakistan borders the countries of India, Iran, Afghanistan, and China. It is 796,000 km^2 in area, which is roughly double the size of Japan. The population is 150 million people, approximately 1.2 times that of Japan. Pakistan's main industries are agriculture and cotton production.

The country's domestic transportation network is formed mainly around the north-south corridor that connects the major cities where people and industries are concentrated: Karachi, the southern city which handles over 90% of the country's trade; Peshawar, the major northern city; and Islamabad, the capital city. Of these, the railway has approximately 8,600 operating kilometers[1], of which the main part connects Karachi and Peshawar. In the late 1950s, the railway played an important role in freight and passenger transport in Pakistan, handling 73% of the domestic freight transport and 42% of the domestic passenger transport. However, starting in the 1980s, the railway became unable to keep pace with the increasing demand for transportation, and railway transport volume ceased to rise mainly due to superannuation and lack of sufficient locomotives[2].

[1]"Operating kilometers" refers to the distance traveled by commercial transportation such as railways and buses on regular routes. The operating kilometers of Pakistan Railways are approximately 30% that of Japan.
[2]In the early 1980s, Pakistan Railways had approximately 490 electric diesel locomotives, which were the main type of locomotive in use, but over half of those had surpassed their durable lifespan.

1.2 Objectives

locomotives by constructing a locomotive manufacturing factory and transferring locomotive manufacturing technology to Pakistan, where railways play an important role in freight transport, and thereby contribute to the economic development through stabilization of rail transport.

1.3 Borrower/Executing Agency: Islamic Republic of Pakistan/ Ministry of Railways

1.4 Outline of Loan Agreement

Loan Amount/Loan Disbursed Amount	9,760 million yen/9,670 million yen
Exchange of Notes/Loan Agreement	August 1982/February 1984
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	 2.75% 30 years (10 years) Partial Untied
Final Disbursement Date	August 1994
Contractor	Marubeni, Hitachi
Consulting Services	Japan Railway Technical Service (JARTS)
Project Identification and Preparation Study (such as Feasibility Study (F/S))	1983 Japan International Cooperation Agency (JICA)

2. Results and Evaluation

2.1 Relevance

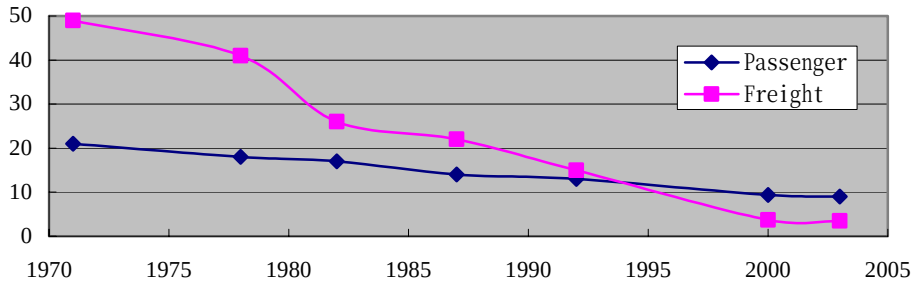
Since the 6th 5-year plan (1983-1988), the securing of rail transport capacity and rational distribution of traffic between railways and roads were emphasized in Pakistan's transportation policy. In the railway sector, an important topic was the renewal of the superannuated infrastructures such as locomotives and rails. In response to this need, this project was planned as a part of the progressive plan for domestic production of locomotives[3], and it had great urgency. Moreover, the railway transport volume was forecasted to increase by approximately 3% annually at the time of the appraisal. Therefore, the priority of this project was high at the time of the appraisal.

Recovery of the railway's share of long-distance large-volume freight transport continued to be stressed in the 7th 5-year plan (1988-1993) and afterwards with more emphasis on public investment in the railway sector. However, although railway transport volume was forecasted to increase at the time of the appraisal, the freight transport volume actually declined by approximately 50% when the averages of 1986-1990 and of

[3]The progressive plan for producing locomotives domestically which was drawn up by the government stated that it would make operation, maintenance, and repairs more efficient through standardization, conserve foreign currency, and promote related domestic industries, and so it was very responsive to the important issues at that time.

1996-2000 are compared. The passenger freight volume was limited to an approximately 1% increase (Figure 3), and the railway's share of domestic freight transport in 2003 plummeted to 5% (Figure 1). Due to these facts, the need for new locomotives is lower than expected[4]. On one hand, the domestic production of locomotive parts still has a certain amount of relevance from the standpoints of foreign currency saving, greater efficiency in operation, maintenance, and repairs thanks to model standardization, and promotion of related domestic industries. However, it must be said that the priority of this project has declined compared to the time of the appraisal, given the current situation in which many locomotives and main parts including engines are being imported.

