4.2.9 Make Reasonable Scale of Investment

ENR has suffered from a huge capital cost burden. Decision making for railway investment is very important for management improvement. This is especially true because fund raising at ENR will be changed after 1998/99. Investment decision making will become much more important than it has been.

(1) Utilize existing assets more efficiently

Each department of ENR tends to request more facilities, equipment and so on, even if it has enough existing assets. Therefore, the first thing ENR should do is to examine whether existing assets are utilized efficiently or not.
As pointed out before, ENR's asset turnover ratio, which is one measure of productivity of assets, is low compared with developed countries. On the balance sheet of ENR, rolling stock consists of 51% of fixed assets. This ratio is relatively high compared with JR East (4.5%). Therefore, the management of the rolling stock in ENR is much more important than in JR east. For example, as explained in 4.2.8, there is room to increase the utilization rate of rolling stock. Improvement of the utilization rate of existing assets would reduce required investments and increase the asset turnover ratio. As a result, ENR can improve profitability without significant investment.

(2) Investment decisions based on objective standards

ENR selects appropriate investment projects among many investments requested by each department. Before making an investment decision, financial evaluation of each investment project is necessary due to the limitation of funds. Railway is a capital intensive business and construction projects require a long time. Investment decisions impact ENR business results over many years. This can be seen in the long asset life, and long term capital costs such as payment of interest and repayment of principal and depreciation. Therefore, investment decisions should be done carefully based on objective economic standards. Financial ratios such as the asset turnover ratio should be checked closely every year. Whether investments succeed or not can be evaluated by checking financial ratios like the asset turnover ratio.

1) Standard for investment decisions
(a) Financial Internal Rate of Return, and Net Present Value
What is the appropriate measure as an objective standard when investment decisions are made? Financial Internal Rate of Return (FIRR) and Net Present Value are two of the most appropriate financial valuation tools for each investment project. FIRR is calculated as follows. FIRR is defined as the discount rate which can make the fianancial cost and benefit equal. Therefore, profitability of each project is measured by comparing the FIRR of each project. At the same time, the level of interest rate for funding investments should be taken into consideration. FIRR should be bigger than the interest rate for funding an investment. FIRR should be one of the standards for making decisions regarding investment.

Calculation of FIRR :
① Forecast investment.
② Forecast financial statements.
③ Calculate profit before interest and tax based on the financial forecast, and calculate cash flow based on this profit forecast.

④ Calculate the discount rate which makes is the amount of investment equal to the present value of cash flows forecast. It is easy to calculate the discount rate using a personal computer.
⑤ FIRR is the discount rate calculated above.

A disadvantage of FIRR is that one can ignore the importance of Net Present Value. Therefore, analysis of Net Present Value should be used together with FIRR analysis.

Calculation of Net Present Value :
① Forecast investment.
② Forecast financial statements.
③ Calculate profit before interest and tax, based on the financial forecast, and calculate cash flow based on this profit forecast.
④ Calculate the difference between amount of investment and present value of cash flow in the forecast period.
⑤ The difference calculated above (present value of cash flow - amount of investment) is recognized as Net Present Value.

The project which has a bigger net present value is selected as the best investment, after comparing the net present value of each project.

As mentioned above, a combination of FIRR and Net Present Value is one of the most appropriate objective standards for selecting investment projects.

(b) Asset Turnover Ratio
Asset Turnover Ratio is useful to measure the efficiency of investment. Therefore, Asset turnover ratio is effective as a complementary tool.

Calculation of Asset Turn Over Ratio :
① Forecast amount of investment
② Forecast annual revenue in target year
③ {annual revenue in target year ÷ (investment amount - accumulated depreciation)}

In general, both increased revenue and cost reduction are expected as effects of investment. If cost reduction does not result in a higher asset turnover ratio, the investment should be reconsidered. Asset turnover ratio measures one aspect of the effect of investment.
Equity or debt can be used to finance an investment. The asset turnover ratio can be useful to analyze the pace at which investments are repaid. As is clear from the calculation method, revenue is the numerator. If costs such as personnel are subtracted from the revenue numberator, then the resulting asset turnover ratio should be larger than the interest rate, or the investment doesn't cover financial costs. The asset turn over ratio should definitely be much higher than fund raising costs, because there are various costs besides interest, such as personnel cost.

Therefore, in case of ENR which asset turn over ratio is very low, asset turn over ratio can be useful as the minimum hurdle ENR must clear. However, asset turn over ratio should be used to measure for the efficiency of whole entity and the efficiency of accumulated investment, rather than the evaluation of each investment project.

(3) Establish the investment discipline like cash flow base

In making investment decisions, fund raising should be taken into consideration, especially as government support to ENR will be terminated after 1998/99. ENR should not forget that it suffered from a huge interest burden in the late 1980's due to huge investments. Investments which exceed cash flow result in depending on debt for fund raising. In other words, negative free cash flow means ENR will accumulate debt every year. Debt has two obligations: payment of interest and repayment of principal. ENR should establish more discipline in investment decisions. For example, the scale of investment should be kept within cash flow until establishing a sound and sustainable financial structure. In other words, if ENR keeps the discipline that free cash flow is positive when ENR decides to invest, ENR can avoid the risk of debt accumulated to finance railway investment. In this Study's "Without Case", debts are forecast to accumulate to LE 3,235 million in 2001/02, because the size of annual investments exceed cash flow from 1995/96 through 2001/02. If ENR continues this investment behavior, ENR will face a vicious circle in which ENR must borrow money to repay debt. After JR East was privatized in 1987, it established the financial discipline of keeping investments within the size of depreciation. By maintaining this discipline, JR East succeeded in reducing its huge debts in a short time.

(4) Clarify the responsibility between ENR and government

Railway investments such as new line construction may be necessary for national interest goals. In such cases, these investments can make ENR's financial situation vulnerable due to huge investments in projects which may not be financially viable. Fund raising and costs related to these investments should be borne by government. There are 2 possible goals of a railway investment: national interest or improving ENR's business. In accordance with these 2 goals, responsibility and authority between ENR and the government should be separated clearly. Separating infrastructure and operation should be considered as one of the measures to clarify the relationship between ENR and government.

4.2.10 Close Lines Which are Lightly Used

This section will discuss the possibility of closing unprofitable lines. Analysis will cover profitability, social impact, and alternative transport available.

(1) Background

ENR's financial drain on Egypt's government budget has been steadily increasing since 1979. The challenge is to find the most effective method of eliminating losses while minimizing negative social impacts.

One of the most effective ways to reduce costs while minimizing social impacts is closing selected lines. Some lines in rural areas were constructed before road transport was available, but now most of the local population rides share taxis. This left many trains largely empty, except for government employees or student riders who have free or heavily subsidized tickets. As can be seen below, branch lines do not contribute much to total ENR revenues, so closing some of the these lines may not so much improve ENR's fiscal position. However, maintenance of lines which are extremely lightly used harms the national economy and is a waste of railway assets and personnel.

TABLE 4.2.10-1 Revenues by line type (millions of LE)

Year	Line Type		
	Main	Branch	Urban
1981/82	21,195	3,903	4,456
1982/83	25,267	4,583	5,584
1983/84	28,556	4,753	6,181
1984/85	31,648	4,900	7,241
1985/86	35,862	5,154	7,932
1986/87	48,084	5,906	9,544
1987/88	59,811	6,958	6,680
1988/89	78,059	8,932	3,814
1989/90	99,059	10,592	4,188
1990/91	102,990	12,139	6,106
1991/92	124,970	16,100	8,564
1992/93	137,262	19,251	10,849
1993/94	158,280	26,086	10,906
1994/95	173,462	29,848	13,207

(Sources: Study Team; ENR Plan For Achieving a Balance Between Revenues and Expenditures, Ministry of Transport, 1993, Mustafa El Guindi)

(2) Concept for line closure

In Chapter 3.9.6, the cost recovery ratio of each line was estimated. The revenues of many lines do not cover costs, especially several lines with extremely low cost recovery ratios. Some lines have already lost their role as a useful means of transport. Such these lines should be closed. Basic principles for line closure are as follows:

a. Extremely few passengers.
b. Alternative transport is feasible and more economical.
c. Transport volume is not forecast to increase much.
d. The line is not an important freight or passenger by-pass route.
e. There is no extension or improvement plan for the line.

(3) Analysis & recommendations

In cooperation with ENR, the Study Team took the following actions to consider which lines are appropriate to close:

(1) Survey of 12 lines.
Completed a survey of 12 lines which are candidates for closing. Over 1,000 passengers were asked questions to evaluate the social impact of closing each line. Alternative transport available was also evaluated.

(2) Financial analysis

To decide which lines are losing the most money, the Study Team analyzed each line to calculate costs are revenues, as shown in Table 4.2.10-2.

To make best use of Egypt's resources, this Study estimates the cost difference between railway and bus transport. This is estimated with some assumptions of how many passengers are required for railway to be more efficient than bus transport. By this estimate, railway and bus transport are equally efficient if an average 6,000 passengers ride daily (including both directions) as shown in Fig. 4.2.10.1. If the average passenger volume on the line is less than 6,000 passengers, bus transport is more efficient. If there are less than 3,000 passengers daily, then we can clearly state that bus will be much more efficient. By this standard, 8 lines should be converted to bus transport. However, 3 lines among these can not be closed for special reasons. Therefore this Study recommends that 5 lines be closed (Table 4.2.10.3).
(Note that the Mowaslet El Roda line should also be closed, but detailed data was not available for cost recovery calculation)

Table 4.2.10-2 Passenger Volumes & Cost Recovery Ratios (1994/95)

No.	Section/Line	Km (A)	Pass - km (daily, 1000) (B)	Pass. Number (B ÷ A)	Cost Recovery Ratio	Notes
1	Cairo - Alexandria	209	28,074	134,327	1.11	
2	Cairo - El Sad El Ali	898	41,252	45,937	0.72	
3	Benha - Ismailia - Port Said	191	7,755	40,602	0.86	
4	Tanta - Mansoura	54	4,770	88,324	0.97	
	MAIN LINES TOTAL	1,352	81,851			
7	Nefsha - Suez	88	764	8,681	0.58	
8	El Mansoura - Domietta	63	1,314	20,859	0.67	
9	Zagazig - Tanta	57	1,034	18,144	0.53	
10	Imbaba - Itay El Baroud	120	302	2,517	0.22	Cannot close
11	Alex. - Sidi Gaber - Abu Quir	22	2,786	126,636	0.48	
12	Cairo - Qalyub - Tanta	107	2,998	28,020	0.87	
13	Ein Shams - Suez	129	982	7,615	0.65	
14	El Wasta - Abu Kesah	61	911	14,931	0.62	
15	El Marg - Shebin Kanater	21	161	7,690	0.18	
16	El Mamoura - Rashid	66	175	2,650	0.13	Cannot close
17	Mansoura - Mataria	71	600	8,444	0.29	
18	Cairo - Qalyub - Zagazig	77	1,282	16,648	0.48	
19	Zagazig - Mansoura	69	1,352	19,591	0.50	
20	Abu Kebir - El Salheia	34	289	8,491	0.22	
21	Benha - Zefta	34	458	13,462	0.34	
22	Faqus - El Sammana	10	18	1,800	0.05	Close
23	Menuf - Kafr El Zaiyat	49	304	6,199	0.16	
24	El Santa - Mahalet Rouh	19	222	11,671	0.31	
25	Mahalet Rouh - Damanhur	74	1,155	15,610	0.44	
26	Benha - Menuf	25	411	16,434	0.38	
27	Abis - Qabbary - Marsa Matruh	304	1,535	5,051	0.54	
28	Sherbeen - Qelein	82	1,573	19,184	0.86	
29	Bouseli - El Qassabi	29	161	5,540	0.25	
30	El Fayum - Sinnuris	12	20	1,667	0.05	Close
31	Desuq - Mottoes	27	68	2,519	0.10	Cannot close
32	El Abased - Tebeen	20	-	-	0.48	
33	El Geish - El Magharat	24	-	-	-	
34	Samala - El Saloum	260	7	27	0.13	Cannot close
35	Tebeen - Managim	346	-	-	1.00	
36	El Ithad - Qabbary	108	-	-	0.51	
37	Beni Suef - El Lahun	25	33	1,320	0.10	Close
38	Shaweish - M. Abu Sammad	12	10	833	0.06	Close
39	El Gabal El Asfar	7	-	-	-	
40	Kafr Saad - Kafr Silman	3	1	333	0.03	Close
41	Kafr Bateikh - Domietta Port	15	-	-	0.53	
42	Qena - Safaga	233	-	-	0.16	
	BRANCH/SUBURBAN TOTAL	2,703	20,925		0.58	
	TOTAL	4,055	102,776		0.76	

The recommendations resulting from (1) Survey of 12 lines, and (2) Financial analysis are :

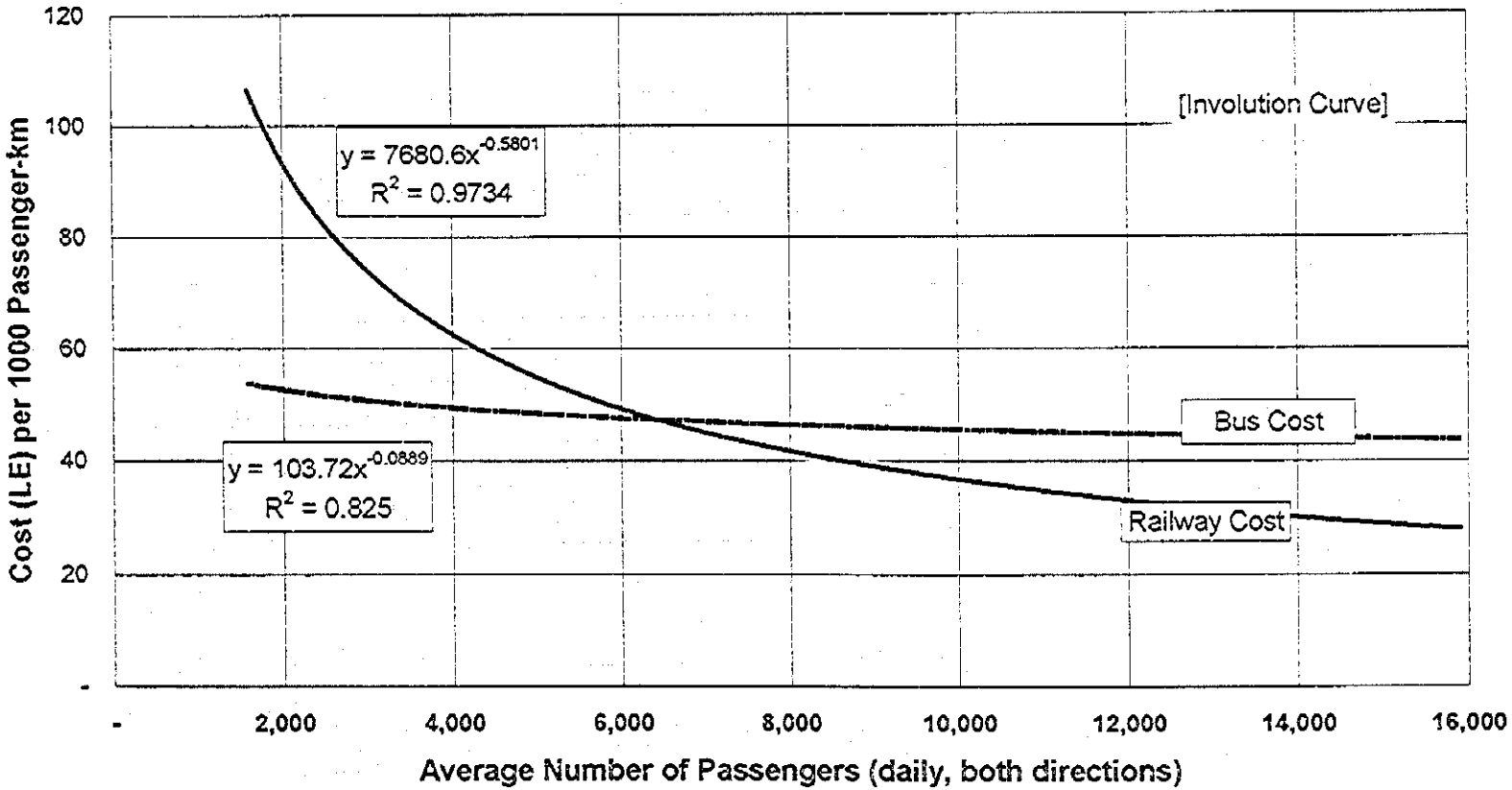
Table 4.2.10-3 Line Closure Recommendations

No.	Railway Segment	Revenues ÷ Costs (ENR avg: 76%)	Loss Estimate (1994/95) (1000 LE)	Close or Don't close	Savings from closing line (1000 LE)	Savings from Closing Line and Providing Bus Service (1000 LE)
14	El Fayum - Abu Kesah	62%	1,477	Don't close		
20	Abu Kebir - Faqus - El Salhia	22%	2,023	Don't close		
21	Benha - Zefta	34%	1,737	Don't close		
22	Faqus - El Semaina	5%	668	Close	668	302,471
24	El Santa - Mahalet Rouh	31%	987	Don't close	0	
29	Bouselli - El Qassabi	25%	1,268	Don't close	0	
30	El Fayum - Sinnuris	5%	714	Close	714	366,426
31	Desouk - Mottoes	10%	1,258	Don't close	0	
37	Beni Suef - Shaweish - El Lahun	10%	785	Close	785	772,380
38	Shaweish - Menshat Abu El Sammad	6%	313	Close	313	358,531
40	Kafr Saad - Kafr Suleiman	3%	69	Close	69	73,879
	Mowaslet El Roda - El Roda	1%	46	Close	46	42,191
		TOTAL :	11,299		2,595	1,915,879

Source: JICA Study Team

Note: Detailed data was unavailable for Mowaslet El Roda line.

Fig. 4.2.10.1 Cost of Passenger Volume (Railway vs. Bus)

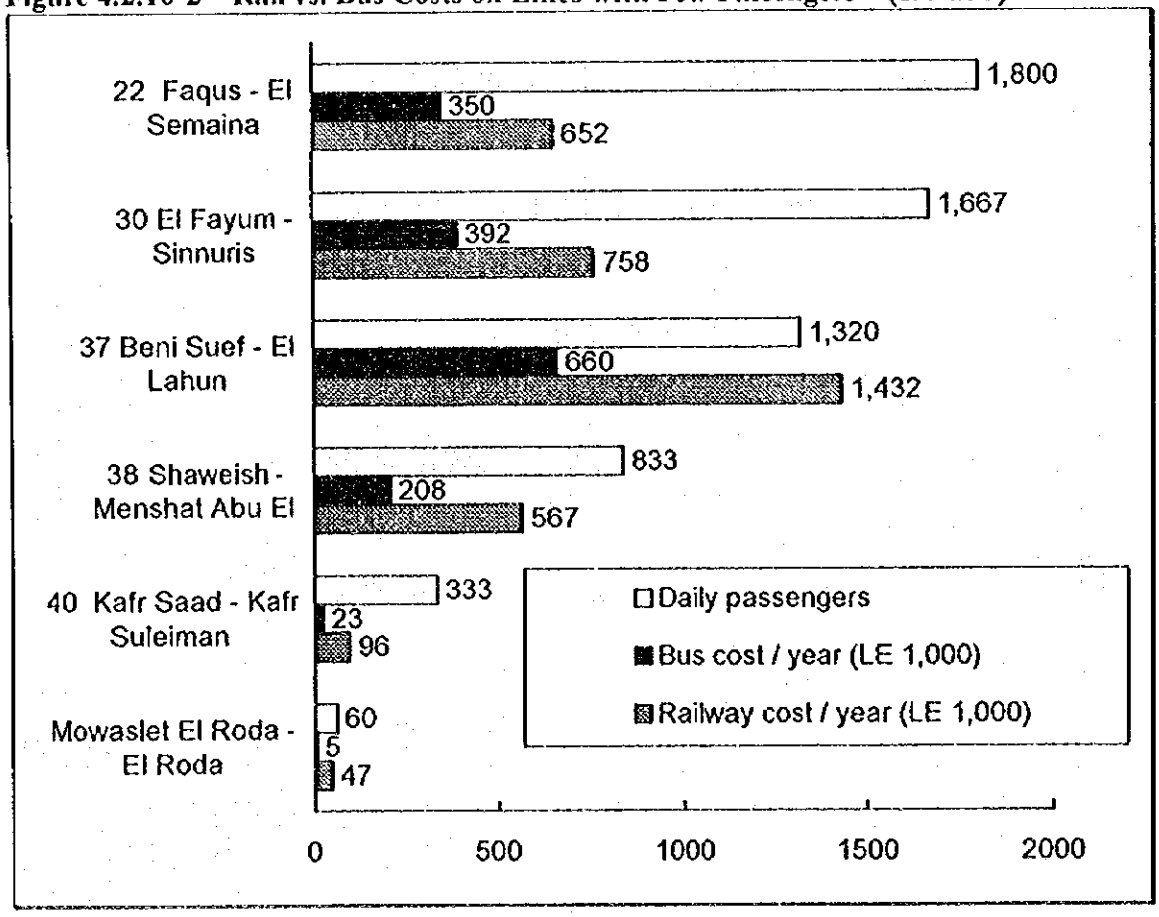


The equations in Figure 4.2.10-1 above are used to compare yearly costs of rail and bus service.

RAIL COST PER YEAR	365 days x (daily passenger-km ÷ 1000) x (7680.6) x (daily passengers)$^{-0.5801}$
BUS COST PER YEAR	365 days x (daily passengers-km ÷ 1000) x (103.72) x (daily passengers)$^{0.0889}$

Figure 4.2.10-2 below shows the result of this equation for several lines which are lightly used. It shows that bus service is more appropriate for these lines.

Figure 4.2.10-2 Rail vs. Bus Costs on Lines with Few Passengers (1994/95)



Note: These costs are calculated by the formula comparing rail to bus. Other parts of the report made more detailed calculations to calculate the 1994/95 costs of these lines.

Source: JICA Study Team

(3) Results of survey of 12 lines

Based on the Study Team's analysis and advice from ENR and TPA officials, the Study Team selected 12 segments which are prime candidates for closing. These 12 segments are all branch lines, and were considered to be possible candidates for closing. Some of these lines are very lightly used and very unprofitable. Alternative transport was also evaluated.

A surveyor for the Study Team visited each of these 12 lines. A questionnaire survey described below was performed at the 7 lines which were suggested by ENR. The questionnaire survey is described in section 9.2.1.

A detailed description of each of the 12 lines surveyed and recommendations is in Appendix 4.2.10.

4.2.11 Make the Organization More Business Oriented

The Approach Taken to the Study

The views in this Section of the report have been developed following interviews with leading figures in the TPA and all the current Vice Chairmen of ENR (excluding the Vice Chairman Construction) together with other key Managers in the Railway.

The interviewees were asked for their views on a series of proposals issues that had been formulated following a set of earlier interviews with a group of senior managers. They were also asked for any comments they wished to make on any other aspect of the operation of the current organization that was not covered by the particular agenda which they had been given.

The issues that were listed by the Consultant for the attention of the interviewees were as under :

The future role of the Chairman and Vice Chairmen
The future role of the Commercial Department
The case for an independent Safety Organization
The case for re-looking at Training
The working relationships of the Zonal and Headquarters organizations
The establishment of a Management Change Organization
The establishment of a Productivity Organization

Understandably, the views obtained from approximately 20 interviewees did not amount to an absolute consensus and occasionally there were diametrically opposed views expressed. These contributions have, however, been invaluable in formulating these proposals which represent a beginning to the organizational reform of ENR.

Where conflicting views on an issue have been expressed, these have been reflected in the explanation of the particular proposal and broad reasons for the recommendation made are also included.

<u>The Issue under consideration</u>

The future role of the Chairman and Vice Chairmen

This item arises out of lengthy discussions on the respective roles of the Chairman and Vice Chairmen and the appropriate top level organization that will be required to enable ENR to make a successful transition into a Commercial organization. It was, unfortunately, not possible to interview the Chairman himself as during the period of this particular examination he was away from work on sick leave.