Figure 1: Changes in the Railway's Share (%) of Passenger and Freight Transport



2.2 Efficiency

2.2.1 Output

This project constructed a factory (annual output: 25 locomotives) in Nowshera, Northwest Frontier Province of Pakistan, to manufacture 2000-horsepower diesel electric locomotive bodies, rail tracks, and frames, and to assemble motors, axles, and entire locomotives. Following the completion of the factory, technology for locomotive manufacture was transferred by providing documents and blueprints, technical training, and production guidance in manufacturing five locomotives with imported parts. This project loan covered the entire foreign currency portion necessary to produce the above output, which was implemented for the most part as planned.

2.2.2 Project Period

The project period was originally scheduled for February 1984 to June 1988 (53 months), but the actual project period was February 1984 to August 1994 (127 months), which was 240% longer than planned. The primary reason for the extension of the project

[4]In the JICA Feasibility Study, it was assumed that the freight transport demand and the passenger transport demand would increase by 2.6% to 3.6% annually, and, based on that, it was forecast that 25 to 45 new locomotives annually would be necessary.

was in the delay in the budget approval process[5]. Other factors include the delay in disbursement of the local currency portion of the budget, adjustments in the bidding specifications, and adjustments in the facility design.

2.2.3 Project Cost

The project cost in the original plan was 21.35 billion yen, but the actual project cost was 16.17 billion yen, which is 5.18 billion yen less than (or 75.7% of) the original amount. The local currency portion of the project cost increased due to the rise in prices and the hike in customs taxes on imports that occurred during the delay in the project. However, because the rupee/yen rate plunged during the implementation of the project, the total cost was decreased in yen base. The foreign currency (i.e. yen) portion of the project was implemented for the most part as planned.

Table 1: Comparison of Planned and Actual Project Cost

Item	Planned	Actual	Difference
Foreign Currency Project Cost	9.76 billion yen	9.67 billion yen	- 90 million yen
Local Currency Project Cost	11.59 billion yen	6.50 billion yen	- 5.09 billion yen
(Local currency project cost in rupees (Rs.))	(610 million Rs.)	(970 million Rs.)	(360 million Rs.)
Total	21.35 billion yen	16.17 billion yen	- 5.18 billion yen
Exchange Rate	1Rs.＝19.0 yen (at appraisal)	1Rs.＝6.7 yen (1984-1996 average)	—

Source: Pakistan Railways

2.3 Effectiveness

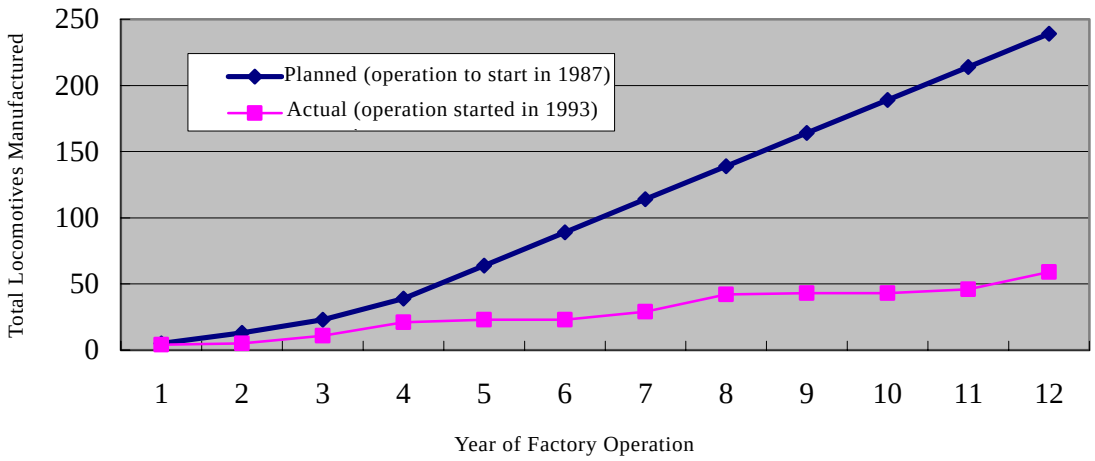
2.3.1 Results of Locomotive Manufacture

In this project, the factory was scheduled to manufacture 39 locomotives annually for the first 4 years of operation, and 25 locomotives, which was the maximum production capacity, from the fifth year onward. However, only 59 locomotives were actually manufactured in the 12 years since the operation started in 1993 (approximately 25% of the 239 planned, Figure 2)[6]. The average availability factor of the factory (based on days of operation) was 75% to 80% in most areas, but only 40% to 50% in some areas. The reason why the manufacture of locomotives did not proceed as planned was the financial limitation. In fact, all of the locomotives manufactured or rehabilitated were financed by foreign assistance such as ODA loans.[7] The Pakistani Government did not allocate any

[5]The budget of this project was approved at one point in 1981, but after signing the loan agreement in 1984, re-approval became necessary for an increased budget. In 1989, the increased budget was approved. The reason why the budget was increased was apparently due to the rise in prices and the drop in the value of the rupee, but the details are unclear as to why such a lengthy amount of time was required for the re-approval.
[6]In addition, 21 locomotives were rehabilitated, and 9 locomotives were repaired following accidents.
[7]43 locomotives were financed through yen loans (e.g. Diesel Electric Locomotives Rehabilitation Project

budget for the manufacture of locomotives other than ODA funds. Furthermore, Pakistan is scheduled to receive assistance from China henceforth for the manufacture of 38 locomotives by FY2007.

Figure 2: Total Locomotives Manufactured at the Risalpur Locomotive Factory: A Comparison of Planned and Actual Levels



2.3.2 Achievement of Domestic Production of Locomotives

The original plan of this project was to attain a domestic locomotive production rate[8] in Pakistan of 20% in the first year of operation, 30% in the second through fourth years, 35% in the fifth through ninth years, and 50% from the tenth year onward. However, the current domestic production rate is 33% for Japanese locomotives manufactured from parts imported from Japan, and 8%~13% for US and Chinese locomotives. The main reasons for the small increase in domestic production rate were as follows: lack of technical support from the foreign companies for domestic production of locomotive parts which requires advanced technology, and the difficulty in accumulating the knowledge of domestic production because of the various types of locomotives produced at the factory (i.e. Japanese, US, and Chinese).

It was also anticipated that greater efficiency would be achieved in operation, maintenance, and repair as the standardization of locomotives progressed with increasing domestic production. However, because of the varied types of locomotives manufactured at the factory and the low rate of domestic production, the types of locomotives has increased from 24 in 1983 to 25 currently, instead of the standardization.

(1)), and 16 locomotives were financed through suppliers' credit from China.
[8]Locomotive Domestic Production Rate = (price of imported complete locomotive - price of imported parts) / price of imported complete locomotive

2.3.3 Achievement of Technology Transfer

Under this project, Japanese locomotive manufacturing companies provided technical documents. As for training, 78 man-months received overseas training, and 149 man-months for domestic training. Moreover, production guidance was conducted at the factory. According to the factory management, the technology transfer implemented by Japanese companies was detailed, and the quality of the guidance was extremely high. The technology transfer was initially for the manufacture of the Japanese 2000-horsepower locomotives, but subsequently the factory staff utilized the knowledge and experience gained from the training to manufacture locomotives from other countries and the 3000-horsepower locomotive. This project contributed to the establishment of a technological base of the factory.

2.3.4 Condition of Manufactured Locomotives

A. Japanese 2200 horsepower locomotive (model number PHA-20)

A Japanese locomotive about to depart a station

Five Japanese locomotives manufactured in this project were gradually put into service between the end of 1993 and August 1994. The average rate of operation[9] up to this time is 83%, which is close to the planned rate, 85%. The operating rate of other 18 Japanese locomotives of the same model which were put into service between 1995 and 1997 has not been produced. Average operational efficiency[10] of the 23 locomotives in 2003 was 382 km/day per locomotive, which is 1.5 times the overall average operational efficiency of the Pakistan Railways, 263 km/day per locomotive. According to the Pakistan Railways, the performance of the Japanese locomotives is sufficiently high, and the electrical systems in particular are exceptionally outstanding. However, there are problems in crankshafts of engines to be bent or bearings to be damaged often. As a result, major engine parts need to be replaced more frequently. The Pakistani Government is continuing to study ways to resolve these problems.

Out of these 23 Japanese locomotives, 80% are used for passenger trains and 20% are used for freight trains, based on the policy that gives preference to reliable locomotives of high performance for locomotives for passenger trains, where speedy and timely service is required.