The proposition under consideration was that whatever were the final proposals to be adopted it was clear that major and radical changes were going to take place within ENR over the coming years.

These changes require a strong strategic focus and must be lead from the top. This lead could best be provided by the Chairman.

There was unanimity from all concerned that the Chairman should concentrate on the strategic issues but general concern was expressed that he was often distracted from this role by the day to day matters of running the railway.

The over-riding feeling expressed was that the Vice Chairmen should be given more freedom to make decisions within their own disciplines and that they should not be so reliant on referring matters to the Chairman for decisions, thus, in turn, leaving him free to concentrate on strategic issues.

If this approach could be successfully fostered it might not be necessary to propose the creation of this new post. However, the Chairman's involvement in daily issues appears to stem from a need to know what was currently happening in order to deal with regular queries from the Ministry.

This is, perhaps, a significant cultural issue within the organization which also arises later in these proposals and whilst there are proven methods of improving the situation these would take time to reach full effect.

The pressing need for the Chairman to take a strong strategic lead at an early stage dictates that there would be real value in providing an alternative focus for day to day issues, hence the proposal for the creation of a Chief Executive.

During these discussions a case was also made for a rationalization of the current Vice Chairmen positions. It was felt that the existing 6 posts (Excluding the Metro) could be reduced to 3 by merging the responsibilities as under :

Vice Chairman	Vice Chairman	Vice Chairman
Commercial	Signalling	Rolling Stock
Operations and Zones	Permanent Way	
Finance	Construction	
Administrative Affairs		

Whilst such an organization could work it is considered that it does not take sufficient account of the need to restructure to provide greater emphasis on the commercial and marketing aspects to make it appropriate for the current situation.

The Proposal

To create a new position of Chief Executive who would be charted to the Chairman of ENR and have direct organizational responsibility for the day to day running of ENR.

The post would be responsible for all the day to day activities of the current Vice Chairmen but would not include any longer-term areas such as planning, investment, change management, productivity etc. for details of which see the subsequent proposals in this section.

The principal activities of the new position could be summarized as follows :

- Responsible for the day to day running and performance of ENR
- Agreement of Annual Budgets
- Monitoring of Annual Budgets
- Performance targets and monitoring

The Issue under consideration

The future role of the Commercial Department

This is a key aspect of the organizational development of ENR. In an increasingly competitive commercial environment and with the objective to achieve full cost recovery over the next two to three years it is inevitable that the emphasis will switch more and more to the needs of the market.

ENR's success in achieving its commercial and financial goals will to a large extent depend on the ability of the commercial organization to generate increases in business volume and revenue.

The current organization does not reflect an enterprise that is gearing up for the demands of a commercial market-based world.

Commercial thinking must predominate and be seen to be leading ENR's decision making.

There was a broad acceptance that the Commercial Department would, in the future, need to take a more pro-active role in generating business. However views were also expressed that this did not warrant organizational changes.

After consideration of all the views expressed and paying particular attention to the forecasts of traffic potential it is considered necessary to separate the Commercial Department from its present position as an adjunct to the Operations Function and establish its organizational independence.

At the same time it would also be necessary to create a highly professional sales and marketing organization that will be able to exploit the opportunities that exist for new business and successfully compete with the private companies.

The Proposal

To create a separate organization for Marketing and Sales under a position of Vice Chairman.

This should involve an examination of the current activities carried out within the existing Research and Marketing organization and the revamping of these to separate out the administrative processes from the more pro-active Marketing and Sales input.

Emphasis should also be put upon the process of producing and updating the business specifications for the train services.

Consideration should also be given to recruiting senior Marketing and Sales staff from outside the Railway and embarking upon a program of professional marketing training for selected staff from within the industry.

The issue under consideration

The case for an independent safety organization

During the time of the investigations Managers expressed considerable concern and sensitivity over the whole issue of operational Safety.

The question of safety checks and audits, independent from the main Production Departments, was generally supported and it was felt that the basis of such an organization already existed under Saeed Ahmed Abu el Fatah the General Manager (Inspectors).

From an interview conducted with this gentleman it appears that the organization which he heads is not exclusively concerned with safety but operates as a Performance Inspectorate carrying out spot checks within all the Production Departments and Administration. There is a role in examining safety regulations and this will occasionally result in new regulations being formulated. However the principal method of producing unified Safety Regulations is through a coordinating group comprising senior members of all the Production Departments.

There was enthusiastic support for an extension and strengthening of the role of this independent safety group and it was generally considered that the safety of the railway was of such prime importance that more resources should be allocated to this task.

The Proposal

There should be an independent review of the Safety arrangements and organization within ENR to establish whether there was a case for creating a dedicated Safety organization reporting directly to the Chairman or Chief Executive if it is decided to create such a position.

This review should take full account of the Safety Management practices that are being carried out on other Railway systems and in other industries such as Chemicals, Oil and Shipping.

The benefits to ENR of carrying out such a study are to be found in two main areas :

The discipline of studying how the railway is organized to handle safety and failure of defense mechanisms.

The prevention of loss to the Railway both in terms of physical and human assets and loss of confidence by the public.

Areas which should be covered include :

- Assessment of risks and the method of controlling them.
- Methods of prioritizing spending on loss prevention measures

- Accident investigation and how root causes are identified and corrected
- The safety culture and how all levels of staff are involved in working safely
- Establishment of standards of competence of people and performance of equipment
- How accidents and warnings of accidents are recorded, analyzed and processed
- How Safety Improvement targets are set and measured

The objective is to identify the risk of loss to the railway and to demonstrate that measures exist to control these risks.

The issue under consideration

The case for re-looking at Training

The issue of training was raised several times during the interviewing sessions. The Training organization currently operates on a largely traditional base of specific skill training.

The Training budget of LE 1.3 million represents only approximately 0.2% of the total business turnover as opposed to the application of conventional wisdom that a reasonable annual investment in training, in normal times, should be in the order of 2% to 3%.

There are two issues that need to be taken into account in determining what action, if any, needs to be taken in respect of the Training organization.

First - Management Training.

There was a general acknowledgment from several interviewees that a number of the problems currently being encountered within the organization were arising as a result of inadequate or non-existent management training.

From investigations made it did appear that after the initial period of post-recruitment training the amount of actual management training, as opposed to skills training, provided by ENR was minimal.

When questioned about the difficulties of operating in the current organization the key problem areas that emerged were the lack of assertiveness in dealing with superiors, an inability to fully delegate responsibilities to the lower levels of the organization and an inadequate understanding of the principles of empowerment.

Secondly, the move towards a more business led organization and the organizational changes that this will inevitably bring in its wake will make the need for training and retraining even more important.

The training focus will need to expand to include courses on Change Management, Market Strategies etc.

Training will almost certainly be seen as a high-profile support mechanism to the whole process of change.

The Proposal

There should be a complete re-evaluation of the ENR training programs, to anticipate and support the changes in organization and business culture that was to take place.

They should be restructured to embrace the following new elements :

Core Management Skills
Managing a Team
Interpersonal Communications
Managing assertively
Negotiating Skills
Time and Priority management
Empowering and developing staff
Managing and implementing change
Business management
Marketing strategies and tactical plans
Safety Management

With initial set-up support from an outside agency these courses could be run at the Wardan Training Centre and when fully established be considered 'for sale' to other organizations.

The Issue under consideration

The working relationships of the Zonal and Headquarters organizations

This issue was discussed with the six Vice Chairmen of ENR and 3 current or former Zone Managers. Views were also expressed from the representatives of the TPA.

The initial contention that was the basis for the discussions was that Zones had insufficient decision-making authorities to operate as effective Line Managers. This tended to result in decisions being largely made at Headquarters level.

What emerged from discussions with the interviewees was that the Zonal Managers did have adequate authorities on all operational issues.

They were considered to be 'mini - Chairmen' within their own Zone and, in principle, encouraged to act as such by the Vice Chairmen.

Their local business and financial roles were, however, less well defined.

So, organizationally, the structure looks to be satisfactory for the present circumstances.

The significant difference in the responses received was in relation to how the organization actually functioned in practice.

There was an almost unanimous view from Headquarters respondents that the organization worked well in practice. This tended to contrast with the views of the Zonal managers who felt that they were not always left to make their own Zonal decisions and were subject to undue influence from Headquarters from time to time.

This tends to be a cultural problem and is to some extent an extension of the Ministry / Headquarters relationship referred to in the first section of these proposals.

The Proposal

There is no short-term solution to this problem but there are a number of ways in which the situation can be improved.

Systematic Management Training in the areas of Assertiveness, Delegation and Empowerment could begin to help all parties to become more comfortable with operating within the agreed organizational framework.

For this to be truly effective, however, it was strongly pointed out by one of the interviewees that such training would, ideally, need to embrace the whole managerial chain starting at the Ministry.

The other long-term solution was to re-examine the way in which Zone Managers were appointed to their positions.

There should be a more flexible approach to filling these posts with due cognizance being taken of the key ingredients of attitude, experience, training and performance.

The opportunity should also be created to be able to consider managers with proven track records from outside the Railway.

The Issues under Consideration

The establishment of a Management of Change organization

The Management of Change issue, to some extent is a corollary of the proposal to create a position of Chief Executive to free the Chairman to concentrate on the strategic planning and longer-term change role.

If the major changes referred to in this and other sections of the report are to be successfully implemented there will be a major logistical task of planning, developing, communicating and coordinating the changes.

Whilst the Chairman would be the logical person to provide the managerial impetus for these changes, experience gleaned from organizations who have undergone this process points to the need for a small group of specialists who are responsible for coordinating the whole process .

They would ensure that the Functional Managers, who must lead the process from the top, cover all the aspects of the change and they would provide the essential liaison between Departments when Functional proposals overlap.

They would provide a change management support service to the Chairman who would be leading the process.

The establishment of a Productivity organization

This proposal relates directly to the recommendations in section 4.2.7 on Staff Reductions.

A unanimous view has been expressed that it would be possible to systematically reduce staff numbers providing that there was professional acceptable evidence of current overstaffing.

Whilst the statistical comparisons provide a strong guideline to probable overstaffing the only reliable way to positively establish optimum staffing levels is to undertake work measurement at selected sites.

This is the reason for considering the establishment of a Productivity Section.

The Proposal

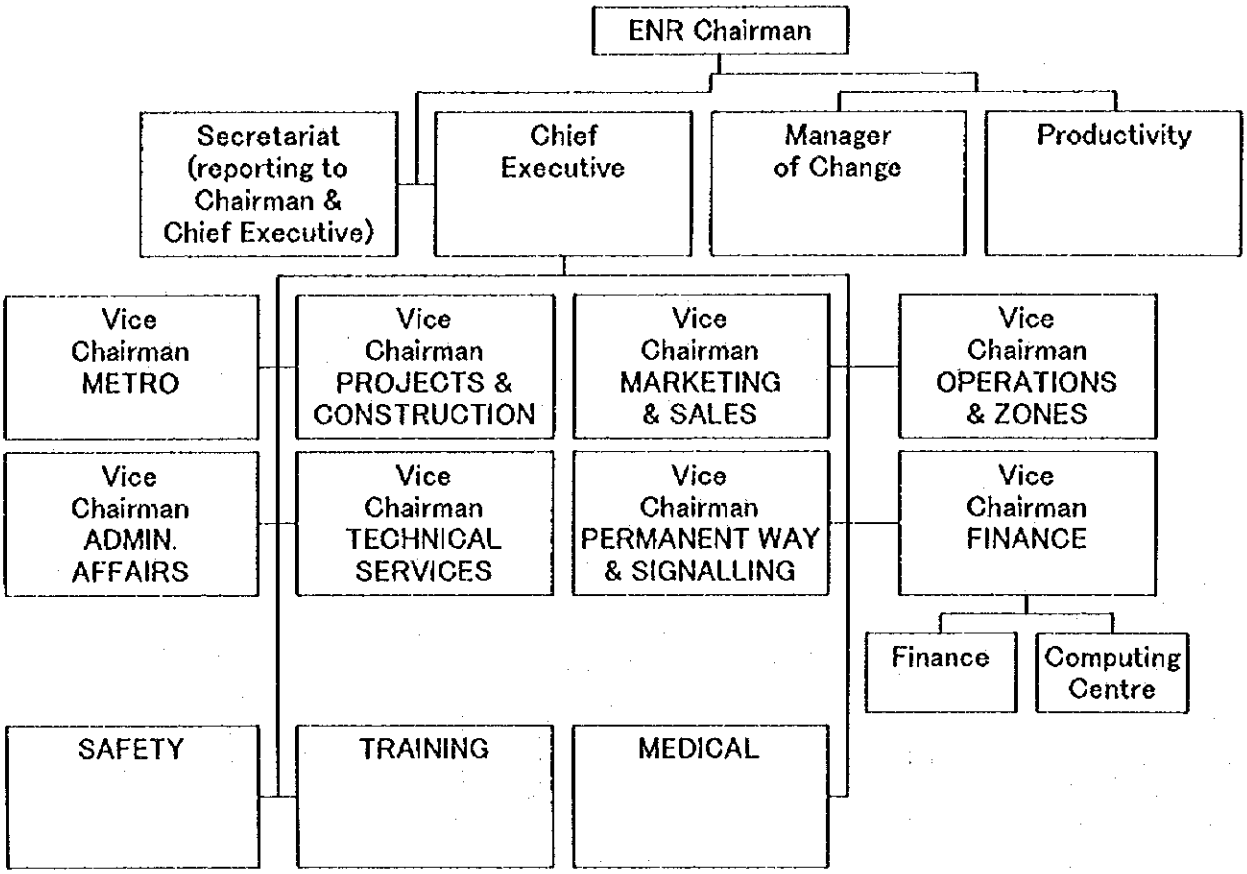
It is proposed that a Change Management Group , which would include Productivity, should be established.

It would report direct to the Chairman and be responsible for :

- The development of an organizational and change strategy for ENR
- The development of detailed implementation plans
- The production of detailed productivity exercises to establish correct staffing levels.

If this proposal is accepted, the impact upon the ENR organization would be as indicated in the following chart :

Figure 4.2.11 Position of proposed Manager of Change



4.2.12 Correct the Data Collection System

(1) Necessity of appropriate data/information

In order to smoothly carry out railway operation and management, it is a basic requirement to evaluate the transport situation and accurately exchange information. Important data and information for train operation and management are :

a. Data/information for railway business
- Transport volume of passengers : by type of service and by location (stations, agents etc.)
- Transport volume of freight
- Revenues of passenger and freight
- Passenger kilometers, freight ton kilometers, etc.

b. Data/information for traffic
- Passenger reservations
- Freight transport information
- Situation on trains : number of passengers on trains, congestion on trains

c. Data/information for train operation
- Number of operating trains by section
- Car formation by train
- Train kilometers of each train : passengers, freight, other
- Locomotive kilometers, passenger coach km, wagon km, etc.

There are also data for management of personnel, finances, stores & purchases, infrastructure, etc. It is not too much to say that the railway management is based on this data. This data will become more important each year.
Among this data, data of passenger and freight transport volume and passenger-km and ton-km estimated by sales results is closely related to railway revenues. By analysis of transport trends based on this data, future strategies to develop the railway business can be established. So, this data is very important. On many railways in the world, this data was previously estimated manually. Now many railways carry out these calculations by computer. Computers are used for efficiency, speed, and accuracy.

(2) Current condition and some thought of ENR data collection system

The Study Team tried to get accurate data for passenger volume and passenger kilometers, because the passenger revenue per passenger kilometer is too small compared to the minimum tariff per kilometer. However, it could not be clarified, even though the statistical data for passenger volume is estimated by the Computer Center of Head Office in Cairo, based on data sheets collected from all passenger stations every month.
This passenger data is printed on 3 sheets: (1) to check revenues; (2) for statistics; (3) to be kept in the station. This data is summarized after the end of each month. This system needs to cope with a huge amount of data input work because it is handled by only the Head Office. Therefore, it seems that to input errors cannot be avoided, and it is impossible to check mistakes, even if the station accurately recorded their data.
Meanwhile, the data for freight transport seems to be adequate, as there are not as many freight stations and customers, compared with passenger transport.

JNR utilized the same system as ENR - sales ticket data on 3 sheets. This data was also used for revenue management and statistics data. The recording sheets consist of 2 parts, a daily report, and a monthly report made up of the daily reports that month. Monthly reports were submitted to the regional accounting office on 2 sheets, one for revenue check and another for statistics, same as the ENR system. The regional office summed up all station data within the region, and then this was sent to the head office. This way the data was checked twice. One was by station itself, and other one was by regional accounting office. In the station, it was checked with the actual total money from tickets sold and daily revenue recorded.
Consequently, calculation mistakes were minimized.
Another merit of this method was that regions could know their revenue situation. This was useful for development of railway business by regional management.

(3) Direction to reform the data collection and information system

First, ENR should focus on improving its passenger sales recording system.
This should include a data checking function. One way is for data to be gathered in regional offices, and they check and total these figures before sending to the head office.
The final goal is to computerize all aspects of the data collection and information system. However, this is a long term goal requiring much investment. Above all this requires much time for staff training to handle computer data. So construction of the data collection and information system should be carried out step by step.

First stage of reformation of the data collection system :

a. Marketing and sales management system for each region
b. Accounting and financial management system
c. Adjustment for commercial system

The following is a process and measures to reform the data collection system.

(4) Data collection system

1) Basic policy
In order to check the data input, a distributed system will deliver data to each office, workshop, warehouse, etc.
The most important purpose of this system is that the data will be checked by the person who knows the original data. After checking the results, the data will be gathered at the head office.

2) Development plan

a. Education
Before starting to make a new system, ENR should have the skill top manage recent technologies. At least three types engineers are required, as shown in Table 4.2.12.1. Members of this project should be chosen from the system analysts in the current information systems department in order to build ENR's own system. This stage requires approximately 6 months.

Table 4.2.12.1 Required engineers

Type of engineer	Required skills	No. of engineers
OS, network	Windows-NT, Windows 95, TCP/IP	1
Database	Sybase (for UNIX and Windows-NT)	1
Application	C language, SQL, VB, EXCEL etc.	2

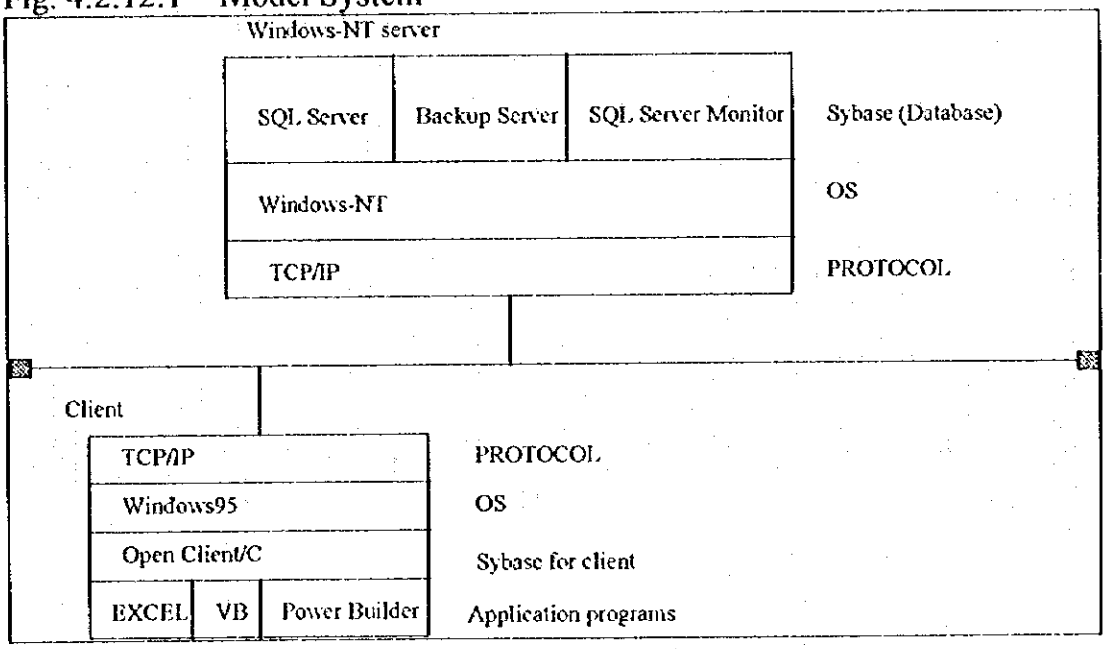
b. Making a model system

After completing training required, a model system should be produced (An outline of a model system is shown in Figure 4.2.12.1). The first goal of this stage is a regional accounting and financial management system, and sales management and marketing system for Cairo area. By developing this system, ENR experts will gain experience developing the new system. Once this system is completed, each regional office can manage its own financial situation by applying this new system.

At this stage consultants with skills in distributed systems should be used.

The model system should take one year to develop.

Fig. 4.2.12.1 Model System



c. Organization after making a model system

After completing the model system, organization of the Information Systems Department should be changed. The main purpose of this change is that the information systems department manages all of ENR's information systems.

A new section which can manage new information system technology is needed. Staff in this new section should be increased each year.

The training section for end users should be expanded, because they will be required to maintain some aspects of their hardware by themselves, because it will be a distributed system. When

an end-user computing environment is provided, they will be required to be able to use PC software at least.
A help desk is also required in the operation section to answer for the user's inquiry.

The figure of new organization plan is shown on Fig. 4.2.12.2.

d. Policy for current system

a) Ticket reservation system
The current ticket reservation system started in 1994. This system is fault tolerant system because this system is for customers. This system should be independent because this system should not be influenced by other systems. So this system will remain after starting to develop the new model system.

b) Commercial system
The commercial system is an old type of system. Annual maintenance cost of this system will be high, and upgrading to the latest version of this system is a senseless investment. So this system will be eliminated when the new system is installed. During the time that both the old and new systems are used together, the data for the old system will be prepared and transferred to the new by diskette or magnetic tape.

e. Expansion plan for other applications
In order to provide complete management information, these three applications will be developed :

- Management system for purchasing materials and inventory
- Management system for rolling stock and maintenance (including trucks and electrical facilities)
- Statistic system

A schedule is shown in Table 4.2.12.2

Figure 4.2.12.2 Organization Chart for New System

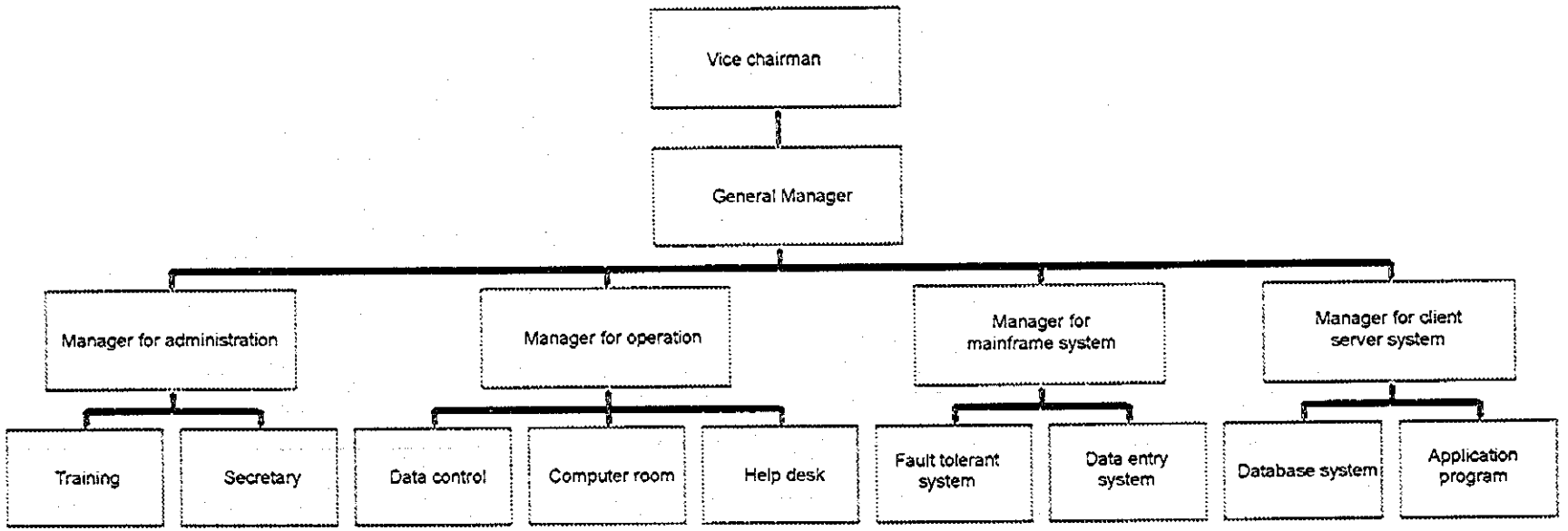


Table 4.2.12.2 Schedule of Future Plan

Item	Action	1997	1998	1999	2000	2001	2002
Education	Development	—					
Development of model system (Accounting and financial management system, Sales management and marketing system)	Development	—	—				
	Expansion		—	—			
Management system for purchasing materials and inventory	Development		—	—			
	Expansion			—	—		
Management system for rolling stock and maintenance	Development				—	—	
	Expansion				—	—	
Statistic system	Development					—	—
	Expansion						

f. Expansion to all of ENR's regional offices

Four applications (Accounting and financial system, Sales management and marketing system, Management system for purchasing and inventory, Management system for rolling stock and maintenance) will be expanded to all of ENR's offices, workshops, warehouses, etc. after each application is developed. Then these offices can closely manage their finances, inventory, etc.

g. Consolidation of entire system

After completing the entire system, a server system for consolidation of data should be established in the Cairo computer center. This server can provide management information to the board. This server should be a UNIX system because this system should be able to handle high volumes of data. By using a Sybase platform, an application programmer does not have to worry about different operating systems (OS).