[9]"Average rate of operation" is the percentage of days in operation annually, excluding the days spent in the factory for maintenance.
[10]"Average operational efficiency" is the distance traveled per day per locomotive.

B. US 3300 horsepower locomotive (model number AGE-30)

US locomotive being overhauled

Between 1998 and 2000, the factory manufactured 20 US locomotives, and prior to that, 10 completed locomotives were imported. In total, 30 locomotives of the same model are in operation currently. According to the Pakistan Railways, the performance of the US locomotives is the most excellent of all locomotives owned by them. Their average operating rate is extremely high, at 88.5%. The average operational efficiency of 763 km/day per train (in 2003) is approximately three times as high as the overall average operational efficiency of the Pakistan Railways, which is 263 km/day per train. These 30 US locomotives are operating as long-distance limited express trains, which are the backbone of the passenger transport.

C. Chinese 2500/3500-horsepower locomotive (model number DPU-20/30)

Chinese locomotives before completion

The Chinese locomotives manufactured at the factory were put into service for both passenger and freight transport. The service started only recently in 2003, and no data was available on their operating rate or their operational efficiency.

2.3.5 Economic Analysis

The economic internal rate of return (EIRR) at the time of the appraisal was 11.9%, but when the EIRR was recalculated for the ex-post evaluation, the result was negative. Factors that led to the negative EIRR include: (1) the number of locomotives manufactured and the rate of domestic production were far less than planned and (2) the project period was extended. The EIRR for the appraisal was calculated under the following conditions.

Conditions:

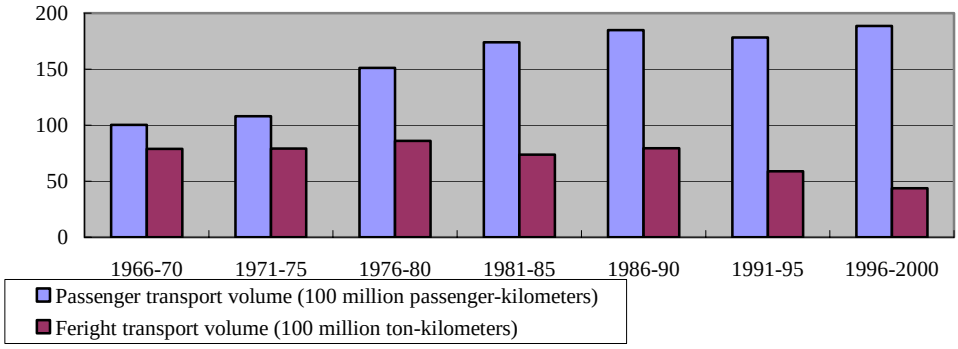
- Project Life: 20 years
- Benefits: cost of introducing locomotives in the event that the factory was not constructed (cost of importing complete locomotives)
- Expenses: Cost of introducing locomotives when the factory is constructed (factory construction cost + locomotive manufacturing cost)

2.4 Impact

2.4.1 Meeting the Demand for Rail Transport

Since the locomotives manufactured at the factory were put into service in the 1990s, passenger transport volume has increased slightly by nearly 3% annually, but freight transport volume dropped sharply (Figure 3). Reasons for the slump in freight transport volume include public investment that gave priority to the road sector, superannuated and outdated locomotives, freight cars, and rails, competition with highly convenient freight transport by motor vehicles, Pakistan Railway's overemphasis of passenger transport, and inefficient train service.

Figure 3: Changes in Pakistan Railways' Passenger and Freight Transport Volume (1966-2000)



Furthermore, the 59 locomotives manufactured at the factory constitute 70% of the total of 84 locomotives that Pakistan Railways has procured since 1993. Currently, they constitute just over 10% of the 539 electric diesel locomotives owned by the Pakistan Railways, and most of them are used for passenger transport. Also, the annual distance traveled by the 43 Japanese and US locomotives, excluding the recently introduced Chinese locomotives, constituted 22% (2003) of the annual distance traveled by all of the Pakistan Railways' diesel electric locomotives. The annual distance traveled by these 43 locomotives is estimated to be 6.6 billion passenger-kilometers[11] or a total of 20 million passengers transported.

2.4.2 Promotion of Related Domestic Industries

In the progressive plan for domestic locomotive production, promotion of related domestic industries through domestic manufacture of locomotive parts was anticipated. However, domestic industries have not been promoted due to the low percentage of domestic production.