3) Recommendation of flow chart for checking the data

The following procedure is strongly recommended in order to make the data reliable. The policy of this procedure is that the data is checked manually, by the system, and by computer outputs. The data is also checked by input operators and the persons who make the original data.

The flow chart of the data checking system is shown in Fig. 4.2.12.3.

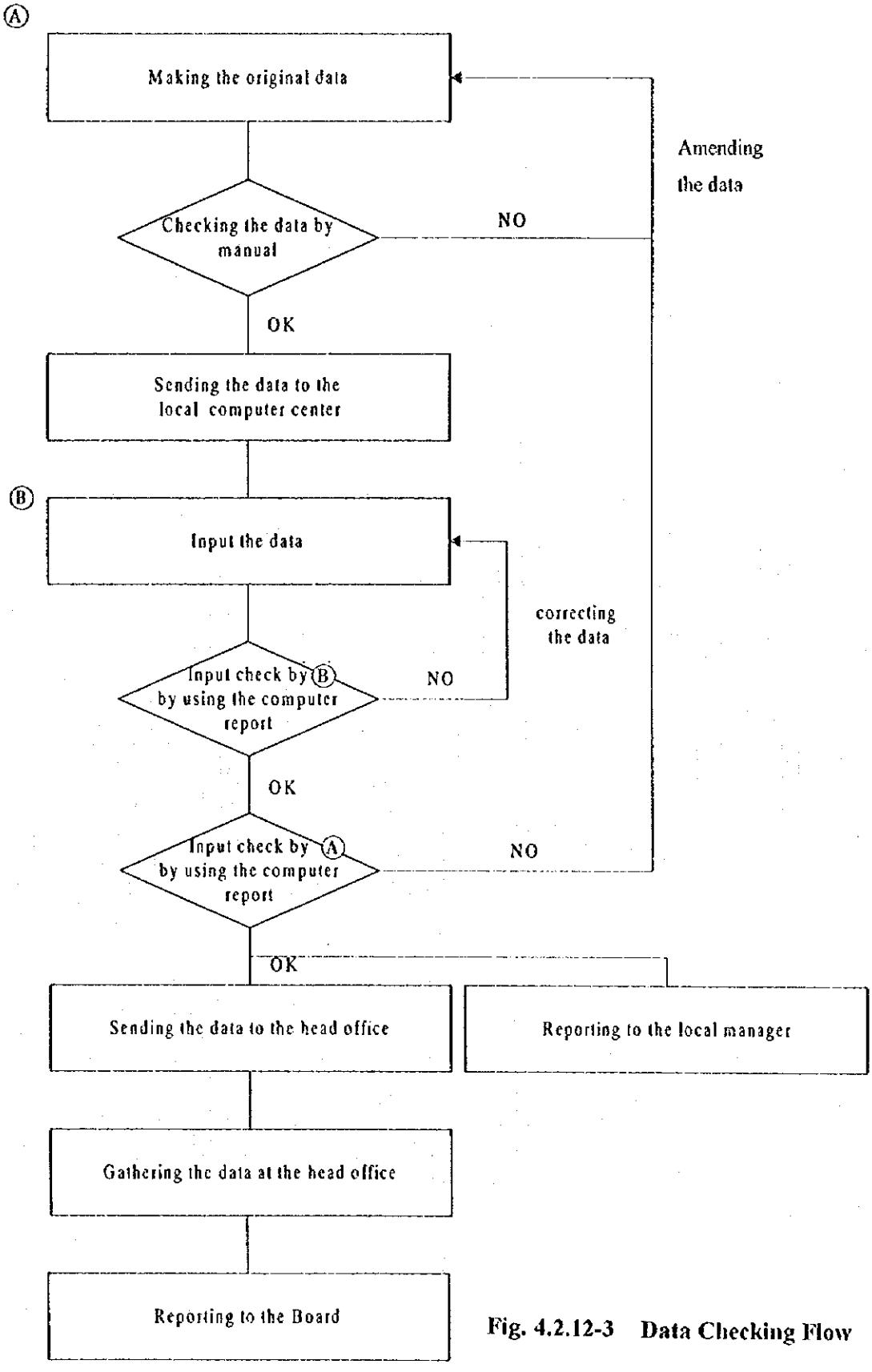


Fig. 4.2.12-3 Data Checking Flow

4.2.13 Enhance the Safety Device on Main Line

(1) Absolute train stop

Absolute train stop herein referred to is a system which stops a train forcibly if the driver should overlook the stop signal. ENR has applied ATC to the main trunk lines that carries with the function of absolute stop. However, the other main lines have no absolute stop installed, so the ATC should be gradually extended on the priority line basis. In this process, ATC may be simplified only for the absolute stop purpose.

(2) Electrified signal

The electrified signal herein referred to is the electrical signal system designed to detect the train and change the signal aspects automatically, and also equipped with the interlocking functions of the switch and signal. The system is able to enhance the safety and efficiency of train operation distinctly.
ENR has been pushing ahead with electrified signal for the main trunk lines. However, the line sections already equipped with it are currently very limited in the ENR main lines.
Therefore, the electrified signal is to be gradually extended on the priority line section basis for the purpose of reinforcing business improvement.
In the event of the signal to be electrified, it is suggested that the electronic interlocking be introduced in place of conventional relay interlocking in the way stations.
The electronic interlocking featuring a good expandability and reliability, etc. as shown in Table 4.2.13, it has been applied for many stations in Japan.

(3) Transmission of essential information (for train block & dispatching)

The train blocking is vital important for the purpose of safety of train operation.
It is said that ENR suffers unexpected cutoff or loss of aerial wires for staff, Tyris, and tokenless train blocking respectively. This trouble may not only threaten the safety of train operation, but also greatly disturb the normal train operation.
Since the aerial wire is mostly owned and operated by ARENTO, it is suggested that ENR strenuously request ARENTO to convert the existing aerial wire into underground cable.
In terms of communication between way stations and the control center for train dispatching, it is currently available by both radio and wire. However, radio access is limited due to mechanical capacity, so the aerial wire attached to ARENTO should preferably be converted into the underground cable at the same time of the conversion of train block wire.
In the event of the conversion of aerial wire into underground cable, it is suggested that its capacity be as large as possible, providing for future data transmission.

4.2.14 Improve Track Maintenance System

As mentioned in Chapter 3.12, track maintenance work especially tamping work for main lines in ENR is carried out by mechanical system which is by 32 tamping machines including 7 switch tamping machines, 20 ballast regulators and 6 ballast cleaners. However, these works are almost carried out by 2 joint concerns based on the contracts using these machines, even with that work was directly carried out by ENR previously.
Meanwhile, the track maintenance work by ENR itself is mostly carried out by manual of gang without machines except fastening tightening work, rail holing and rail sawing. The ballast tamping works which are large share in track maintenance work are carried out by Beaters (Tamping Pick).
In view of the current situation and considering increase of track maintenance work volume by increase number of trains and speed-up of trains, the following items would be considered as subjects to improve for the time being.

(1) Expanding mechanical works and organization

The work volume by mechanical machines will be expanded in consideration of efficiency and quality of maintenance work. So that, the machines especially M.T.T should be added. In that occasion, the works by machine should be carried out not only by the contract basis but also direct execution by ENR gangs themselves. By this way, it would be thought not only to upgrade the efficiency of track works but also to transfer the technical way for the mechanical maintenance work. So that, some maintenance organization should be modified such as establishment of machine groups in region.

(2) Installing Hand Tie Tamper (H.T.T)

At present, the track maintenance work on the main lines is mostly carried out be M.T.T for overall tamping work and for partial tamping work as well. The work has never been used by Hand Tie Tamper (H.T.T) machine. In view of effective use of M.T.T machine and ENR employees, it is considered to adopt H.T.T machines for spot tamping work.

(3) Furnishing mobility

Facing the increase of track maintenance work volume from now, it is considered to furnish the mobility for track gangs.
At present, the Flying Gangs have been established in some maintenance Zones on the main lines in order to do active track maintenance work according to the circumstances of train operation, but they do not have any road transport equipment. The mobility for them are mostly trolley and motor trolley on the railway. These transportation will be sometimes restricted by increase number of trains. Furthermore, it will be endangered in frequent train operation and high speed train operation.
Judging these conditions and future aspect, road transportation like pickup trucks should be adopted for carrying of equipment and gangs.
This system change is favorable to start from for Flying gangs and then to each gang.

4.2.15 Develop the Diversified Business

(1) Background

The purposes of diversified business is as follows:
i. Increase the revenues of ENR as a whole
ii. Utilize ENR assets effectively :
- facilities
- business / information networks
- human resources

According to the Article 2 in the ENR Law (Law No. 152), ENR has the responsibility to establish railway networks, operate them, provide their related services, and establish, manage and maintain the firms and bodies necessary to perform these services. In order to achieve its objectives, ENR may establish joint stock companies after the approval of the Minister of Transport (Article 4).
From a legal standpoint, ENR can actively develop a diversified business. Diversified Business can be one of the major sources of ENR revenues.

(2) Possibility of "Diversified Business"

1) Re-development of station facilities

a. Re-development is possible at major stations such as Cairo, Alexandria, Sidi Gaber, Luxor, and Aswan, which are located in densely populated cities with high potential for commerce and tourism.

b. Strengthening of commercial and restaurant facilities to increase related revenues.

c. In the case of Cairo Station, re-development of the station building itself should be considered, with proper conservation of the existing aesthetics, especially the outside walls.

d. Generally, stations are situated as a functional center of passenger services for ticketing, sales kiosks, restaurants, in addition to commercial, financial (bank), information, and medical services. Consequently, multiple functions should be considered when redeveloping the major stations.

Then stations can attract more passengers/users for various purposes.

2) Re-development of ENR real estate

a. Re-development of the land nearby the major stations
One example is the land area near Cairo Station, which can be developed for commercial/shopping/car-parking facilities, taking advantage of the surrounding real estate situation.

b. Re-development of the land of the previous "Freight Train Shunting Yard"
Now ENR freight train operations do not rely on the shunting yard system. So the yard is not used for its original purpose. Re-development of the land of the closed shunting yard

should be carried out.

3) Extension of related product sales for outside market

Sales to outside clients should be pursued for products produced in ENR. This business sector has benefits for ENR such as efficient utilization of facilities and manpower.

4) Promotion of tourist businesses such as travel agent/hotels by utilizing effectively the nation-wide business and information network and human resources of ENR

By integrating the business of the transportation (travel) service of passengers by railway, and the business of arranging the travel and accommodation service, ENR can attract more passengers for tourism and expect more revenues. Fortunately, ENR has a network of railway stations almost everywhere in Egypt. By using its network, ENR can develop this business. Stations can be the bases for the tourist business.

(3) Pre-condition for land re-development (Constraint for Land Re-development)

Currently, ENR does not have full ownership of the real estate it utilizes. Accordingly, the diversified business related to real estate re-development can only be carried out after this constraint is removed. However, when this constraint is removed, land re-development will be a major source of benefits for ENR.

(4) Management structure

The management structure for the above diversified businesses should be made on the basis of a joint operation and/or joint company with outside private companies (domestic / foreign) which have experience in the specified business fields. At first, the staff of ENR will learn from such outside companies for the specified business field, and step by step, they may obtain the necessary skills and experience.
If a joint company, ENR should hold more than 50% of the shares, to maintain control.

(5) Path to realization

First it is necessary to establish the proper organization in ENR, i.e. a study group on "Diversified Business" composed of staff from related departments/sections within ENR.

The tasks of the study group are as follows:

- Research the possible business fields for ENR "Diversified Business".
- Examine the current conditions of ENR assets/facilities which have the possibility of conversion to other purposes or to promote more efficient utilization.
- Examine the management /operation scheme suitable for such a "Diversified Business".
- Clarify the preconditions or constraints for ENR "Diversified Business" - legal, financial, marketing and human resources aspects.
- Propose suitable ENR "Diversified Business" to top ENR management.

Then, the selected high priority diversified businesses will be carried out as soon as possible.

4.2.16 Make the Relationship between Government and ENR Clear

(1) The most crucial issue

The most crucial issue concerning the relationship between the government and ENR is ENR's dual character. ENR is obliged to play a public roles in transport as a government agency, while it must compete with other modes of transport, as the market economy increases its power daily. A typical example of its public role is the heavy discount of passenger tariffs for students and government employees. An example of its competition is the fact that ENR faces fierce competition from deluxe buses equipped with TV, A/C, and clean toilets on the Cairo-Alexandria corridor, the most profitable segment for ENR.

The impact of this dual role on ENR's business is huge in various ways. This not only harms its financial performance, but also drastically reduces ENR's commercial spirit and its will to restructure.
For example, even if ENR executives try to close lines with very small traffic volume which cannot be made profitable by any effort, the political pressure makes closing the lines impossible. ENR is told it must serve the public interest, so ENR executives lose the will to restructure due to impossible conditions.
Furthermore, ENR's executives and other employees think that ENR will never go bankrupt regardless of how bad its finances are, because ENR is a state-owned organization. This attitude is not compatible requirements for commercial competition. This will further worsen the finances of ENR, eventually leading to increases in the government's financial burden.

In order to prevent the above situation, it is essential to set a clear distinction between the public role which the government intends to have ENR execute, and the commercial business which ENR must carry out with a flexible and competitive attitude.

First of all, the clearly separated financial reports are required, and the government should compensate ENR for losses caused by its activities for the sake of national interest, on condition that ENR executes its duty faithfully and reasonably.
Second, the government should strictly refrain from executing its power over ENR, taking advantage of its strong position as both the stockholder and regulator. More concretely, it is advisable for the government to gradually reduce restrictions imposed on ENR and enable ENR to conduct, on its own judgment, activities like personnel and organization changes and tariff revisions as freely as possible. The decision of ENR's annual budget, which now requires the approval of the People of Assembly, should only require the approval of or notification to the Minister of Transport.
On the other hand, it is necessary for ENR to be prepared to lose various privileges it is enjoying now because it is a state-owned organization.

The benefit obtained by clarifying the relations between ENR and the government will be very large for both the government and ENR.

(2) Separation of powers to be considered

If ENR was a private company, it would follow the laws regulating private companies in general, which establish the separation of powers between stockholders and management. In ENR's case, the law might be written as follows :

The following is a general observation on the separation of powers within a corporation, in contrast with functions of respective organs in a stock corporation. Each country employs a different system for establishment and management of a stock corporation, and the following is an illustration for discussion purposes.

a) Owners/shareholders

The following businesses are under the jurisdiction of shareholders due to the magnitude of their inherent interest:

A. Matters relating to organization, including dissolution, merger, business transfer, capital decrease, amendment to Articles of Incorporation / Association, etc.
B. Matters relating to management, including appointment of directors, auditors, liquidators, remuneration for their services, discharge of their liabilities, etc.
C. Financial matters, including approval of financial statements, distribution of dividends, issuance of convertible bonds, approval of liquidator's report, etc.

b) Board of Directors

A. Decision on execution of business
B. Convocation of shareholders meeting and selection of agenda for shareholders meeting
C. Approval of share transfer (in case of a closely held company)
D. Opening of a branch
E. Appointment of representative directors and executive officers
F. Capital increase within the authorized capital

c) Auditors

A. Auditing of financial documents
B. Auditing of business matters in light of laws/regulations (if required)
C. Appointing of directors (in Germany)

d) Councilors

A. Matters delegated by laws/regulations

(3) Deregulation

1) What improvement measures are to be taken or considered for removing the current restrictions if any on the current ENR business?

In reviewing the current framework of the ENR Law, it is noted that certain restrictions on the decision-making process and implementation of the daily operation should be removed. Particularly, it should be clarified that the daily operation of ENR is to be conducted at the sole responsibility of the management of ENR. Current provisions of the ENR Law are not clear in this respect, because the ENR business is generally supervised by Ministry of Transport (Article 17, 23 and 1 of the ENR Law).

If the current ENR business is to be privatized, such restrictions would have to be removed including those such as:

(a) Appointment of Representative Directors, President and Chairman
(b) Board decisions regarding daily operation

The current relationship between MOT and ENR of 3.16.1(1) above reflects the dual status of the State as the owner/shareholder and as the regulatory authority to implement the national transport policy. When removing any restrictions on ENR business, the

necessity of control should be separately examined for each of the said dual status on a case by case basis. In privatization, ownership will be transferred to the new shareholders, and regulatory authority will remain with the Government, which will continue to set restrictions to as limited an extent as necessary for administering national transport policy, as mentioned in 2) below.

2) Regulation based on the national transport policy

a) Under different legal systems of other countries, it is possible for the government to generally review the financial condition and technical aspects in the operation of railway businesses owned by public and private companies, by requiring a license or approvals of matters such as a basic business plan, tariffs, opening and closing of lines, and by stipulating the relevant technical guidelines to be complied with, in order to implement the national transport policy.

b) If ENR's business is to be privatized, the Egyptian Government may want to implement a new transportation policy to regulate the privatized ENR business to protect public interests. The most important regulations would be those to ensure safe operation of trains. Perhaps environmental regulations would be also important. Once necessary regulations are established by the government, such regulations should be complied with by ENR, and required measures should be carried out at the responsibility of the ENR management. Very strict restriction is generally undesirable for railways companies to compete with other railway companies and other transport modes. The business and operation plan of ENR should be implemented solely at the responsibility of ENR management, provided that ENR should comply with the regulations to protect public interests. Especially financial matters should be solely determined within ENR, except the subsidy granted by the government.

(4) Budget approval

Currently, the ENR budget is approved at the People of Assembly. But revising the law should be seriously considered to allow ENR to act more flexibly in its competitive market. Also, the separation of accounts for Government subsidies should be considered, as mentioned in (5) 1) below.

(5) New business approval and land use

It is understood that now a special task force is studying the method of purchasing the land from the Government, consisting of the representatives of MOF, MOT and ENR.

(6) Separation of accounts for Government policy and financial measures for certain exemption

Separation of accounts between ENR's commercial operation and actions for implementing Government policies should be thoroughly studied. This will clarify the respective responsibilities of ENR and the Government in the operation of ENR business.
Clarifying the responsibilities of ENR in its operation would serve to facilitate change of the Government policy to ENR from the current general subsidy, to compensation for services of ENR which the Government requires for implementing national programs (public service obligations).

1) Separation of Accounts

In order to clarify the responsibility of ENR (and that of the Government as well), and to lessen the burden on ENR, certain expenditures and discounts now paid by ENR should be compensated by the Government. The following items should be considered for Government compensation:

a) Projects for new line construction for national policy

In addition to the capital costs, a portion of the operation costs should be paid by the Government.

b) The following excessive discounts for political purposes should be at least partly compensated by the government

- Special discount for students
- Special discount for government employees
- Special discount for military

2) Custom duty exemption

a) The ENR Law provides for certain exemption from obtaining the relevant licenses under the Import and Foreign Exchange regulations for importation of production equipment, materials, machines, equipment, spare parts and the transport means which are necessary for the activity of ENR (Article 10). Also the equipment, machines, and technical sets necessary for the operation of ENR projects are exempted from taxes and the custom duties (Article 11). However, transport means are not exempted for the purpose of Article 11. While domestic production of transport means is generally recommended, if certain expensive locomotives, passenger cars and other rolling stock are to be imported for the time being, exemption from custom duties should be obtained so that the financial status of ENR may be more effectively improved.

b) At present, ENR pays custom duties assessed under Presidential Decree No. 351 of 1986 for Custom Tariffs. Currently the tariff rate is 5% for locomotives, passenger cars rails, etc., and 60% on signal systems. Some parts could be accepted as the normal parts (mechanical) for the above items. ENR appropriates funds to pay for custom duties in its annual budget. On the other hand, there is a procedure available for refunding a portion of the duty paid at the time of custom clearance. For example, if 55% is later repaid, the eventual burden on ENR is only 5% (60% - 55% = 5%). For locomotives, if 1% equivalent is later repaid, then ENR pays only 4% in total. This refunding procedure is rather complicated, and usually MOF is reluctant to approve refunding, because the entire duty portion is given on the budget of ENR, and if duty is refunded for certain items then MOF may want to compensate the equivalent amount from other items in order to keep the duty portion on the ENR budget. If the custom duty is exempted as provided for under the ENR Law, no appropriation would be required for this portion in the budget and thus no balancing would be necessary between the budget and the actual payment. Also there would be no necessity for following the complicated refunding procedure for customs duties.

4.2.17 Promote the Local Production of Diesel Electric Locomotive

(1) Necessity of local production of DEL

As seen in the Report, to make the ENR's business profitable is not easy at all. One of the major reasons is the fact that ENR has to import her locomotives, important tools of the transport, from foreign countries at the significantly expensive international price, while ENR's average passenger fare (passenger revenue divided by the passenger-km), the main source of revenue, is extremely low from the international point of view. By a trial estimation, transportation costs per passenger kilometer are calculated as 2 - 4 PT, within this cost about 60 % are capital cost of rolling stock, i.e. 1.5 - 2.5 PT. Against this cost, passenger tariff of 3 Class which shares 70 % in total passenger revenues are 1.21 PT per passenger kilometer. It means that the passenger tariff does not cover only that capital cost. Namely, the tariff is too low, or the capital cost of rolling stock especially locomotive is expenses compared with the tariff. However, it does not enable to rise the tariff in full width from social matters point of view.

One significant solution of this problem is to produce the locomotives in a domestic factory as much proportion as possible.

Besides above, ENR will be obliged to replace many aged diesel electric locomotives (DEL) by new ones from 2001. Actual total number of 2475HP and 1650HP DELs is 576. As the service life of DEL is 25 years, average number of DELs to be newly procured annually will exceed 25 taking the increase of traffic demand into consideration. Annual production of 25 DELs may justify the construction of the new factory. Moreover, it will contribute to expansion of employment opportunity.

However, the construction of such factory requires huge amount of investment which ENR cannot afford at least for the time being. Therefore, it is essential to execute separately the thorough feasibility study from various point of view.

(2) Example of DEL manufacturing factory construction

Firstly, one example is introduced. Thanks to the OECF loan, 9,760 million yen, by the Japanese Government in 1984, new construction of DEL manufacturing factory in a certain foreign railway was completed in 1994. This factory has production capacity of 25 DELs per year.

Local production portion is as follows.

1) Manufacturing of carbody and bogie excluding wheel-set and axle bearing, and assembling along with wiring and piping.
2) Assembling of main generator and traction motor by procuring from foreign countries necessary materials such as armature shaft, silicon steel plate, commutator, etc.