[11]This is equivalent to about one-sixth of the passenger-kilometers of the Tokaido Shinkansen in the same year.

2.4.3 Contribution to Local Development

Following the government's policy to decentralize the locations of industries, a relatively undeveloped area was chosen for the factory location, with the anticipation of ripple effects on local development. Currently the factory employs approximately 600 persons (and approximately 300 employees' families live in the residential area next to the factory). In the Risalpur area, the northern part of Nowshera in Northwest Frontier Province, where the factory is located, an industrial park (with 45 companies and approximately 1,000 employees) and an export processing area (with 10 companies and approximately 80 employees) were developed after the project completion. This project has no direct relationship with the industrial park and the export processing area, though a certain degree of effectiveness in job creation is recognized from the standpoint of local development. No particular problem was reported in land acquisition (20 farm households) under this project.

2.4.4 Foreign Currency Saving

According to the Pakistan Railways, approximately 1 billion rupees (approximately 24 million US dollars) of foreign currency was saved by manufacturing the 59 locomotives from 1993 to 2003, compared to importing the same number of completed locomotives.

2.4.5 Environmental Impact

No particular negative environmental impacts were reported concerning the project's construction and operation of the factory at the time of the evaluation. As confirmed in the field inspection, there were no noise or vibration, and the wastewater treatment facility was reported to be operating properly.

2.5 Sustainability

2.5.1 Executing Agency

2.5.1.1 Technical Capacity

At the Risalpur locomotive factory, the basic technology for manufacturing locomotives was adequately established through the technology transfer under this project. Three-quarters of the staffs who participated in the technology transfer currently remain at the factory. Therefore, it is considered that the results of the technology transfer have been adequately maintained. In the future, the factory plans to work on the designing of locomotive parts with the aim

Employee working in factory

of raising the domestic production rate, which will also enhance the technical capabilities of the factory. Moreover, the factory is making preparations to acquire an ISO9000 in 2005, and its technology sustainability seems to be high.

It is considered that more efforts needs to be made to improve the management of operation data and the train service of the Pakistan Railways, which is one of the reasons for the low level of rail transport volume. Nevertheless, no technical issues that directly affect the project sustainability were observed.

2.5.1.2 Operation and Maintenance System

In the latter half of the 1990s, Pakistan Railways undertook a privatization policy (splitting up infrastructure, passenger and freight sectors) spearheaded by the World Bank, but this did not lead to an improvement in the efficiency of train service or in operating income and expenditures[12]. For this reason, in 1999 the Pakistan Railways took back the privatization policy, began to explore methods of reform for creating a public corporation, and allowed private enterprise to enter into the rail service partially, which were thought to be more achievable. The Pakistani Government's intentions for the reform are clearer than previously, but resistance from the Ministry of Railways and insiders at the national railway is strong, making the outcome unpredictable.

The Risalpur locomotive factory belongs to the manufacturing and service sector of the Pakistan Railways. Currently, this factory and the passenger car factory in Islamabad together have been considering to form a subsidiary financed by the Pakistan Railways within 2005.

2.5.1.3 Financial Status

The income and expenditures of the Pakistan Railways are structured so that overspending in passenger transport is supplemented by income from freight transport[13]. In 2000's, there were excess spending of approximately 8 billion rupees annually (Table 1). Excessive spending increased considerably from 3.1 billion rupees in FY1993, and all of it is supplemented with government subsidies. However, in recent years, the income has been increased due to the raise in fares, reinforcement of fast trains[14], and

[12] Because the passenger sector was assigned the better-performing locomotives to maintain the timetable, the freight sector fell into a greater trouble. Adjustments between the two sectors became difficult, and confusion occurred in the management and train service.

[13] Fare income per kilometer traveled in 1996 was 155.2 rupees for passenger transport and 469.6 rupees for freight transport. The reasons why the income from passenger transport is low include the fact that Pakistan Railways has kept the passenger fare low so that it is competitive with bus fare, and that unprofitable train lines have not been closed.

[14] The fast trains which were reinforced during 2002 to 2004 are: 1) Lahore – Karachi, 2) Lahore – Faisalabad, 3) Rawalpindi – Quetta, 4) Sialkot – Rawalpindi, 5) Lahore – Rawalpindi, 6) Faisalabad – Karachi, 7) Multan – Faisalbad.

introduction of coaches with new design.[15]

Due to the financial difficulty of Pakistan Railways, the factory's locomotive manufacturing budget is all funded by ODA (Yen loans and Chinese suppliers' credit).