(3) Estimation of DEL cost for ENR

1) Cost structure of recent Japanese DEL is as follows.

Carbody including assembly, wiring and piping	36%
Bogie, including wheel-set and axle bearing	16%
Engine	18%
Electric equipment, machines and apparatus	26%
Braking device	4%

2) Even in the case of domestic production, some parts should be imported from foreign countries. The following assumption has been made. As for carbody, the imported portion accounts for 30%; as for Bogies 30%; as for Engine 100%; as for Electrical part 50%; as for Braking device 100%. Thus the following table is acquired.

	Imported	Local
Carbody including assembly, wiring and piping	10.8	25.2
Bogie	4.8	11.2
Engine	18.0	0
Electrical part	13.0	13.0
Braking device	4.0	0
Total	50.6	49.4

3) To estimate the necessary cost of the local production portion converted into the foreign currency, the following assumption has been made.
In case of the local production of Cairo Metro electric railcar train having unit configuration of 2M1T, cost structure is 2.03 million LE for the imported portion and 0.12 million LE for the local production portion which consists of manufacturing carbody and bogie, excluding wheel-set and bearing, and assembling equipment along with wiring and piping. Namely, local production portion accounts for 5.6% of the total cost. Local production portion of electric railcar unit should be larger than that of DEL because the former includes the trailer car in which the local production portion must be higher. In this case of DEL, however, local production of main generator and traction motor is taken into consideration.
Therefore, it is assumed that local production portion converted into the foreign countries accounts for 6% of total cost. Then, local production cost per DEL is estimated as 56.6 (50.6+6) % of imported complete DEL.
In case of the above-mentioned foreign railway, local production cost is said to be 60% of imported complete DEL. Finally, local production cost in Egypt is also assumed as 60% of imported complete DEL.

(4) Evaluation of DEL manufacturing factory construction

The factory for the local production of DEL may have the same scale with the sampled Foreign Railway factory. Therefore, the construction cost of the new factory is tentatively estimated as $9,760 \times 10^6$ yen in 1984, or $11,350 \times 10^6$ yen in 1995 (inflation rate of Japanese yen from 1984 to 1995 is 1.163) or 113.5×10^6 US$ (US$1 = J. Yen 100 in 1995).

The cost of imported complete 2475HP DEL for ENR in 1995 may be $2,294 \times 10^3$ US$ from the Fig. 3.11.2 of the Report. In case of local production, it will be $1,376 \times 10^3$ US$, saving 918×10^3 US$ per locomotive.

In simple and rush calculation, the factory construction cost could be recovered by local production of 124 DELs or in 5 years in case of 25 DELs production per year.

4.3 GUIDELINE OF PRIVATIZATION

4.3.1 Significance of Privatization

Recently, around the world, the privatization of national railways has been gaining momentum. There are two main purposes of privatization: one is to make the management of railways more competition-oriented and thus more efficient; the other is to lessen the financial burden of the government for sustaining the national railway.

In most countries, the railway had been playing an active role in developing the national economy as almost the sole means of ground transport for many years until recently. Partly because of the huge amount of investment required to develop the railway, and partly because of its monopolistic status, the railway, especially the inter-city and freight railway network, used to be run by the government in almost all countries in the world.

However, with road and air transport developing rapidly and with the competition within the transport market becoming more and more severe, the national railway has become unable to cope with the situation due to its rigid management as a governmental organization, losing much of its market share, and facing financial difficulties. To find a way out of this situation, privatization of the national railway is often proposed, taking into consideration the fact that the railway is no longer a monopolistic means of transport.

As for Egyptian National Railways, it has come to face severe competition from road, water, and air transport, because of rapid development of highways, harbors, and airports. However, for the time being, ENR as a government owned railway is obligated to play a role in executing national projects such as sustaining the low-income stratum of society and bringing transport to underdeveloped areas. Therefore, it appears that immediate privatization of ENR is too early to be executed, although its privatization in the medium term is inevitable, considering Egypt's steady trend toward a market economy. Even at present, privatization of ENR should be examined in earnest.

This chapter provides basic conceptual information as a guideline for future consideration of privatization of ENR.

4.3.2 The Types of Privatization

There are various types of privatization executed in the world. Among them, team is to introduce two types, the Japanese style and the European style, as typical examples.

(1) Common aspects

Although the two types of privatization mentioned above differ significantly, there are common aspects: the reasons why the national railways should be privatized and the final goal of privatization.

a. The reasons why national railways should be privatized

Both in Europe and in Japan the national railways have or had similar problems as mentioned below :

- Ambiguous goals - Public Service or Self-Financing operation
- Lack of competitive, market based thinking from management & staff
- Lack of commercial independence
- Government control over staff pay, fares and tariffs
- A centralized organization that limited flexibility
- Severe legal restrictions on business activities

- Outdated regulations that were applied rigidly
- Overstaffing and poor productivity

b. The final goal of privatization
The final goal of privatization is the same in Europe and in Japan:

The privatized railway organization should be profitable without government support and free from government intervention as much as possible.

(2) The European approach

EU Directive 91/440, Jul. 1991 recommended the member states to make the distinction between the provision of transport services and the operation of infrastructure for the purpose of:

1) Making the government clearly responsible for the development of the appropriate railway infrastructure.
2) Improving operations efficiency, to prepare for competition.
3) Allowing open access to track infrastructure by competing railway companies.

This approach is to restructure the railway into a business totally different from the conventional railway. Since the birth of the first railway in 1825, the railway was operated in integration with its infrastructure, regardless of type of management. The new approach is similar to that of road transport, where the government builds, owns and maintains the infrastructure, on which anyone with an eligible license can use if he/she drives a qualified vehicle.

The main reasons why EU is trying to adopt such a revolutionary means to revitalize the railway business can be described as follows:

- Financial difficulties of railway business due to the generally low railway traffic density in European countries with heavy burden of building and maintaining the infrastructure.
- Need to allow open access to railway infrastructure as an integrated network in EC as a whole.

As for the situation of the national railway of each country, there are big differences between them. Therefore, EU has proposed three steps to be adopted in accordance with the degree of development of each railway.

- separation of accounts
- organizational separation
- institutional separation

Today, various types of privatization of the national railways within the frame of the EU Directive are progressing in several European countries. Two types are briefly introduced below.

a. The Swedish rail approach

Swedish Rail can be considered a leader among European railways. In 1988, one year after the privatization of Japanese National Railways took place, Sweden established 'Banverket' (BV) and Swedish Railway (SJ), (a totally different organization from the old

Swedish Railway, but with the same name).
BV is a governmental organization, responsible for the investment and the maintenance of the infrastructure. SJ undertakes railway operations. SJ is owned by the government at present, and is planned to be privatized in the future.
The investment plan for the railway infrastructure is decided through a social cost/benefit analysis and is paid by the government. SJ pays a rental charge for infrastructure to the government, although the amount of the charge is significantly below the total amount of the capital cost and the maintenance cost of the infrastructure. Thus the operation cost of the railway operator can be significantly reduced from the previous period.

b. The British Rail approach

The approach of British Rail was significantly different from the Swedish approach.
In 1994, the British government established the Rail Track Company, the sole organization which owns and maintains the infrastructure of British Rail, and privatized it.
As for the railway operation, the newly established (or to be established) 25 Franchises (including private companies) operate the passenger trains, and 7 private freight and parcel companies operate the freight and parcel trains. They have to pay expensive rental charges for utilization of infrastructure from Rail Track Company, which, as a private undertaking, should be profitable without government subsidy.
The train operating companies receive government subsidy to balance their finances.
With multiple operating companies using the same line/segment, free access, one of the targets of EU Directive, will be realized.

(3) The Japanese approach

In April 1987 the Japanese National Railways (JNR) was privatized and divided into six regional passenger railway companies and one nationwide freight railway company. In this case, each railway company owns, maintains and builds (if necessary) its infrastructure. The only exception is the Japan Freight Railway Co., which rents the common infrastructure from the related passenger rail companies at an avoidable cost basis.

In Japan, thanks to the high population density in inhabitable land, railway traffic density, especially that of passengers, is very high compared with European countries. Thus many private railway companies thrive without significant government support, even today. Then why did only the national railways face financial difficulties? The real reasons which caused JNR financial difficulties were almost same as the ones described in (1) a. of this chapter. Also, labor and management had an extremely poor relationship, which prevented almost every effort at restructuring the business. Furthermore, the huge amount of long term debt which was accumulated over a long period made the financial status of JNR worse than that of the European railways. (JNR had to borrow money to invest in building infrastructure such as the expensive SHINKANSEN, and to balance its annual deficit)

To fundamentally eliminate the above mentioned causes of JNR's sever problems, it was decided that there was no way except through privatization and division of JNR. Also, it was estimated that if the long term debt and number of staff could be reduced to an appropriate size (the number of staff were reduced from 300,000 to 200,000), all of the privatized companies could be profitable without government support.
However, the average traffic density of the three small island passenger companies were so

small that their financial difficulties were been expected from the beginning. Therefore, they were exempted from bearing long term debt from the start, unlike the larger JR companies. These three island companies received a stabilizing fund corresponding to their expected financial difficulties.
As for the freight company, traffic density of which is also small, it was decided to rent common infrastructure from the related passenger companies at an avoidable cost basis.

After ten years, the results of the above mentioned privatization are remarkable:

- The tariffs of the three major passenger companies was not raised since the privatization took place in 1987, despite increasing wages and higher prices of other goods and services (tariffs of the above mentioned small island companies were raised by about 8% in January 1996 for the first time).
- The long term debt borne by the major companies has been steadily decreasing.
- The quality of service remarkably improved, which steadily increased transport volumes.
- Both management and labor are working with market-oriented attitudes.

(4) Brief Comment on the two types of privatization

As observed in this chapter there are significant differences between the European and the Japanese approach.

- The European approach is to separate the railway operation from the infrastructure and to privatize the operations, while the investment and infrastructure maintenance remains the responsibility of the government (except the British Railway approach).
  There may arise controversy over whether it is proper to separate the maintenance of infrastructure such as track and signaling system from the railway operation, to maintain safety of railway operation.
  However, most European railways cannot be profitable without escaping from the financial burden of maintaining infrastructure, mainly due to their low traffic densities. This problem remains to be seen in future.

- On the contrary, the Japanese approach privatized its National Railways together with the infrastructure, dividing it into several passenger companies and one freight company, avoiding the controversial issue of the above mentioned safety problems.
  The main reason which enables this approach is Japan's high traffic density, thanks to high population density along railway routes.

4.2.3 Toward Privatization of ENR

Thorough examination of the present status of ENR reveals that there exist almost the same problems experienced by national railways in European countries and Japan. To fundamentally solve these problems, privatization of ENR will eventually be required.

Then what type of the privatization is most appropriate for ENR ?

It is not easy to properly answer this question at present.

The study team made a rough analysis of the financial status in case of separation of infrastructure from operation, and has found that the removal of the capital and maintenance cost of infrastructure does not significantly improve ENR's financial situation. Instead, the capital cost of relatively expensive imported rolling stock (especially locomotives) is significantly more than the cost of infrastructure. Rolling stock expenses are more troublesome for ENR finances.

The regional division of the network such as seen in the Japanese approach is not appropriate for ENR, because the size of the network is not large enough to justify regional division.

In view of ENR's high traffic density of passenger transport, which can be compared to that of the Japanese railways, if all the problems described in this study can be completely solved, it may be possible to privatize ENR as a profitable railway company together with its infrastructure.

However, it is too early to make a final decision on the direction of privatization of ENR. The most essential thing is to take the step of 'separation of accounts' according to the EU Directive, accumulate accurate and adequate data, and thoroughly analyze the data. Through these steps, the right direction toward privatization of ENR will be found.

CHAPTER 5 BUSINESS IMPROVEMENT ALTERNATIVES

5.1 BUSINESS IMPROVEMENT FACTORS

The most important items to improve the ENR's business are described and qualitatively discussed in Chapter 4. The business improvement alternatives aim to quantitatively test the effect of each improvement factor proposed. So only those factors with effects which can be quantitatively measured are considered. The following are such factors.

(1) Tariff increase

It is clear that the railway tariffs for both passenger and freight in ENR is very low. ENR tariffs are among the lowest the world, even if the per capita GDP of each country is taken into consideration. In the short term, an overall tariff increase is needed. Therefore, in the alternatives, the rate of tariff increase is set up according to "Scenario 1" mentioned in Chapter 4.2.1. The proposed rates of increase are as follows.

a. "Without Case"

(a) 1996/97 to 1997/98

There was no tariff increase in January 1996, probably because the Government publicly promised to suspend all kinds of prices in Egypt to curb the drastic inflation. During the period from 1996/97 to 1997/98, it is assumed that **tariffs of all modes will increase 10% annually**. This rate is based on the following assumptions and conditions:

i. Increase of consumer prices influence ENR operating expenditures. By taking into account of performance of consumer prices in the past, prices are predicted to rise around 6.5% yearly.

ii. ENR's low tariffs influenced other modes of transport so seriously that they were forced to drastically restructure their operations, because they cannot increase tariffs without improving service, and they are not subsidized by the Government. In this sense, ENR can act as a "Price Leader". It is expected that other modes will follow tariff increases by ENR.

iii. According to the traffic survey carried out by the study team, around 20% of ENR passengers seem prepared to pay at the maximum a tariff increase of 10%, and around 30% of railway passenger seem prepared to pay at maximum a tariff increase of 100%. Therefore, it seems that a 10% railway tariff increase will not be a large financial burden for many passengers.

iv. ENR tariff increases were in the range of 10% to 15% during the past several years.

(b) After 1998/99

After 1998/99, **the rate of tariff increase is fixed in this case at 5% for all modes**, which can be considered to be the minimum rate of tariff increase, taking account of future consumer price increases of around 6.5% per year.

b. Case 1-1 and Case 1-2

(a) 1996/97 to 1997/98

During the period from 1996/97 to 1997/98, it is assumed that the **tariffs of ENR and other modes will increase 10% and 8% per year, respectively**. The assumptions and conditions of setting up the tariff increase rate are almost the same as those of the "Without Case".

(b) 1998/99 to 2001/02

During the period from 1998/99 to 2001/2002, it is assumed that the **tariff of ENR and other modes will increase by 7% and 5% per year, respectively**. Basically the same assumptions and conditions as those of 1996/97 to 1997/98 are applied to this period. Setting a tariff increase rate of 7% for ENR is based on the assumption that travel time is shortened by increased frequency and faster speed. Setting up a tariff increase rate of 5% for other modes is based on the same assumption as the one of "Without Case".

(c) 2002/03 to 2011/12

During the period from 2002/03 to 2011/12, **the ENR tariff increase rate is set at 5% per year**, based on the following assumptions:

- Tariff increases of 7% every year will become a financial burden for users.
- 5% per year will be acceptable for users, because it will be lower than the rate their income increases, and 5% per year is needed to cover increases in consumer prices of around 6.5% per year.

The same assumptions for tariff increases are applied to other modes.

c. Case-2-1 and Case 2-2

(a) 1996/97 to 1997/98

During the period from 1996/97 to 1997/98, it is assumed that **tariffs of ENR and other modes will increase 10% per year.** The assumptions and conditions for setting the tariff increase rate are almost the same as those of the "Without Case".

(b) 1998/99 to 2001/02

During the period from 1998/99 to 2001/2002, it is assumed that **tariffs of ENR and other modes will both increase yearly by 7%.** Basically the same assumptions as those of 1996/97 to 1997/98 are applied to this period. Setting the tariff increase rate of 7% for ENR is based on the assumption that travel time is shortened by increased frequency, and by speeding up. Setting a tariff increase rate of 7% for other modes is based on the assumption that other modes will follow the same rate of tariff increases as ENR.

(c) 2002/03 to 2011/12

During 2002/03 to 2011/12, **the rate of tariff increase of ENR is set at 5% per annum** based on the same assumptions as those of **Case 1-1** and **Case 1-2**.

The tariff increase rates of all cases mentioned above are applied to both passengers and freight, and are considered to be average rates of tariff increase. Actually, different rates of tariff increase can be applied by line and by class for passengers, and by line and by commodity for freight on the basis of elasticity and cross-elasticity from detailed traffic demand analysis, sensitivity analysis, and simulation of financial improvement of ENR.

(2) Intensifying the ticket checking system

Nonpaying passengers are estimated to be 15% to 25%, mainly passengers in normal 2nd and 3rd class.
In every **With** case, it is assumed that **the collection of fares from nonpaying passengers of these classes will be improved by 5% in 1997/1998, and 15% in 2001/2002**, from current levels, by strengthening ticket inspection.

(3) Speed-up

The team discovered that at present most passengers are not time-sensitive, and speed-up will not increase demand very much, but it is effective for raising the efficiency of crews and rolling stock.
In every With case, 10% reduction of the travel time between major stations on the main line are proposed (refer to Fig. 5.1.1).

(4) Introducing government compensation

In principle, receiving the subsidies from the government is not preferable in a market oriented economy, even for the railways.
However, if the central government forces ENR for political reasons to follow its instructions which will certainly cause huge and unreasonable financial losses, ENR will be entitled to receive compensation within the limit of losses caused by the government.

The team considered the following two cases appropriate :

1) Excessive discount rate for government employees, students, etc. This kind of discount is implemented for national goals and not for competition in the transport market. The amount of this compensation is assumed to be 10.6% of the total 1997/98 passenger revenue.
2) New line construction such as to Sinai Peninsula. The line will be constructed to develop the area for national goals. However, with the very small amount of transport volume anticipated on the line, the financial results of this new line including capital cost will be greatly unprofitable at least for the medium term. Therefore, government compensation is justifiable. The team's proposals do not include calculations for capital or operation costs of such lines.

(5) Reduction of staff

ENR labor productivity is less than 60% of that in developed countries around 1992, so the reduction of staff is inevitable to improve ENR's finances. However, rapid and large scale reductions including compulsory dismissal may cause social unrest and cannot be implemented. Therefore, the team considered it effective to strictly curb the number of new recruitment to reduce employees.

In Without case, it is estimated that the rate of the new recruitment remains same as the current

level, namely 1.63% of total employees.

In Case 1-1 and Case 2-1, new recruitment is not done until Jan. 2002 to gain financial health as early as possible. After that, new recruitment is to be carried out slowly, to gradually improve labor productivity in 2010 to the point that it will almost reach the level of developed countries around 1992.

In Case 1-2 and Case 2-2, new recruitment is to be limited to 1% of total staff each year until Jan. 2002, to gain financial health quickly. After that, new recruitment is to follow in almost same manner as that of **Case 1-1** and **Case 2-1**.

(6) Closure of lightly used lines

Closure of exceedingly lightly used lines has been proposed, considering benefits for both the national economy and business improvement of ENR. For every **With** case, closure of **five** branch lines, namely **Faqus - El Sammana, El Fayum - Sinnuris, Beni Suef - El Lahun, Shaweish - M. Abu Sammad and Karf Saad - Karf Silman** lines by 98/99 has been proposed, as described in 4.2.10. It is assumed that those lines will be closed by 98/99 (refer to Fig. 5.1.1).

(7) Other improvement items

For every **With** case, among the improvement items listed in Chapter 4, the following items which can easily be quantitatively calculated are taken into consideration to make the financial analysis.

- Raising availability of rolling stocks
  The availability of rolling stock, especially diesel locomotives, are increased from 74% at present to 85%.
- Correction of data collecting system
  It is assumed that ENR will install an adequate OA system to let the management access reliable up-to-date information.
- Enhancing safety devices on the main line
  The automatic signaling-system on the major lines is to be installed to increase operation safety.
- Development of diversified business
  Although it is not easy for ENR to develop the diversified businesses because ENR does not own the land it uses, ENR needs to earn extra revenues from commercial activities such as restaurants and travel agencies around the large passenger stations. 1% increase in the total revenues is anticipated from 98/99.

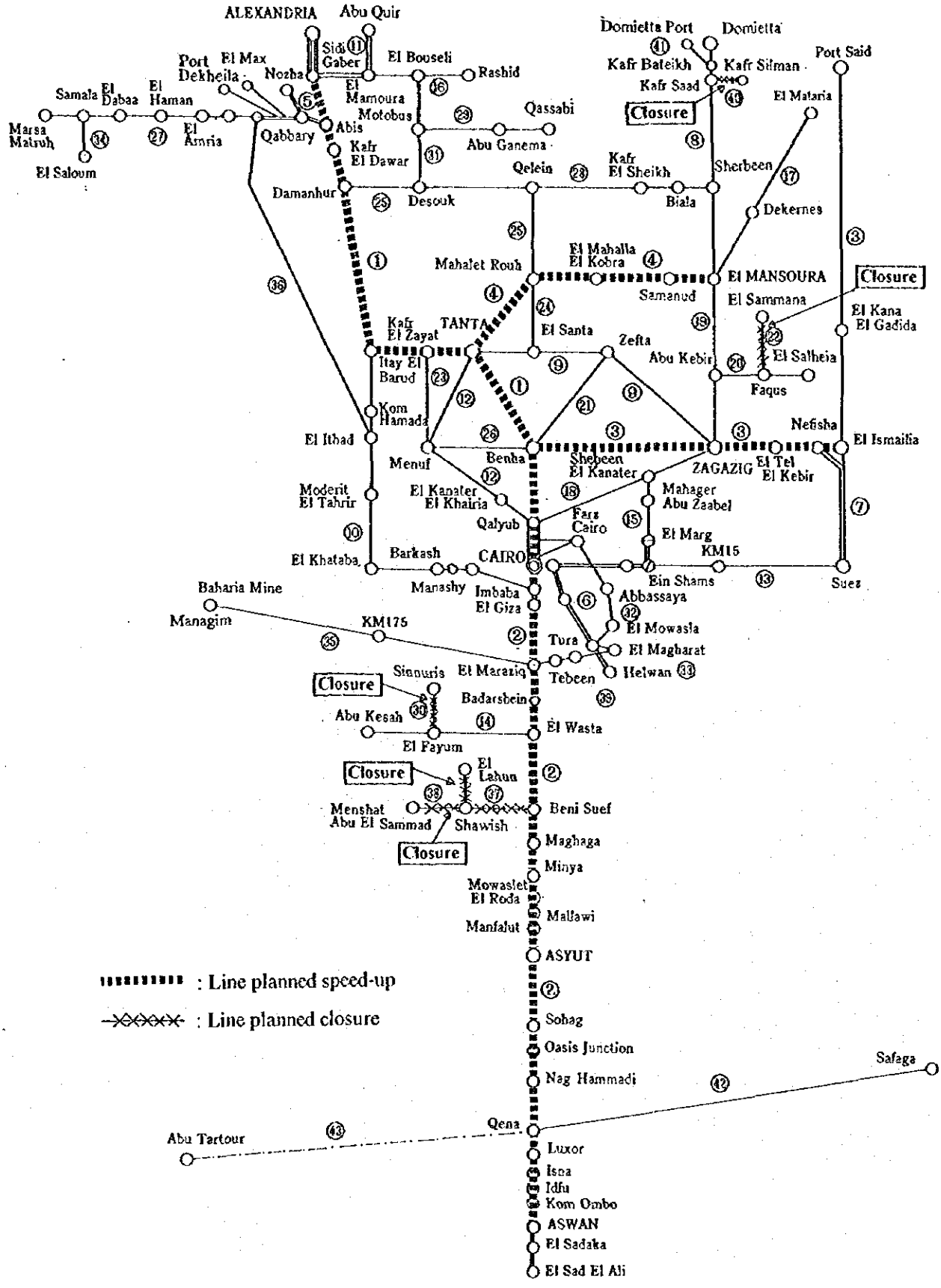


Fig. 5.1.1 Lines planned Train Speed-up and Closure Lines

5.2 POLICY OF CASE CLASSIFICATION

The alternative cases are classified into two cases: the case of the status quo (**"Without"** cases), and cases with variable improvement factors (**"With"** cases).

For every case, railway expenses including wage cost have been estimated to increase in parallel with the inflation rate, estimated in the range of from 7% to 9% for the consumer price index, and from 5.5% to 6% as for the wholesale price index.

"Without"

In this case, no improvement factor is assumed except the fare increase, the annual growth rate of which is 5%, just same as that of other modes of transport.

"With" Cases

*To produce the alternative cases, **fare increase** and **mode of staff reduction** are selected as variable factors because they are the dominant factors to control the financial status of ENR. However, the other factors described in Chapter 4 are also very important for ENR's improvement, and have been taken into consideration in every "with" case.*

Case 1-1

In this case, the tariff increase rate of ENR is assumed at 7% yearly, and that of the other modes is assumed at 5%. New recruitment is assumed to be stopped until 2001/2002.

Case 1-2

In this case, the tariff increase rate is assumed to be the same as in **Case 1-1**, while new recruitment is assumed to be carried out at 1% of the total number of staff. Therefore, the difference between **Case 1-1** and **Case 1-2** is the difference of the new recruitment.

Case 2-1

In this case, the annual tariff increase rate of ENR is assumed at 7%, just the same as that of other modes, while new recruitment is assumed to be stopped until 2001/2002.

Case 2-2

In this case, the tariff increase rate is assumed to be the same as in **Case 2-1**, while new recruitment is assumed to be carried out at 1% of the total number of staff.

In short, in terms of tariff increase, Case **1**-1/2 can be called the "7-5 case", and Case **2**-1/1 the "7-7 case". In terms of recruitment, Case 1/2-**1** can be called the "no-new-recruitment case" and Case 1/2-**2** called the "minimum recruitment case".

Table 5.2.1 gives an outline of all five alternatives, including **"Without"** case.

Table 5.2.1 Business Improvement Alternative Cases

	Tariff Increase	Strengthen Ticket Checking	Train Speed-up	Introducing Government-Compensation	Reduction of Staff	Line Closure	Other Improvement
Without	Rail: 5% Other modes: 5%	No	Current Speed	Status quo	Recruit at Current pace	None	None
Case 1-1	Rail: 7% Other modes: 5%	Yes	10% on main line	For Excessive discount & new line for development	No new recruitment	5 lines	Done
Case 1-2	Rail: 7% Other modes: 5%	Yes	10% on main line	For Excessive discount & new line for development	1% new recruitment	5 lines	Done
Case 2-1	Rail: 7% Other modes: 7%	Yes	10% on main line	For Excessive discount & new line for development	No new recruitment	5 lines	Done
Case 2-2	Rail: 7% Other modes: 7%	Yes	10% on main line	For Excessive discount & new line for development	1% new recruitment	5 lines	Done

Each case was tested under the condition where the government support is terminated in 97/98 and where it is postponed until 2001/2002.

CHAPTER 6 TRANSPORT DEMAND FORECAST

6.1 INTRODUCTION

Estimating future transport flows of passengers and freight can be considered the most important issue of the transport planning process. This can be attributed to their major role in assessing the investment plans and evaluating different improvement policies of any transport system such as railways. The accuracy and reliability of the estimated future transport flows depend to a great extent on the analysis procedure and quality of available data. Transport demand is determined through quantitative relationships with socio-economic parameters such as population, gross domestic product (GDP), production, consumption, etc. Completeness and reliability of quantified description of the present situation depends on the availability of the above-mentioned socio-economic variables. Then, mathematical models can be calibrated for different stages of transportation using the data of the base year (1995). The calibration parameters of these models are assumed to be valid and applicable in the future. Expected flow in the future can be determined by applying the calibrated models to the future socio-economic variables.

Although this sequential approach could be applied in case of railway passengers, it was not applied (completely) in case of freight movement. In ENTS IV-Highways, a comprehensive production-consumption study has been conducted to predict the commodity transport in the future. The current study depends on the freight movement data collected from ENR Computer Center to build the base year O-D matrices for different commodities. The constructed O-D matrices are projected to the future using appropriate growth factors derived from the commodity, population and GRDP growth rates.

Figure 6.1 shows a general flow chart describing the methodology adopted to forecast the volume of passengers and commodities transported by railways.

6.2 ZONING SYSTEM

One of the most important issues in transportation planning is to divide the study area into an appropriate number of traffic zones. It is often difficult to decide what level of aggregation should be used in analyzing data. Selecting a coarse zoning system will result in sacrificing the accuracy of the trip distribution model by converting some interzonal trips into intrazonal trips. On the other hand, dividing the study area into a huge number of traffic zones may complicate the analysis procedure. To keep consistency and integration with previous national transport studies in Egypt, the Study Team adopts the zoning system defined in ENTS II, III and ENTS IV-Highways.

The whole country is divided into 188 traffic zones which are further aggregated to the 29 semi-governorate system. The 188 and 29 zoning systems were used in analyzing the passenger and freight demand, respectively. Figure 6.2 shows the 29 and 188 zones adopted in the transport demand forecast. It can be noticed that traffic zones 155 to 177 are not shown in Figure 6.2. In addition, the boundary of traffic zone number 8 is shown as a dotted line because it is incorporated into Greater Cairo zone number 1.

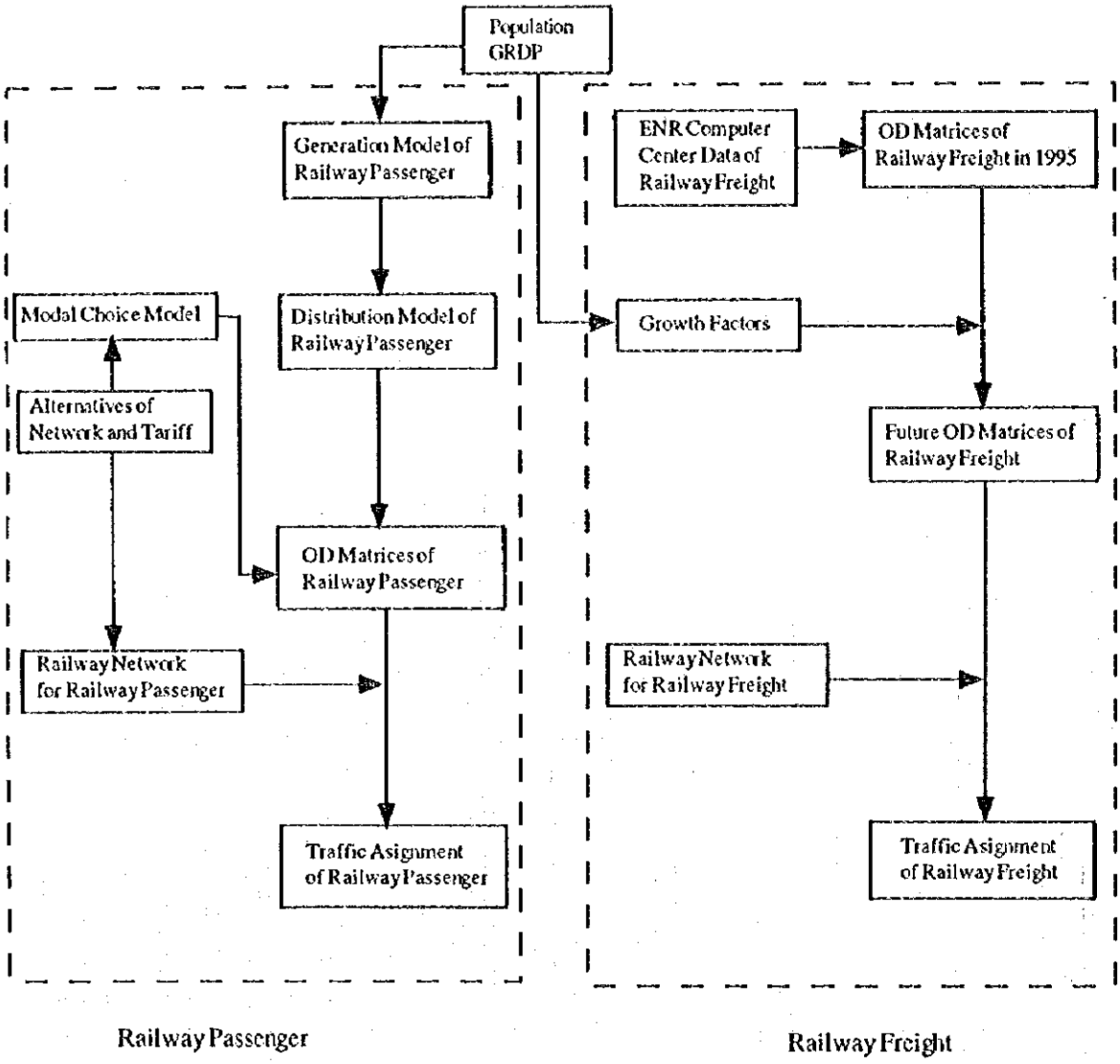


Fig. 6.1 Outline of Transport Demand Forecast

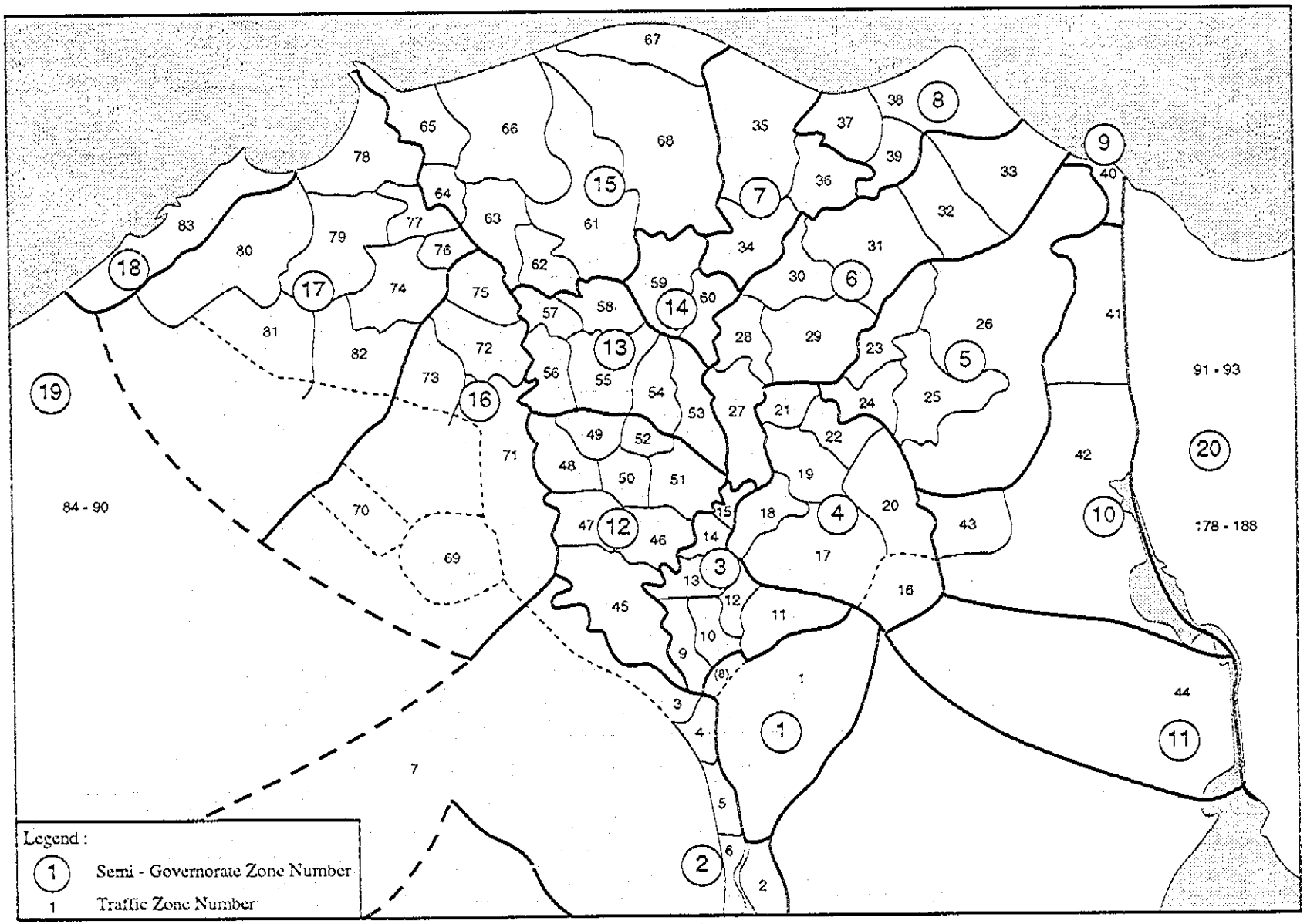


Fig. 6.2 (a) Zoning System (Lower Egypt)

Note : Traffic Zone Numbers of 155 to 177 are not shown.

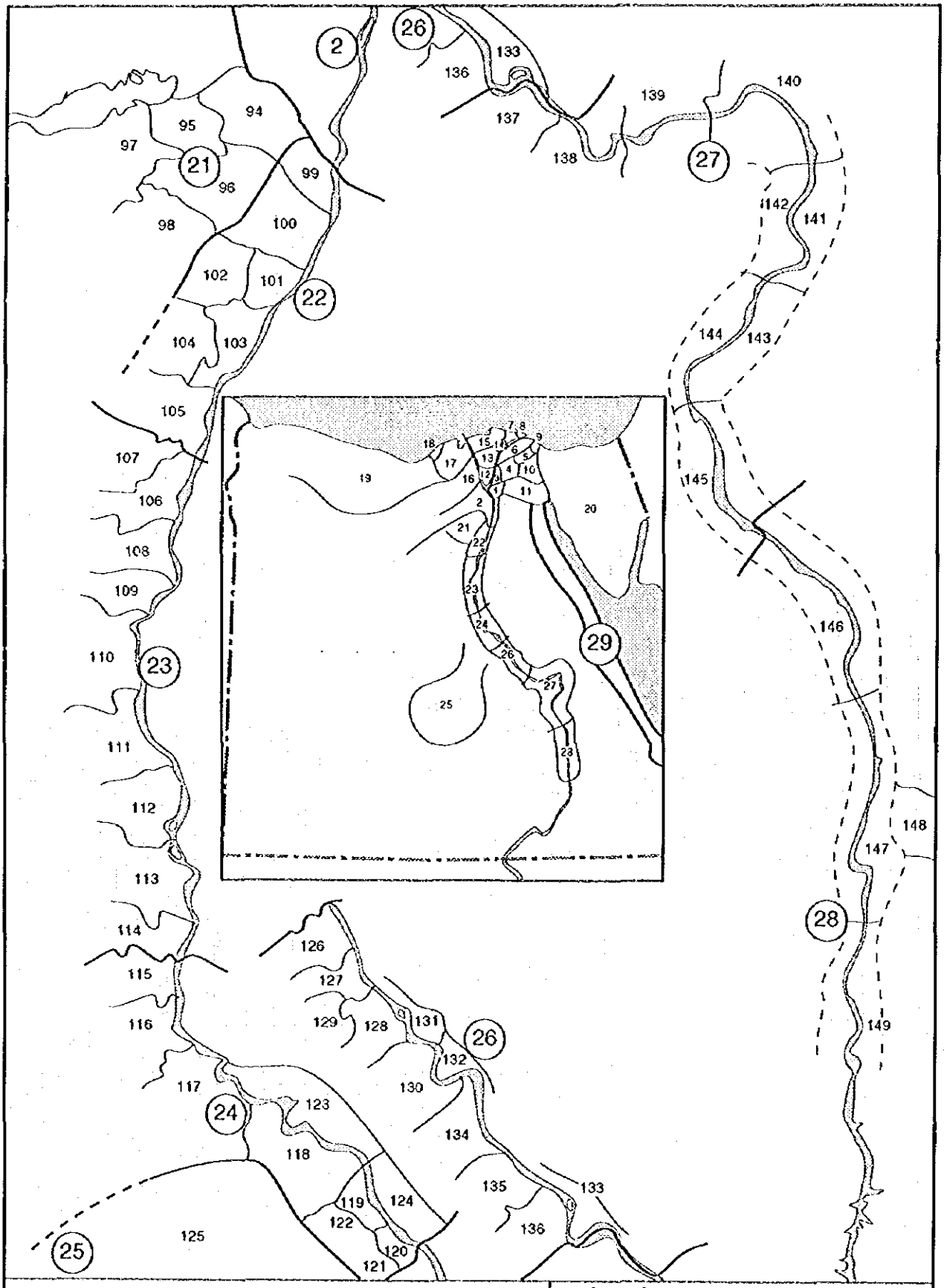


Fig. 6.2 (b) Zoning System (Upper Egypt)

Legend :

(1) Semi - Governorate Zone Number

1 Traffic Zone Number

Note : Traffic Zone Numbers of 155 to 177 are not shown

It should be mentioned that the ENR railway network includes around 900 railway stations. These stations were re-coded according to the 188 traffic zones. The relationships between railway stations and different zoning systems are shown in Appendix P 6.1. Before presenting the steps of modeling and forecasting passenger and freight movement of ENR, it is proper to summarize the field survey conducted by the Study Team in association with the Transport Group, an Egyptian Local Consultant.

6.3 DESCRIPTION OF FIELD SURVEYS

This section aims at shedding some light on the field surveys conducted by the Study Team to assist in developing the models required in the transport demand process and to draw a picture of the current situation of interchangeable movement of railway passengers. Therefore, the Study Team conducted some field surveys on the trains of the Egyptian National Railways and in selected bus and shared taxi terminals during the period December 28, 1995 and January 11, 1996. The field surveys include an O-D survey of railway passengers and a modal split survey on major trunk lines of ENR. Following is a brief description of type of these surveys. The detailed description of these surveys can be found in the Final Report of Field Survey, February 1996.

6.3.1 O-D Interview Survey of Railway Passengers

The purpose of this survey is to assist in identifying the pattern of railway passenger O-D matrix on the Egyptian National Railways (ENR). The interview was carried out using an on board survey, in which the surveyors fill in the questionnaire forms by interviewing the railway passengers in the train. The railway network consists of 43 lines (including freight lines) of different types of operating trains. The O-D survey extends to comprise most of the railway network. The survey covers such information as:

a) Characteristics of Passengers:
Age, sex, nationality, occupation and monthly income.

b) Characteristics of Trip:
- Trip purpose.
- Trip frequency per week.
- Departure railway station, city (or Markaz) and governorate.
- Arrival railway station, city (or Markaz) and governorate.
- Transportation mode from the trip origin to the departure railway station, required travel time and travel cost.
- Transportation mode from the expected arrival railway station to the final destination, estimated travel time and travel cost.
- In-train travel time.
- In-train travel cost.
- Method of fare acquisition or collection (ticket, seasonal ticket, through conductor or kilometer-based ticket) and any relevant information related to fare acquisition (e.g., seasonal ticket may be for one, three, six, nine or 12 months).

c) Other transportation mode than railway available for interview passengers, if any, and its required travel time and required travel cost.

d) Reason for utilizing the railway transportation service.

e) Other items to be noted by surveyor:
- Date and time of survey.
- Surveyed passenger train.
- Class of seat.

(Interview survey sheets show in Appendix S 6. 1 and S 6. 2.)

6.3.2 Modal Split Survey on Major Trunk Lines of ENR

The purpose of the modal split survey is to understand the present condition of the modal split between railway mode and the bus/taxi mode. The "Modal Split Survey on Major Trunk Lines of ENR" is focused on the intercity transportation on the corridors of Cairo-Alexandria, Cairo-Aswan and Cairo-Damietta. The survey objectives are the passengers of bus and taxi which run on the highway in parallel with the railway lines of those corridors. The survey was carried out for the passengers of buses and intercity taxies in the bus and intercity taxi terminals in the major cities of Cairo, Banha, Tanta, Alexandria, Mansoura, Damietta, Beni Suef, Qena and Aswan, which are situated in the trunk railway lines of ENR.

The survey covers information on the characteristics of passengers and their trips similar to that collected for the rail passengers and outlined above. The surveyors interview the passengers who queue up for bus/taxi in the bus/taxi terminals. If there was not enough time to conduct the survey for bus passengers queued at stations this was completed on board the bus.

6.3.3 Breakdown of Field Survey Forms

More than 17,500 survey forms were filled in which can be classified as in Table 6.1. It can be noticed from this table that around 95% of total survey sheets were available for data processing and analysis.

Table 6.1 Breakdown of Field Survey Forms

Type of Survey Form	Total Number of Survey Sheets	Number of Non-Available Survey Sheets	Total Number of Available Survey Sheets
Railway Passenger Detailed Forms	5,778	672	5,106
Railway Passenger O-D Forms	5,778	43	5,735
Bus Passenger Forms	3,618	171	3,447
Taxi Passenger Forms	3,646	56	3,590
Total Number of Survey Sheets	18,820	942	17,878

6.4 TRANSPORT DEMAND MODELS OF PASSENGER

The future number of railway passengers were predicted using the well-known sequential approach: trip generation, trip distribution and traffic assignment on the railways network. Mode choice models of a logit-type were calibrated to assess the effect of different improvement plans or alternative cases on the ridership share of railway passengers. Following is a description for these stages.

6.4.1 Estimation of Total Railway Passengers Based on Field Survey

One major step in the transport demand forecast is to identify the base year data required for the calibration of different transportation models. Fortunately, it was possible to obtain two databases represented by the collected data in the field surveys and the data obtained from ENR Computer Center. A great effort has been done to check, clean and validate the collected data. While the database of ENR Computer Center is very valuable, it is based only on normal tickets. It should be mentioned that normal tickets account for 60% of the total number of railway passengers. Therefore, this database was used mainly in developing transport demand models.

Field survey data was compiled and used to check the first database at different aspects. First, the total number of railway passengers was estimated as shown in Appendix P 6.2. Appendix P 6.2 presents the departure station, arrival station, distance between those stations, train number (selected as a sample for each service), number of trains of such service for each railway line, number of coaches, total passengers and passenger-km. The data are outlined based on the surveyed railway lines in addition to the data obtained from the train's time table. Table 6.2 summarizes these information for each line. The field survey covers almost the whole passenger railway network. However, some lines were excluded from the field survey as can be seen in Table 6.2. The total passenger-kilometer is estimated as 123,689,462 for a total network length of 2,853 kilometers. The total number of coaches and trains were estimated as 8,807 and 1,191, respectively. Moreover, the average number of passengers per one kilometer of the surveyed railway network is estimated as 43,354.

The field survey data was analyzed to estimate the distribution of fare payment method for each railway line as shown in Table 6.3. The normal tickets represent 66.4%, 67.6% and 56.6% for Cairo - Alexandria, Cairo - Aswan and Banha - Port Said lines, respectively. It should be mentioned that the average distributions of fare collection methods are 59.3%, 3.6%, 36.4%, 0.5% for normal, conductor, seasonal and kilometer tickets, respectively. Only 0.4% were coded as "OTHER" which denotes to unknown or missing data. This result supports the assumption used in the subsequent process of developing transportation models.

6.4.2 Trip Generation Model

To calibrate the trip generation model, the following variables were input for statistical analysis based on 188 traffic zones:

(a) Population size as independent variable.
(b) Gross Regional Domestic Product (GRDP) as independent variable.
(c) Number of railway passengers per day for normal tickets as dependent variable.

The daily number of railway passengers generated from or attracted to each of the 188 traffic zones is estimated from the database obtained from ENR Computer Center as follows. Station-to-station O-D data was available for seven consecutive months (May till November, 1995). It was mentioned in the Progress Report that only four months (May, June, September and October) can be used in constructing the base year O-D matrix. This was done after checking, cleaning and validating the raw data obtained from ENR Computer Center. The cleaned data was aggregated to result in the total number of passengers required for item (c) above.