Table 2: Income and Expenditures of the Pakistan Railway (unit: million rupees)

Item	2000	2001	2002	2003	2004
Income	11,953	13,340	14,607	14,568	18,022
Passengers	5,602	6,395	7,163	7,939	9,285
Freight	4,576	4,751	4,802	4,343	5,285
Postal and Packages	439	576	540	744	910
Other	1,336	1,618	2,102	1,542	2,542
Expenditures	20,254	21,247	22,467	20,579	20,574
General Administrative Costs	1,700	1,693	1,904	2,304	2,207
Maintenance and Repair Costs for Rails, Buildings, Train Cars, etc.	4,225	4,746	5,298	5,357	4,962
Operating Expenses (fuel cost, personnel expenses, etc.)	5,074	4,983	5,644	5,967	6,331
Pension Fund and Health and Welfare Costs	2,858	3,052	3,015	3,094	3,095
Interest Payments	2,513	2,399	3,394	2,096	2,117
Repayment (bank overdrafts, foreign loans)	3,190	4,334	3,071	1,410	1,274
Amortization Fund, etc.	694	40	141	351	588
Difference	- 8,301	- 7,907	- 7,860	- 6,011	- 2,552

Source: Ministry of Railways
Note: 2004 figures are provisional.

2.5.2 Operation and Maintenance Status

There are no particular problems in the operation and maintenance of the Risalpur locomotive factory. However, concerning the maintenance and repair of the diesel electric locomotives, due to the large number of models and the financial limitations, it is not easy to procure the spare parts necessary for overhaul and repair, and it is not infrequent that used parts are used repeatedly.

A Japanese locomotive being overhauled

3. Feedback

3.1 Lessons Learned

If the financial capacity of the executing agency or the receiving country are important external factors for realization of a project, the project implementation, approaches, scopes, and phases should be decided after the careful study of the financial plan. This project constructed a locomotive factory with an annual production capacity of 25

[15] The total income in FY2004 was 18 billion rupees, which is 27% increase of that in FY2003. Above all, the income from the passenger transportation was 9.3 billion rupees, the highest in the history of Pakistan Railways.

locomotives based on an assessment of Pakistan Railways' needs. However, the factory's production capacity was not sufficiently utilized due to financial limitations, and 59 locomotives were manufactured so far with the locomotive parts procured by the assistance funds from overseas.

3.2 Recommendations

The Pakistan Railways needs to conduct a market study focused on the recovery of market share in long-distance, large-volume freight transport and to install strategic infrastructure[16], while it steadily promotes administrative reforms such as the formation of a state-owned enterprise and allowance of partial entry of private companies into train service. Furthermore, to utilize production capacity of the Risalpur locomotive factory better, more efficient methods of operation should be studied, including establishment of the factory as an independent company[17].

[16] Pakistan Railways is currently considering the follwing measures to improve the freight traffic.
(1) Container and cargo special trains are being run as per timetable in 40-45 hours between Karachi and Lahore.
(2) Agreements with freight forwarders are in process to attract additional traffic on regular basis.
(3) Additional 15 locomotives are being inducted in freight pool.
(4) Doubling the track from Lodhran to Khanewal (121km) will improve the turn round of coaches, wagons and locomotives.
(5) Procurement of 1600 high capacity wagons of new generation will improve the turn aoround from 21 days to 5 days.
In addition, it appears necessary to install infrastructure for signal lights and communications and to install an MIS to enable collection of data for each sector and each train line for management decisions.

[17] JICA's Feasibility Report states that the factory may become financially independent if the project is implemented appropriately. If the factory becomes financially independent, it seems that it would be able to maintain sounder operation because it would not be affected by the financial condition of Pakistan Railways.

Comparison of Original and Actual Scope

Item	Planned	Actual Performance
1. Output	-Locomotive factory (annual output of 25 locomotives) -Manufacture of locomotives (5 locomotives, 2000–horse-power) -Technology transfer for manufacture of locomotives	Same as left
2. Project Period	February 1984-June 1988 (53 months)	February 1984- August 1994 (127 months)
3. Project Cost		
Foreign Currency	9,760million yen	9,670 million yen
Local Currency	11,590million yen (610million rupees)	6,500 million yen (970 million rupees)
Total	21,350million yen	16,170 million yen
ODA Loan Portion	9,760million yen	9,670 million yen
Exchange Rate	1 rupee＝ 19 yen (as of 1983)	1 rupee＝ 6.7 yen (average of 1984 to 1996)