Next, many runs of fitting different forms of curves (e.g., linear, logarithmic, inverse, quadratic, cubic, compound, power and S-curve) were performed to investigate the relationship between each independent variable and the dependent variable. The cubic and quadratic equations were reasonable with regard to the coefficient of determination (R^2). However, the application of theses models yield unrealistic prediction of railway passengers in the future represented by negative number of passengers in some zones. Therefore, different trials were made using nonlinear regression analysis to develop the following generation and attraction models:

$$G = 57.82\ (POP)^{0.37608}\ (GRDP)^{0.39556} \qquad (R = 0.66) \qquad (1)$$

$$A = 94.83\ (POP)^{0.26677}\ (GRDP)^{0.41831} \qquad (R = 0.78) \qquad (2)$$

where:

G = Generated number of railway passengers per day using normal tickets.
A = Attracted number of railway passengers per day using normal tickets.
POP = Population of each traffic zone (1,000).
GRDP = Gross Regional Domestic Product (1,000 LE)

Generation and attraction models were applied to forecast the number of railway passengers per day generated from or attracted to each traffic zone. Based on the statistics of ENR and the results of traffic survey conducted by the Study Team, the number of passengers using normal tickets constitutes around 60% of total railway passengers. This ratio was used to expand the generated and attracted number of passengers to result in the total number of railway passengers per day for different planning years on the level of 188 traffic zones as shown in Appendix P 6.3. It can be noticed from Appendix P 6.3 that only 108 traffic zones are reported to include generation or attraction volume of railway passengers. Appendix P 6.3 is aggregated to the level of 29 semi-governorate zoning system in Table 6.4.

On the level of 188 zoning system, Appendix P 6.3 shows that in years 1995 and 2012 Greater Cairo zone constitutes the highest number of daily railway passengers (10.6% and 10.7%) followed by Alexandria (5.5% and 6.0%), Banha (2.7% and 2.8%), Imbaba (2.2% and 2.3%) and Mahalla El Kubra (1.7% and 1.8%). On the level of 29 semi-governorate, Figure 6.3-D shows that in year 2012 Greater Cairo comprises 10.7% of total railway passengers followed by Qalyubia (7.4%), Alexandria (6.0%), Menya (5.96%) and Giza (5.95%). Table 6.4 indicates that total number of railway passengers will increase 61% on the average within the period 1995 till 2012. It can be noticed from Figure 6.3-A through Figure 6.3-D that three semi-governorates (Sinai, New Valley and Red Sea) have zero railway passengers because they are not covered by the railways network.

Table 6.2 Passenger-Kilometer, Coach Occupancy and Train Occupancy for Each Railway for Each Railway Line in the Base Year (1995)**

Line Code	Line Name	Length (Km)	Total Coaches	Total Trains	Pass. No. Per One Km	Passenger-Kilometer	Pass Per Coach	Pass Per Train
1	Cairo - Alexandria	208	1,446	146	167,502	34,823,755	116	1,147
2	Cario - Sad El Aaly	892	2,192	225	59,505	53,085,788	27	264
3	Banha - Port Said	192	737	67	58,571	11,254,495	79	874
4	Tanta - Mansoura	--	--	--	--	--	--	--
5	Abees - Ras El Teen	--	--	--	--	--	--	--
6	Helwan - Marg	--	--	--	--	--	--	--
7	Nafeeaha - Suez	91	90	18	3,195	290,589	35	177
8	Manousra - Damietta	63	535	68	60,161	3,762,662	112	885
9	Zaqazeeq - Tanta	56	160	32	18,307	1,029,051	114	572
10	Imbaba - Itay El Barood	119	226	35	19,604	2,341,347	87	560
11	Sidi Gaber - Abu Qeer	--	--	--	--	--	--	--
12	Qalyoub - Minoof - Tanta	94	240	48	22,705	2,125,621	95	473
13	Ain Shams - Suez	135	70	14	6,461	871,290	92	462
14	Wasta - Fayoum - Abuksa	61	151	29	9,347	572,605	62	322
15	Marg - Shebeen El Qanater	21	220	44	17,064	366,135	78	388
16	Maemoora - Rasheed	52	136	23	5,097	263,993	38	222
17	Mansoura - Matareya	71	144	24	4,843	344,855	34	202
18	Qalyoub - Zaqazeeq	--	--	--	--	--	--	--
19	Zaqazeeq - Manousra	71	563	67	92,284	6,509,720	164	1,377
20	Abu Kebeer - Saltheya	34	217	31	6,762	231,325	31	218
21	Banha - Zefta	33	60	12	2,418	79,200	40	201
22	Faqoos - Samaena	10	110	22	5,810	58,740	53	264
23	Minoof - Kafr El Zayat	50	108	24	11,309	564,000	105	471
24	Santa - Mahalet Rouh	19	120	24	3,839	71,820	32	160
25	Mahalet Rouh - Damanhoor	73	181	34	11,557	845,823	64	340
26	Banha - Minoof	26	190	38	24,257	627,042	128	638
27	Qabbari - Marsa Matrouh	295	140	24	4,226	1,246,704	30	176
28	Sherbeen - Qaleen	81	366	66	25,116	2,036,164	69	381
29	Boseily - El Qassaby	29	66	12	897	25,578	14	75
30	Fayoum - Sennoores	12	120	20	2,574	30,240	21	129
31	Desouq - Metobus	27	70	14	3,854	102,760	55	275
32	Abbaseya - Tura	--	--	--	--	--	--	--
33	Geish - Magharat	--	--	--	--	--	--	--
34	Samala - Saloom	--	--	--	--	--	--	--
35	Tebbeen - Wahat El-Bahareya	--	--	--	--	--	--	--
36	Ittehad - Qabbary	--	--	--	--	--	--	--
37	Beni Suef - Lahoon	25	90	18	4,128	101,340	46	229
38	Gaweesh - Abdel Samad	12	40	8	1,937	22,416	48	242
39	Gabal El Asfar - Masanei	--	--	--	--	--	--	--
40	Kafr Saad - Kafr Solyaman	3	20	4	1,398	4,404	70	350
41	Kafr Batteekh - Damietta Port	--	--	--	--	--	--	--
42	Qena - Safaga	--	--	--	--	--	--	--
43	Qena - Abu Tartoor	--	--	--	--	--	--	--
Total		2,853	8,807	1,191		123,689,462		

Average Number of Passengers per One Kilometer of Railway Line = 43,354

** Values are calculated based on the Results of Field Survey and Time Table of Trains.

Table 6.3 Distribution of Fare Payment Method Among the Interviewees of Railway Passengers

Line Code	Line Name	Sample Size	Line Share* (%)	Fare Payment Method					Fare Payment Method (%)				
				Ticket	Paper	Season	KM	Other	Ticket	Paper	Season	KM	Other
1	Cairo - Alexandria	3602	32.6	2391	103	1064	26	18	66.4	2.9	29.5	0.7	0.5
2	Cario - Sad El Aaly	1987	18.0	1344	137	491	14	1	67.6	6.9	24.7	0.7	0.1
3	Banha - Port Said	984	8.9	557	2	412	12	1	56.6	0.2	41.9	1.2	0.1
4	Tanta - Mansoura	--	--	--	--	--	--	--	--	--	--	--	--
5	Abees - Ras El Teen	--	--	--	--	--	--	--	--	--	--	--	--
6	Helwan - Marg	--	--	--	--	--	--	--	--	--	--	--	--
7	Nafeeaha - Suez	90	0.8	46	2	42	0	0	51.1	2.2	46.7	0.0	0.0
8	Manousra - Damietta	870	7.9	408	96	360	0	6	46.9	11.0	41.4	0.0	0.7
9	Zaqazeeq - Tanta	143	1.3	53	2	88	0	0	37.1	1.4	61.5	0.0	0.0
10	Imbaba - Itay El Barood	131	1.2	86	5	40	0	0	65.6	3.8	30.5	0.0	0.0
11	Sidi Gaber - Abu Qeer	--	--	--	--	--	--	--	--	--	--	--	--
12	Qalyoub - Minoof - Tanta	910	8.2	475	0	434	1	0	52.2	0.0	47.7	0.1	0.0
13	Ain Shams - Suez	33	0.3	31	1	1	0	0	93.9	3.0	3.0	0.0	0.0
14	Wasta - Fayoum - Abuksa	317	2.9	207	10	100	0	0	65.3	3.2	31.5	0.0	0.0
15	Marg - Shebeen El Qanater	32	0.3	18	0	14	0	0	56.3	0.0	43.8	0.0	0.0
16	Maemoora - Rasheed	314	2.8	133	4	176	0	1	42.4	1.3	56.1	0.0	0.3
17	Mansoura - Matareya	108	1.0	55	3	50	0	0	50.9	2.8	46.3	0.0	0.0
18	Qalyoub - Zaqazeeq	--	--	--	--	--	--	--	--	--	--	--	--
19	Zaqazeeq - Manousra	288	2.6	120	28	138	0	2	41.7	9.7	47.9	0.0	0.7
20	Abu Kebeer - Salheya	51	0.5	31	0	20	0	0	60.8	0.0	39.2	0.0	0.0
21	Banha - Zefta	47	0.4	23	0	23	0	1	48.9	0.0	48.9	0.0	2.1
22	Faqoos - Samaena	--	--	--	--	--	--	--	--	--	--	--	--
23	Minoof - Kafr El Zayat	73	0.7	28	1	43	0	1	38.4	1.4	58.9	0.0	1.4
24	Santa - Mahalet Rouh	40	0.4	20	1	19	0	0	50.0	2.5	47.5	0.0	0.0
25	Mahalet Rouh - Damanhoor	299	2.7	84	0	208	1	6	28.1	0.0	69.6	0.3	2.0
26	Banha - Minoof	169	1.5	106	1	60	1	1	62.7	0.6	35.5	0.6	0.6
27	Qabbari - Marsa Matrouh	87	0.8	35	3	49	0	0	40.2	3.4	56.3	0.0	0.0
28	Sherbeen - Qaleen	383	3.5	239	2	140	0	2	62.4	0.5	36.6	0.0	0.5
29	Boseily - El Qassaby	23	0.2	19	0	4	0	0	82.6	0.0	17.4	0.0	0.0
30	Fayoum - Sennoores	32	0.3	11	0	17	0	4	34.4	0.0	53.1	0.0	12.5
31	Desouq - Metobus	39	0.4	36	0	3	0	0	92.3	0.0	7.7	0.0	0.0
32	Abbaseya - Tura	--	--	--	--	--	--	--	--	--	--	--	--
33	Geish - Magharat	--	--	--	--	--	--	--	--	--	--	--	--
34	Samala - Saloom	--	--	--	--	--	--	--	--	--	--	--	--
35	Tebbeen - Wahat El-Bahareya	--	--	--	--	--	--	--	--	--	--	--	--
36	Ittehad - Qabbary	--	--	--	--	--	--	--	--	--	--	--	--
37	Beni Suef - Lahoon	--	--	--	--	--	--	--	--	--	--	--	--
38	Gaweesh - Abdel Samad	--	--	--	--	--	--	--	--	--	--	--	--
39	Gabal El Asfar - Masanei	--	--	--	--	--	--	--	--	--	--	--	--
40	Kafr Saad - Kafr Solyaman	--	--	--	--	--	--	--	--	--	--	--	--
41	Kafr Batteekh - Damietta Po	--	--	--	--	--	--	--	--	--	--	--	--
42	Qena - Safaga	--	--	--	--	--	--	--	--	--	--	--	--
43	Qena - Abu Tartoor	--	--	--	--	--	--	--	--	--	--	--	--
	Total	11,052	100.0	6556	401	3996	55	44	59.3	3.6	36.2	0.5	0.4

* Line share is estimated by dividing the sample size of each line by the total sample size.

Table 6.4 Average Generation and Attraction of Daily Railway Passengers for Different Planning Years -- 29 Semi Governorates

Semi Governorate			Estimated Number of Passengers in Year					2012 /
No.	Name	Code	1995	1998	2002	2007	2012	1995
1	Cairo	CAI	164,204	178,967	203,442	229,845	265,806	1.62
2	Giza	GIZ	86,778	100,061	113,768	127,942	147,724	1.70
3	Qaliubia	QAL	110,167	126,170	141,984	159,927	183,935	1.67
4	South Sharkia	SKS	68,426	73,843	82,988	95,046	108,524	1.59
5	North Sharkia	SKN	29,997	32,038	35,962	41,012	46,371	1.55
6	East Dakahlia	DKE	83,094	89,487	100,893	113,704	129,989	1.56
7	West Dakahlia	DKW	35,756	38,474	43,202	48,450	55,292	1.55
8	Damietta	DAM	25,318	27,560	31,178	35,703	41,335	1.63
9	Port Said	PTS	19,195	22,179	25,287	29,106	33,275	1.73
10	Ismaillia	ISM	28,163	32,276	36,192	41,553	47,525	1.69
11	Suez	SUZ	16,332	19,000	21,825	33,858	38,531	2.36
12	Minufia	MIF	89,371	96,798	109,406	123,054	140,630	1.57
13	South Gharbia	GHS	70,799	77,123	86,576	97,933	112,249	1.59
14	North Gharbia	GHN	26,721	29,084	32,972	37,695	43,585	1.63
15	Kafr El Sheikh	KAF	65,024	69,465	77,755	87,394	99,761	1.53
16	South Beheira	BHS	21,784	23,638	26,309	29,967	33,911	1.56
17	North Beheira	BHN	57,667	62,848	70,480	80,729	92,175	1.60
18	Alexandria	ALX	85,593	94,585	107,175	129,102	148,739	1.74
19	Western Desert	WDS	8,807	9,404	10,819	12,462	14,270	1.62
20	Sinai	SIN	0	0	0	0	0	0
21	Fayoum	FAY	41,484	44,611	49,904	56,680	64,537	1.56
22	Beni Suef	BES	56,811	60,572	67,617	76,833	87,275	1.54
23	Minya	MYA	97,734	103,255	115,219	130,582	147,882	1.51
24	Asyut	ASY	63,802	67,797	75,578	87,090	98,758	1.55
25	New Valley	NEW	0	0	0	0	0	0
26	Sohag	SOH	74,048	78,428	88,104	102,246	116,176	1.57
27	Qena	QEN	82,316	87,521	98,467	115,104	131,345	1.60
28	Aswan	ASW	32,844	35,253	39,637	46,108	52,639	1.60
29	Red Sea	RED	0	0	0	0	0	0
TOTAL			1,542,235	1,680,435	1,892,740	2,169,126	2,482,239	1.61

Figure 6.3-A Generation of Daily Railway Passengers in 1995 and 1998 for the 29 Semi Governorates

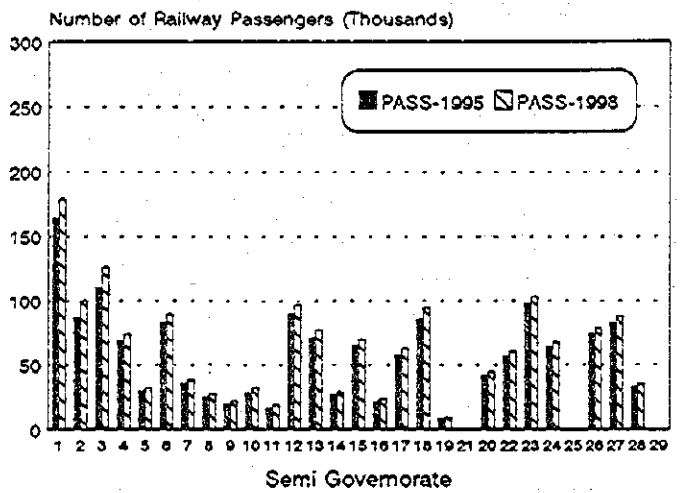


Figure 6.3-B Generation of Daily Railway Passengers in 1995 and 2002 for the 29 Semi Governorates

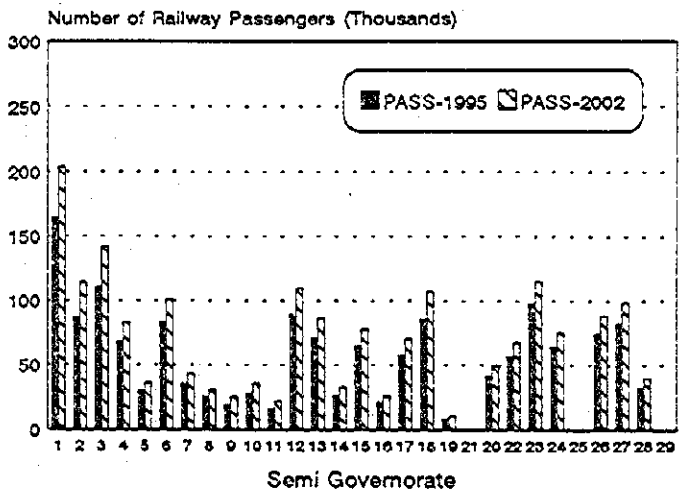


Figure 6.3-C Generation of Daily Railway Passengers in 1995 and 2007 for the 29 Semi Governorates

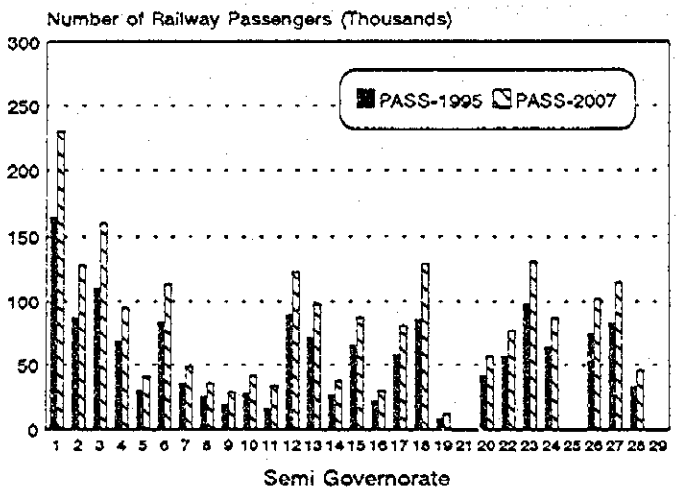
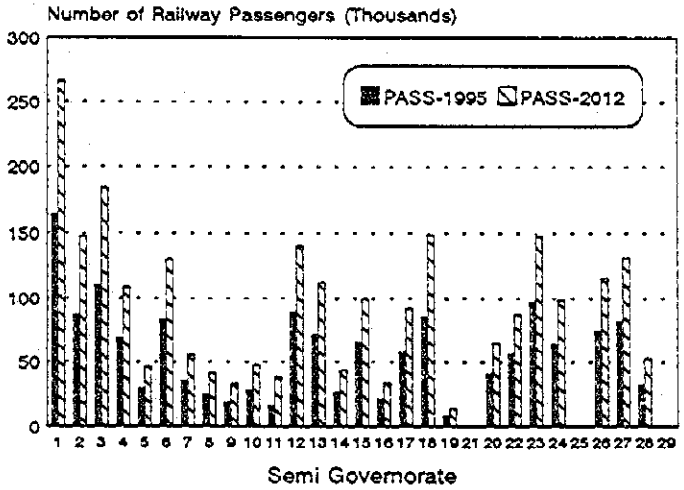


Figure 6.3-D Generation of Daily Railway Passengers in 1995 and 2012 for the 29 Semi Governorates



6.4.3 Trip Distribution Model

Based on the collected data from ENR Computer Center regarding the number of passengers of normal tickets for seven months (May through November 1995), the base year O-D matrix of normal ticket passengers was constructed. The data of July, August and November were excluded from the analysis because they were extremely biased. The average number of passengers of each O-D pair for the remaining four months was calculated based on the existing number of observations for each cell. Appendix P 6.4 presents the average distance O-D matrix for railway passenger kilometers. The average distance of a typical cell was calculated by dividing the total passenger-kilometers by total number of passengers of that cell which is aggregated from the station-based level to 188 zones level.

The gravity model has been receiving considerable attention for application in the analysis of both passenger and freight movements. Because the gravity model is essentially a statistically-based theory and takes on a mathematical form that is computationally tractable and easy to use, it was used in the current study. A doubly-constrained gravity model was calibrated to distribute the average of generated-attracted number of railway passengers based on the 188 zoning system analysis in target years. The gravity model is expressed as follows:

$$T_{ij} = A_i B_j O_i D_j \exp(-\beta c_{ij}) \quad (3)$$

where:

$$O_i = \sum_j T_{ij} \quad (4)$$

$$D_j = \sum_i T_{ij} \quad (5)$$

$$A_i = \frac{1}{\sum_j B_j D_j \exp(-\beta d_{ij})} \quad (6)$$

$$B_j = \frac{1}{\sum_i A_i O_i \exp(-\beta d_{ij})} \quad (7)$$

$$C = \sum_{ij} T_{ij} d_{ij} \quad (8)$$

where:

T_{ij} = Number of railway passengers between zone i and zone j.
O_i = Number of railway passengers originating in zone i.
D_j = Number of railway passengers terminating in zone j.
A_i = Balancing factor for zone i that insures that trip generation satisfies equation (4).
B_j = Balancing factor for zone j that insures that trip attraction satisfies equation (5).
d_{ij} = Average travel distance from zone i to zone j.
C = Aggregate system wide travel cost (distance).
ß = Calibration parameter.

The calibration parameter ß (0.00671584) was used to distribute the average of the generated and attracted number of daily passengers in 1995, 1998, 2002, 2007 and 2012 as shown in Appendix P 6. 5 and P 6.6 for the base year (1995) and target year (2012), respectively.

In order to assess the accuracy of the trip distribution model, the trip length frequency distributions of the synthesized and observed O-D matrices of railway passengers are estimated and shown in Fig. 6.3-A. The horizontal axis represents the distance in 40-km intervals, while the vertical axis represent the present of passengers within each 40-km interval relative to the total railway passengers. The distribution patterns of observed and synthesized O-D matrices are consistent and show the reliability of the calibrated distribution model of railway passengers.

Moreover, a comparison is made between the trip length frequency distributions of observed O-D matrices and the sampled railway passengers obtained from the O-D survey concluded by the Study Team and shown in Fig. 6.3-B. The two distribution curves are almost consistent except for the 200 km interval, which can be attributed to over-sampling of such a category of railway passengers. Therefore, it can be concluded that the distribution pattern of observed railway passengers based on the information obtained from ENR Computer Center is more reliable and dependable than the surveyed sample (compare Fig. 6.3-A and 6.3-B).

6.4.4 Mode Choice Model

To estimate future railways passenger demand, the impact of other competitive modes on the demand volume was analyzed. The modes of intercity taxis and buses represent the most effective competitors to railways. Therefore, the Study Team has conducted a mode choice survey for the passengers of railways, buses and intercity taxis. The railways mode was analyzed against competitive modes (buses + intercity taxis).
The collected data was used to calibrate the logit model which takes the following general form:

$$P_m = \frac{e^{U_m}}{e^{U_1} + e^{U_2} + e^{U_m} + \ldots + e^{U_n}} \qquad (9)$$

where:

P_m = ridership share used by mode m.

U_m = utility function of mode m, which generally takes the following linear form:

$$U_m = a_o + a_1 x_1 + a_2 x_2 + \ldots + a_L x_L \qquad (10)$$

where:

$x_1 \ldots x_L$ = the general characteristics for transport mode or passenger (i.e., travel time, travel cost, comfort and safety for transport mode and average income for passenger).

$a_0 \ldots a_L$ = calibrated coefficients.

n = number of competitive transport modes.

L = number of dependent variables of utility function.

This model can be used to determine the future ridership share of passenger trips assigned to railways in case of different policy changes such as enhancing the service level (speed-up), changing the fare, etc.

The main variables in the logit model can be classified into three categories related to transport system, trip and passenger. The analyzed variables include these three categories as follows:

1) Travel fare in LE
2) Access cost from origin to train station or bus/taxi terminal.
3) Egress cost (LE) from the train station or bus/taxi terminal to the final destination.
4) In mode travel time (minutes).
5) Access time (LE) from origin to train station or bus/taxi terminal.
6) Waiting time (minutes) at the train or bus/taxi terminal.
7) Egress time (minutes) from the train station or bus/taxi terminal to the final destination.
8) The ratio between the fare and income (Fare/Income in LE) could be more significant than fare alone in the model, since the sensitivity of the passenger to fare is related to his monthly income.
9) Trip purpose.
10) Passenger-related variables (car ownership, profession, income, age, sex and nationality).

Several specifications for the variables contained by the utility functions were made to choose the best statistical and logical model form. Table 6.5 shows only the results of three selected runs of logit model calibration. The first model includes transport system-related variables (fare and travel time). The variable of fare divided by monthly income was submitted to the second model. The third model includes all variables that can be submitted to the logit model while satisfying the logical condition (number 1 below).

To choose the best model, the following conditions should be fulfilled:

1) The signs of the variables should be logical. The chosen variables related to transport system should have negative coefficients indicating a decrease in the utility of a mode due to an increase in travel time or fare. Access, Waiting and Egress times were initially rejected because they failed to satisfy such a condition.
2) The variable coefficients should be statistically sound in terms of T-Test statistics for each coefficient being less than 1.960 at 5% confidence level.
3) Finally, the value of ρ^2 that indicates the accuracy of the model as a whole. This value is between 0 and 1, with value close to 1 being statistically better. In addition the percentage of right choices (% Right) reflects the ability of the model to have estimated output equal or close to actual choices.
4) Possibility of forecasting explanatory variables for the sake of testing different alternatives and analyzing their effects on the ridership share of railway passengers.

Although the third model shows the highest ρ^2, the first model was selected to test different alternatives because it satisfies the fourth condition. Based on these criteria, the most appropriate model for all-income groups is expressed as follows:

$$P_{TRAIN} = \frac{1}{1+e^{-(V_{TRAIN}-V_{BUS/TAXI})}} = \frac{1}{1+e^{-(U_{TRAIN})}} \qquad (11)$$

where:

$U_{TRAIN} = -0.5781 - 12.920\ FARE - 0.0723\ TIME$ *All-Income Groups* (12)

$$P_{BUS/TAXI} = 1 - P_{TRAIN} \quad (13)$$

U_{TRAIN} = Utility function of train.
$U_{BUS/TAXI}$ = Utility function of bus and taxi.
FARE = Fare of train minus fare of bus/taxi (LE).
TIME = Travel time of train minus travel time of bus/taxi (minutes).

Another logit model was calibrated for high-income group as a trial to develop a more sensitive model to travel time as follows:

$U_{TRAIN} = 0.4812 - 8.339\ FARE - 0.1022\ TIME$ *High-Income Group* (14)

Both models are applied to test different alternatives as presented in Section 6.5.

6.4.5 Passenger Assignment on the Railway Network

Based on the definition of railway lines in Section 3.2 of Chapter 3, Egyptian National Railways can be divided into 43 lines which can be further subdivided into segments as shown in Fig. 6.5.(a) and 6.5.(b) for Lower Egypt and Upper Egypt, respectively. These segments (or links) are listed in Table 6.6 (in Appendix) sorted by line number as a first key in the first column. The second column represents the segment (link) code based on the line number and the sequential number of link on that line. Based on the train operation presented in Section 3.10, the average speed was allocated to each railway segment. Consequently, the travel time could be estimated for each railway segment, which could be used in turn to search for the shortest path from any railway station to another.

The estimated O-D matrices in target years were assigned on the railways network using an all-or-nothing assignment method to estimate the sectional volume of railway passengers per day. Table 6.7 (in Appendix) lists the passenger volumes on each segment of the railways network in different target years. The results of Table 6.7 (in Appendix) were aggregated from the 218-segment level to the 43-line level as shown in Table 6.8. The average number of passengers per one kilometer (density) on each railway line was estimated using the following formula:

$$PASS_L = \frac{\sum_{s=1}^{S} PASS_S\ DIST_S}{DIST_L} \quad (15)$$

where:

$PASS_L$ = Average number of passengers per one kilometer on railway line **L**.
$PASS_S$ = Number of passengers assigned to railway segment s.
$DIST_S$ = Length of railway segment s.
$DIST_L$ = Length of railway line **L**.
S = Number of railway segments on the railway line **L**.

Figures 6.6 through 6.10 show the traffic assignment maps of railway passengers on the railway network in the target years 1995, 1998, 2002, 2007 and 2012, respectively.
The results of traffic assignment of Table 6.8 can be compared with the results of field survey of Table 6.2 for the main railway lines:

- For Cairo-Alexandria line, passenger-kilometers resulting from the field survey is 34,823,755 or (85%) compared to 40,538,000 resulting from the passenger assignment.
- For Cairo-Aswan line, passenger-kilometers resulting from the field survey is 53,085,788 or (91%) compared to 58,590,000 resulting from the passenger assignment.
- For Banha-Port Said line, passenger-kilometers resulting from the field survey is 11,254,495 or (102%) compared to 11,009,000 resulting from the passenger assignment.

The deviation between passenger-kilometers resulting from the field survey and passenger assignment can be considered within the acceptable limits of accuracy. Moreover, the deviation can be attributed to many reasons such as:

- The field survey does not cover the whole railway network of passengers.
- One coach was selected from several coaches.
- One train was selected from a typical service.
- Effect of hourly, daily and monthly (seasonal) variations.

Fig. 6. 4-A Comparison between Trip Length Frequency Distributions of Observed and Estimated Railway Passengers in the Base Year (1995)

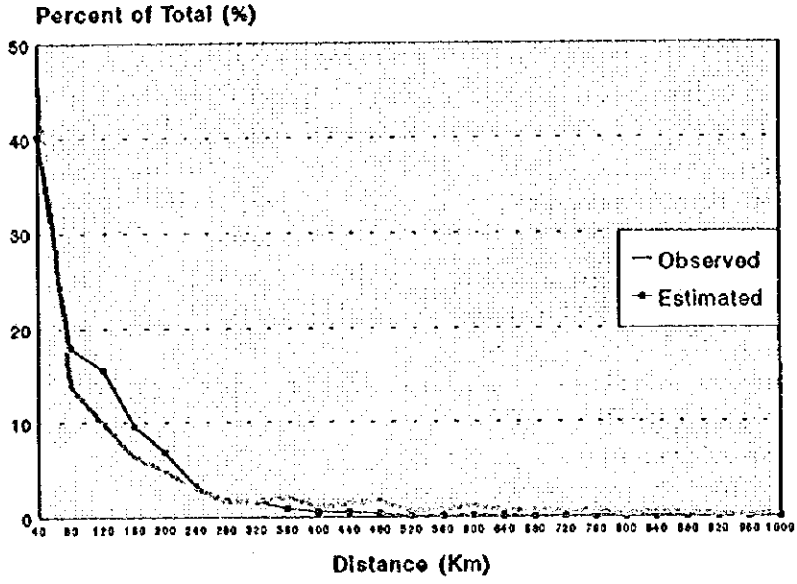


Fig. 6. 4-B Comparison between Trip Length Frequency Distributions of Observed and Surveyed Railway Passengers in the Base Year (1995)

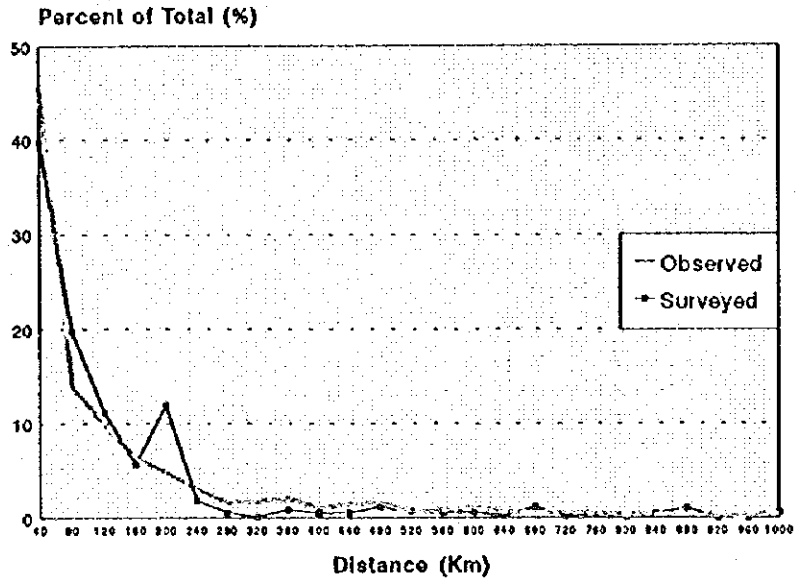


Table 6.5 Calibration Results of Different Specifications of Logit Model

Model	Variable name	Coeff-icient	Standard error	t-Test	ρ^2
(1)	Constant	-0.578	0.075	-7.71	0.700
	Fare	-12.920	0.570	-22.67	
	Travel time	-0.073	0.006	-12.26	
(2)	Constant	-0.601	0.074	-7.07	0.702
	Fare	-9.372	0.952	-9.85	
	Travel time	-0.072	0.006	-12.49	
	Fare/income	-647.200	164.600	-3.93	
(3)	Constant	0.110	0.934	0.12	0.720
	Fare	-8.552	1.010	-8.47	
	Travel time	-0.068	0.006	-11.38	
	Fare/income	-695.200	176.700	-3.93	
	Access Time	-0.260	0.120	-2.17	
	Egress Time	-0.222	0.111	-2.00	
	Trip Purpose	-0.379	0.055	-6.94	
	Nationality	-0.242	0.897	-0.27	
	Sex	0.292	0.203	1.44	
	Age	-0.031	0.006	-4.96	
	Profession	0.318	0.062	4.80	
	Car Ownership	-0.435	0.260	-1.67	
	Monthly Income	0.001	0.0004	3.24	

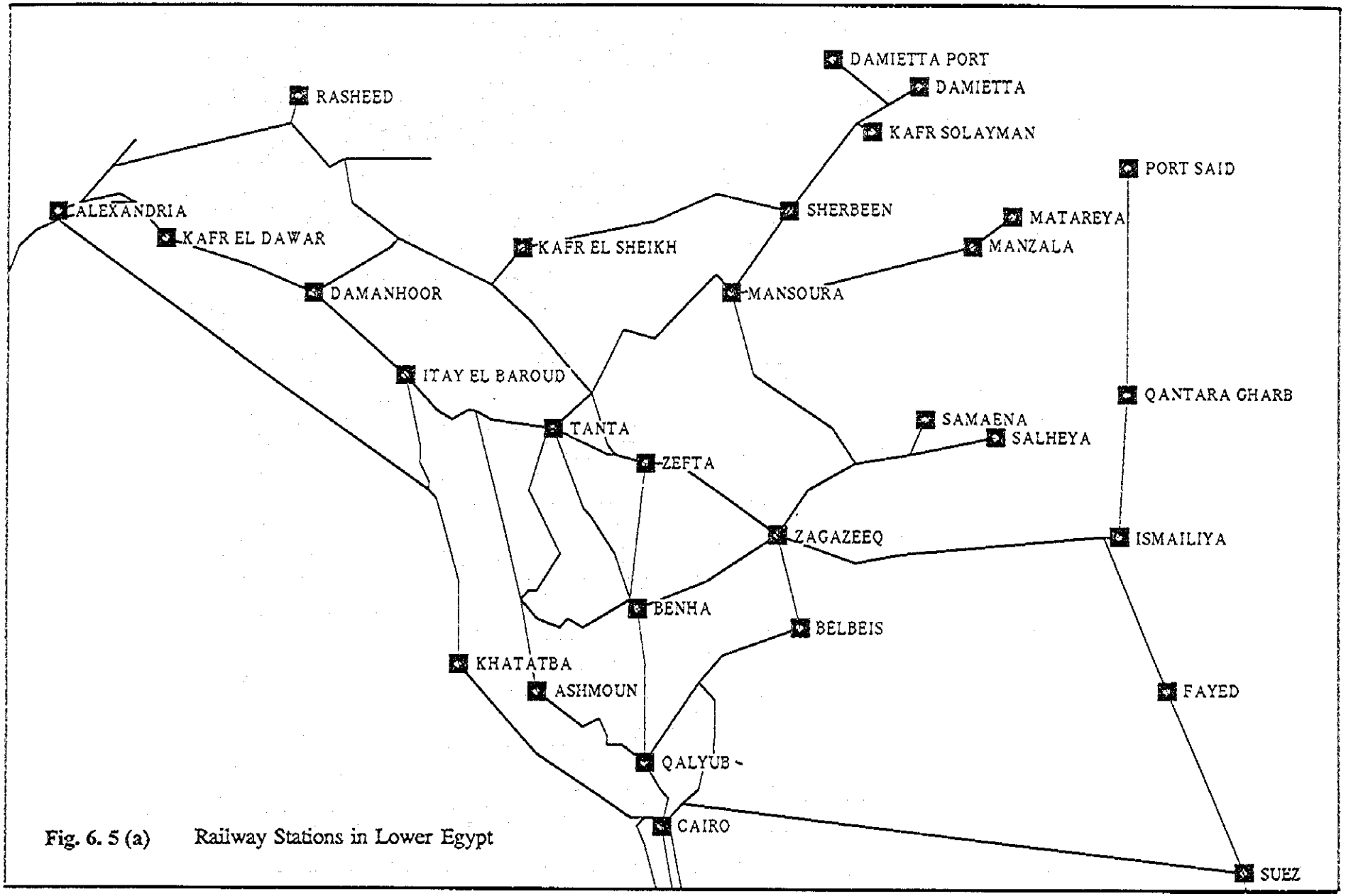


Fig. 6. 5 (a) Railway Stations in Lower Egypt

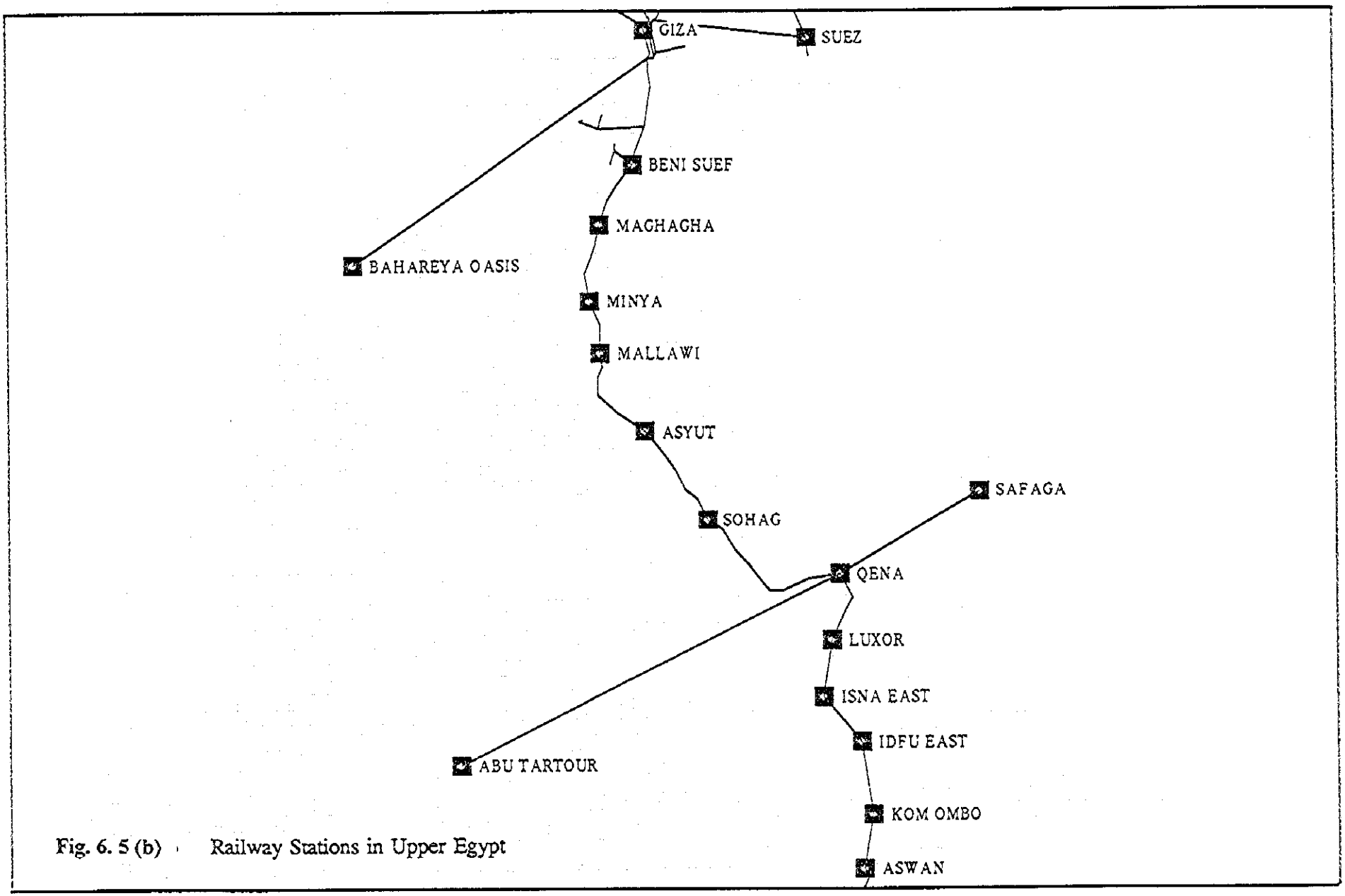


Fig. 6. 5 (b) Railway Stations in Upper Egypt

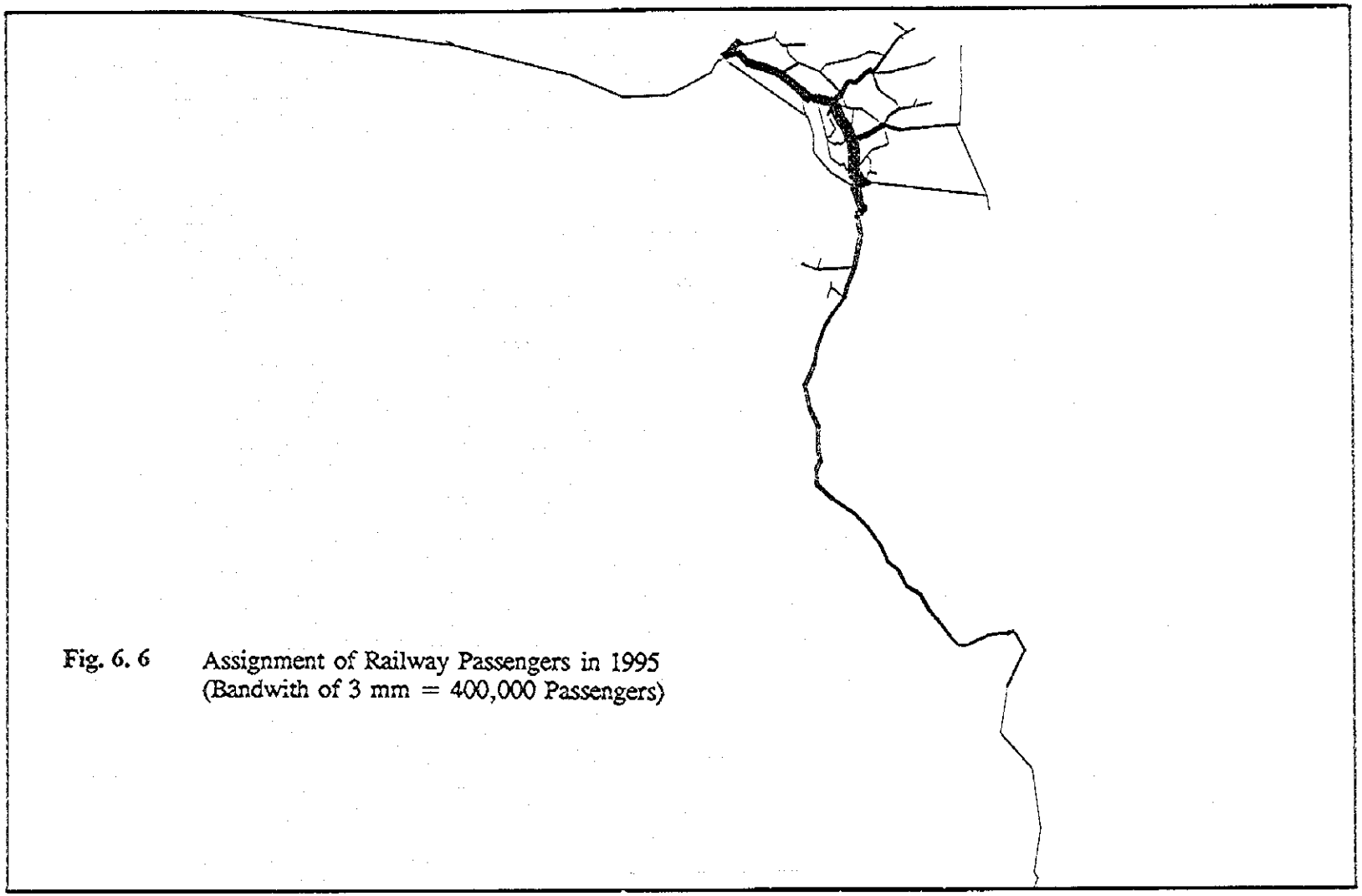


Fig. 6. 6 Assignment of Railway Passengers in 1995
(Bandwith of 3 mm = 400,000 Passengers)

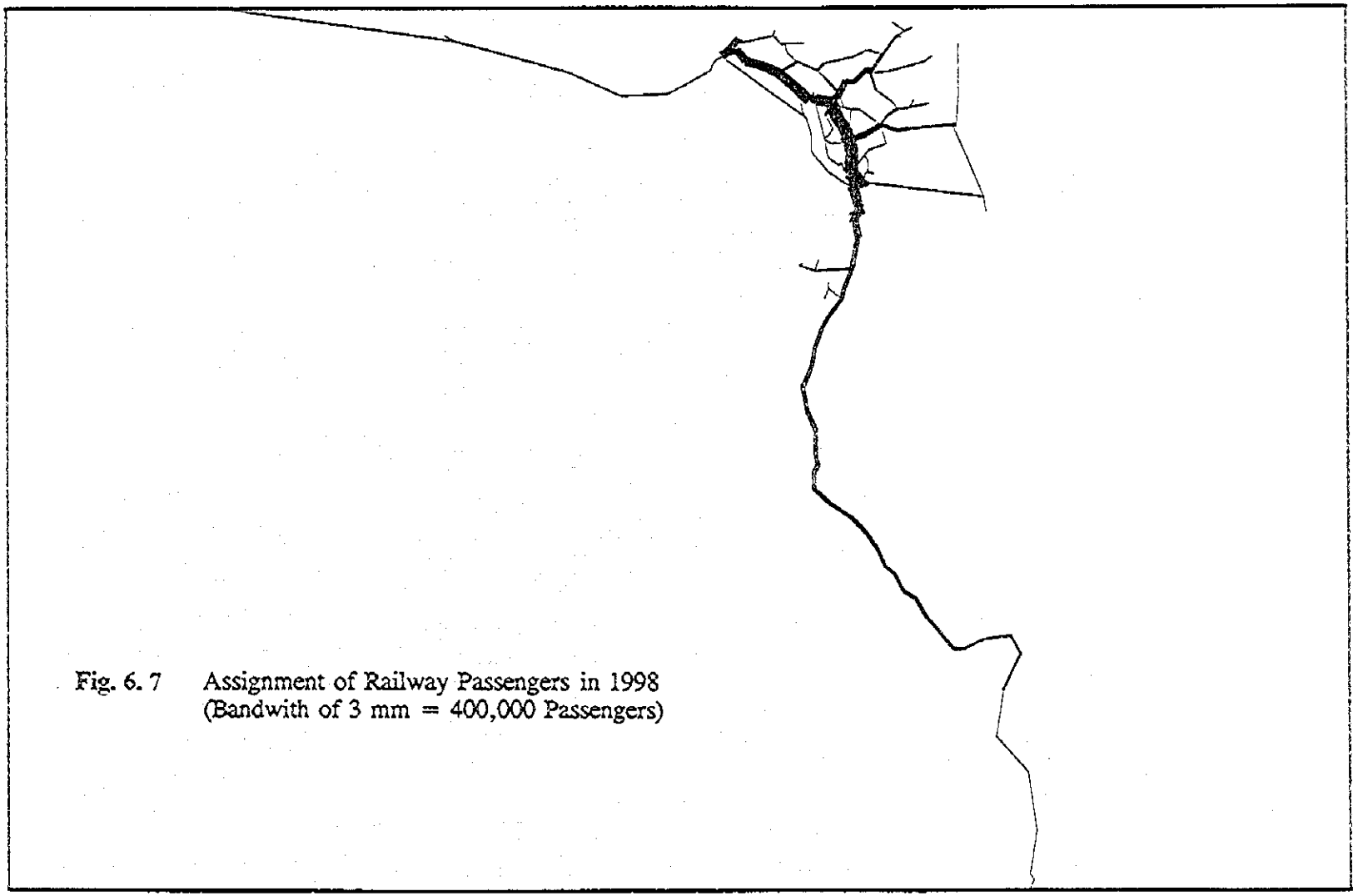


Fig. 6. 7 Assignment of Railway Passengers in 1998
(Bandwith of 3 mm = 400,000 Passengers)

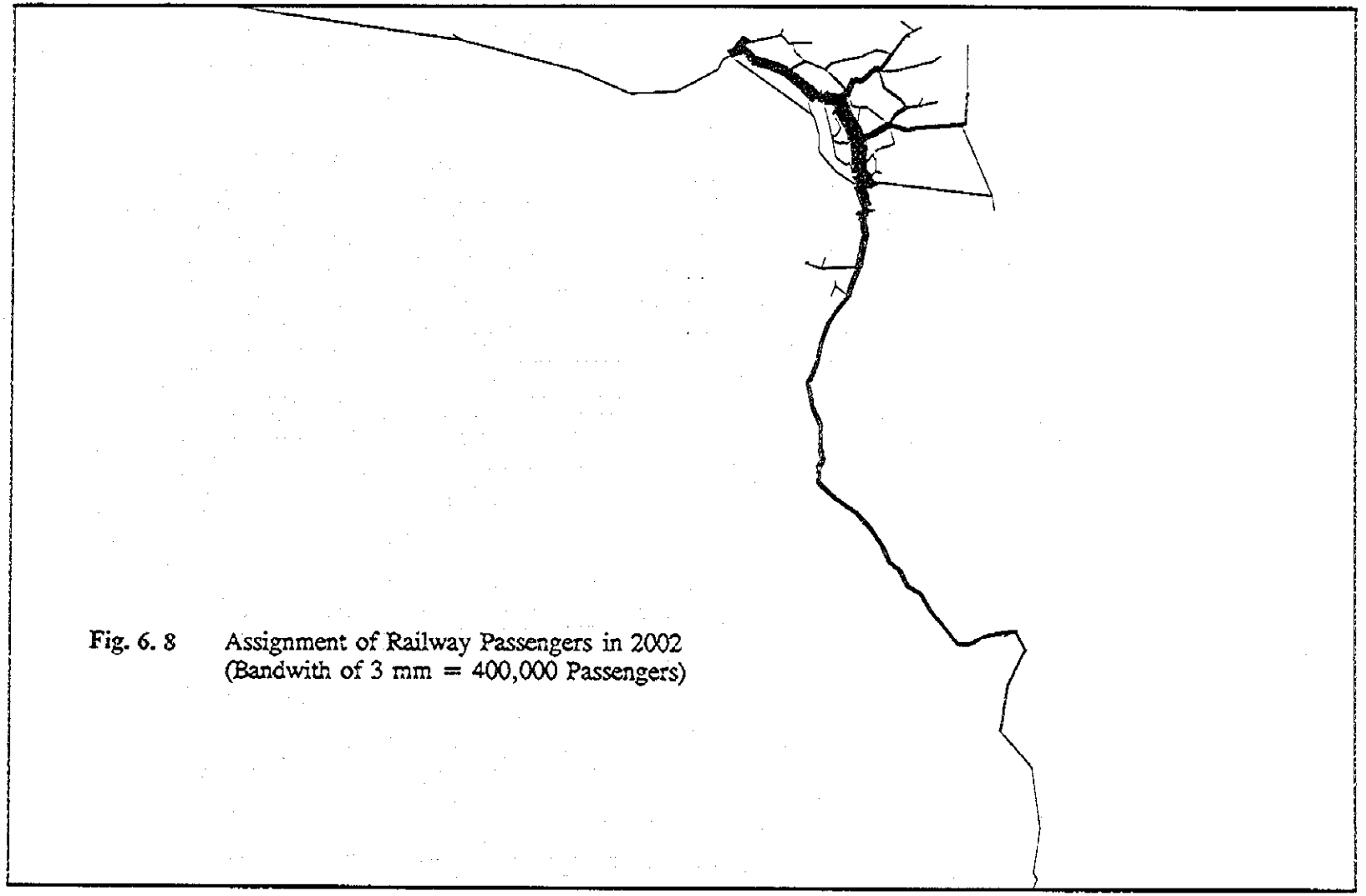


Fig. 6. 8 Assignment of Railway Passengers in 2002
(Bandwith of 3 mm = 400,000 Passengers)

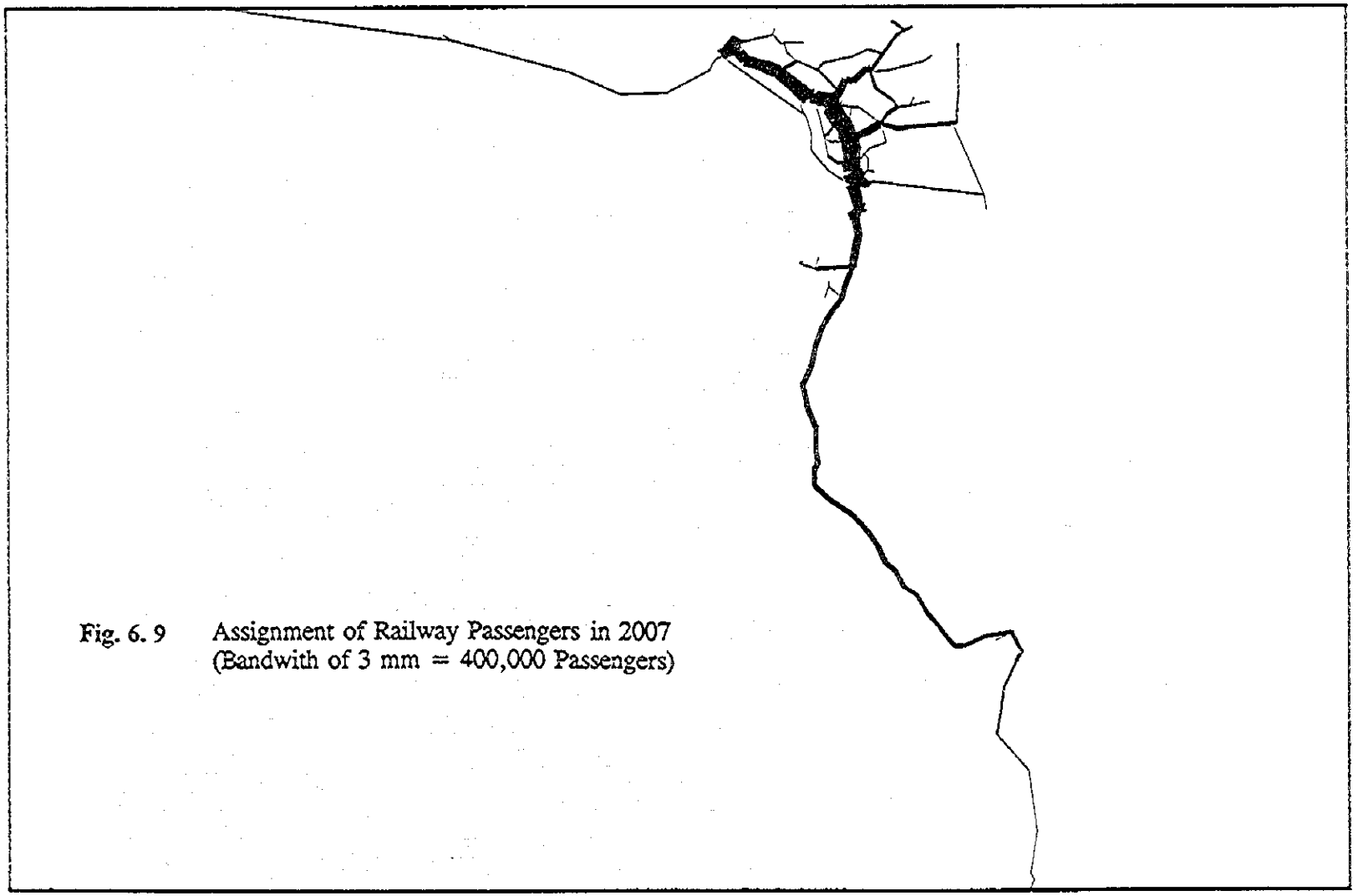


Fig. 6. 9 Assignment of Railway Passengers in 2007
(Bandwith of 3 mm = 400,000 Passengers)

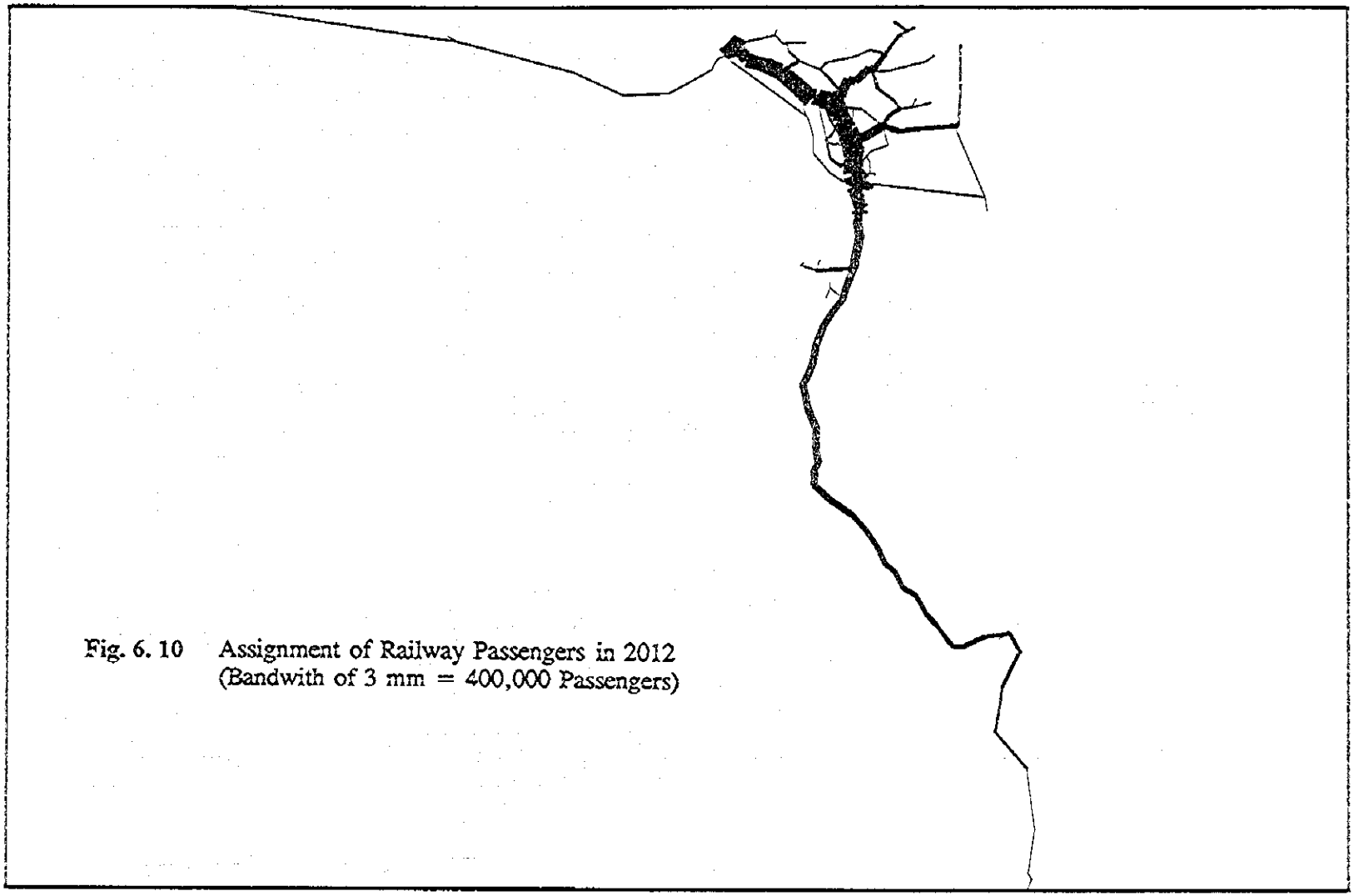


Fig. 6. 10 Assignment of Railway Passengers in 2012
(Bandwith of 3 mm = 400,000 Passengers)

Table 6.8 Number of Passengers per Kilometer and Passenger-Km (x 1000) for Railway Lines in Different Planning Years using All-Income Model: Do Nothing Case

LINE CODE	SEC	LNTH (KM)	Number of Passengers					Number of Passenger-Km (1000)				
			1995	1998	2002	2007	2012	1995	1998	2002	2007	2012
1	24	208	194,990	214,375	242,134	281,062	322,972	40,538	44,569	50,340	58,433	67,146
2	52	892	65,674	70,278	78,900	90,702	103,389	58,590	62,697	70,389	80,918	92,236
3	8	192	57,295	64,356	72,652	83,032	95,008	11,009	12,366	13,960	15,955	18,256
4	5	53	108,411	117,839	133,000	151,575	174,282	5,700	6,196	6,993	7,970	9,164
5	3	15	5,842	6,305	7,228	8,472	9,732	86	93	107	125	144
6	3	41	0	0	0	0	0	0	0	0	0	0
7	3	91	10,032	11,747	13,376	18,489	21,042	913	1,069	1,217	1,682	1,914
8	4	63	50,217	54,569	61,634	70,344	81,159	3,141	3,413	3,855	4,400	5,076
9	6	56	21,994	23,825	26,769	30,163	34,474	1,236	1,339	1,505	1,695	1,938
10	10	119	2,791	3,033	3,379	3,850	4,361	333	362	404	460	521
11	2	38	0	0	0	0	0	0	0	0	0	0
12	13	94	34,323	37,276	42,153	47,588	54,498	3,213	3,490	3,946	4,455	5,102
13	3	135	17,411	19,862	22,769	33,284	38,008	2,348	2,678	3,070	4,488	5,125
14	3	61	35,529	38,495	43,223	49,020	56,011	2,177	2,358	2,648	3,003	3,431
15	8	21	9,015	10,294	11,602	13,071	15,057	193	221	249	280	323
16	2	52	4,039	4,406	4,953	5,694	6,523	209	228	257	295	338
17	3	71	20,126	21,669	24,432	27,527	31,480	1,433	1,543	1,740	1,960	2,242
18	4	62	19,587	21,564	24,278	27,567	31,592	1,219	1,342	1,511	1,716	1,966
19	5	71	45,809	49,278	55,408	62,913	71,648	3,231	3,476	3,908	4,438	5,054
20	2	34	10,089	10,796	12,123	13,822	15,646	345	369	415	473	535
21	1	33	16,697	18,296	20,676	23,688	27,215	547	599	677	776	892
22	1	10	0	0	0	0	0	0	0	0	0	0
23	2	50	7,279	7,889	8,910	10,088	11,531	363	393	444	503	575
24	2	19	14,185	15,275	17,163	19,251	22,084	265	286	321	360	413
25	5	73	37,722	40,611	45,559	51,729	59,169	2,761	2,972	3,334	3,786	4,331
26	5	26	18,994	20,870	23,572	26,437	30,235	491	539	609	683	782
27	10	295	5,928	6,381	7,317	8,521	9,779	1,749	1,882	2,158	2,514	2,885
28	4	81	23,192	24,834	27,830	31,283	35,736	1,880	2,013	2,256	2,536	2,897
29	4	29	6,717	7,326	8,237	9,470	10,847	192	209	235	270	309
30	1	12	17,471	18,838	21,105	23,933	27,294	205	221	248	281	321
31	2	27	27,378	29,559	33,179	37,899	43,365	730	788	885	1,010	1,156
32	5	40	0	0	0	0	0	0	0	0	0	0
33	1	24	0	0	0	0	0	0	0	0	0	0
34	1	260	0	0	0	0	0	0	0	0	0	0
35	1	346	0	0	0	0	0	0	0	0	0	0
36	1	108	0	0	0	0	0	0	0	0	0	0
37	2	25	3,268	3,467	3,864	4,382	4,972	80	85	95	108	122
38	2	12	3,851	4,087	4,555	5,165	5,860	45	47	53	60	68
39	1	7	0	0	0	0	0	0	0	0	0	0
40	1	3	0	0	0	0	0	0	0	0	0	0
41	1	15	0	0	0	0	0	0	0	0	0	0
42	1	233	0	0	0	0	0	0	0	0	0	0
43	1	338	0	0	0	0	0	0	0	0	0	0
TOTAL	218	4431						145,224	157,846	177,829	205,633	235,261

6.5 ESTIMATION OF FUTURE TRAVEL DEMAND FOR ALTERNATIVES

Four types of alternative case-studies are presented in Chapter 5, namely, **Without Case**, **With Case 1-1/2** and **With Case 2-1/2** as shown in Table 5.2.1. **Without Case** denotes to 5 % fare raising for both railways and other competitive modes (bus/taxi). **With Case 1-1/2** denotes to 7 % and 5 % fare raising for railways and other competitive modes (bus/taxi), respectively, while **With Case 2-1/2** represents 7 % fare raising for both railways and competitive modes. Moreover, and an **Extra Case** of 10 % fare raising for both railways and other modes was also investigated. However, the detailed output of this case is omitted from the appendices or text.

The calibrated mode choice models for all-income and high-income groups are applied to investigate the effect of these alternative cases on the railways ridership share in different target years. Three options for each case can affect travel demand forecast, namely speed-up, fare raise and line closure. Closing some railway lines affects the structure of the railway network, while speed-up on major railway lines reduces the travel time on the segments belonging to those lines. Mode choice model is affected by speed-up (or travel time reduction) and fare increase. The revised ridership share modifies the total generation of railway passengers, which affects in turn passengers distribution as follows:

$$t_{ij} = FT_{ij} \qquad (16)$$

where:

t_{ij} = Revised number of railway passengers between zone **i** and zone **j**.

T_{ij} = Number of railway passengers between zone **i** and zone **j** assuming everything being unchanged.

F = Adjustment factor to account for the shift of ridership share of railway passengers due to different alternative cases.

The five railway lines suggested to be closed are:

- Line (22): Faqous - Samaena.
- Line (30): Fayoum - Sennoures.
- Line (37): Beni Suef - Nazelt Gaweesh.
- Line (38): Nazelt Gaweesh - Mansheyat Abdel Samad.
- Line (40): Kafr Saad - Kafr Solayman.

Speed-up is suggested to include the following four major railway lines:

- Line (1): Cairo - Alexandria.
- Line (2): Cairo - El Sad El Ali.
- Line (3): Banha - Port Said.
- Line (4): Tanta - Mansoura.

By incorporating the aforementioned conditions of alternative cases in the logit model presented in equations (11) and (12), different runs were performed. The definition of these runs is given in Table 6.9, while the ridership share of railway passengers is estimated in Table 6.10. The following points can be inferred from Table 6.10:

- Generally, increasing fares is the most effective factor, which dramatically influences the mode choice decision. By raising fare of railways and bus/taxi 7% and 5%,

respectively, ENR is expected to lose 7% of its current ridership share as can be noticed in run R4 when applying the all-income model.

- Increasing fare of 7% for railways and bus/taxi will result in an increase up to 5% in the ridership share of ENR. The same conclusion can be noticed if fare is increased 10% for both modes.
- Travel time reduction or speed-up seems to be ineffective factor in selecting the mode of travel in intercity passenger movement. This can be noticed by comparing each pair of runs in different target years, i.e., (R4 & R5), (R7 & R8) and (R10 & R11). This is true even for the high-income model.

The detailed results of railway passenger assignment for different alternative cases are presented on a link-wise basis in Appendix P 6.7. Each Table of this appendix is further aggregated on line-wise basis in Table 6.11 through Table 6.13 for **Without Case**, **With Case 1-1/2** and **With Case 2-1/2**, respectively. The first three columns of Table 6.11 through Table 6.13 list the line number, number of segments per line and line length. The average number of passenger per one kilometer in different years are presented in the five columns, while passenger-km values are shown in the last five columns.

Table 6.14-1 shows a comparison among passenger-kilometer values for the base year, do-nothing case and different alternative cases in 2012 on the level of railway lines. Taking the base year as a datum or a reference, the passenger-kilometer of railways will increase 62 %, 68 %, 53 % and 69 % for "Do-Nothing Case", "Without Case", With Case 1-1/2" and "With Case 2-1/2", respectively in 2012. From the view point of transport demand, "Case 2-1/2" is superior to "Case 1-1/2". In other words, 16 points (69 % minus 53 %) are gained by raising fare 7 % for railways and competitive modes instead of fare raising 7 % and 5 % for railways and competitive modes, respectively. Another point of interest can be observed from table regarding "Case 2-1/2 or 7% - 5%" and "Extra or 10% - 10%". The gross increase of passenger-km related to the passenger-km of the base year (1995) is the same (69%). This outcome indicates that there is no need to propose a fare raise higher than 7% - 7% for the purpose of increasing the value of passenger-km in the target year (2012). However, the section of the most appropriate alternative is decided based on an overall evaluation as can seen in Chapter 9.

Finally, Table 6. 14-2 summarizes the results of total number of railway passengers per day and total daily passenger-km for different alternative cases in different planning years. Passenger-km values are drawn from Table 6.11 through 6.13, while total daily passengers are estimated by multiplying the ration found in Table 6.10 by its corresponding value of Table 6.4 (which are also added as Base Case in Table 6.14-2) for each planning year, respectively. For instance, the ration of 1.05 (in 2012 for With Case 2-1/2 in Table 6.10) is multiplied by 2,482,239 (see Table 6.4) to result in the value of 2,606,000 in Table 6.14-2. In addition, the "Base Case" or "Do-Nothing Case" is included in the Table to ease the comparison among alternative cases against the Do-Nothing Case".

Table 6.9 Definition of Actions Required in Target Years for Different Alternative Cases

Alternative Case	Year	Action Required in Planning Years			
		Fare Raise*		Speed-up**	Closing Lines
		Railway	Other		
Do-Nothing	1995	--	--	--	--
Without Case	1998	5%	5%	0%	No
With Case		[7%], 10%	[5%], [7%], 10%	0%	No
Without Case	2002	5%	5%	5%	No
With Case		7%, 10%	5%, 7%, 10%	5%	Yes
[With Case 1 or 2]		[7%], 10%	[5%], [7%], 10%	[10%]	Yes
Without Case	2007	5%	5%	0%	No
With Case		5%	5%	5%	Yes
[With Case 1 or 2]		[5%]	[5%]	[10%]	Yes
Without Case	2012	5%	5%	0%	No
With Case		5%	5%	5%	Yes
[With Case 1 or 2]		[5%]	[5%]	[10%]	Yes

* Fare raise of 10% for railways and other modes is investigated and referred to as Extra Case in this Chapter only.

** The speed-up of 5% or 10% will be applied only once in 2002. It should be noted, therefore, that speed-up of 5% or 10% in years 2007 and 2012 is the same as of year 2002.

Table 6.10 Shift of Ridership Share of Railway Passengers as a Result of Adopting Different Alternatives Fare Raise

Alternative Case ->			Without Case		With Case 1				With Case 2		Extra Case	
Fare Raise ->			5% - 5%		7% - 5%		7% - 5%		7% - 7%		10% - 10%	
Applied Logit Model->			All Income		All Income		High Income		All Income		All Income	
Speed Raise%	Year	Run	Share	Ratio*	Share	Ratio*	Share	Ratio*	Share	Ratio*	Share	Ratio*
0%	1995	--	0.470	1.00	0.470	1.00	0.470	1.00	0.470	1.00	0.470	1.00
0%	1998	R1	0.475	1.01	--	--	--	--	--	--	--	--
0%		R2	--	--	0.454	0.97	0.456	0.97	0.477	1.02	0.479	1.02
0%		R3	0.480	1.02	--	--	--	--	--	--	--	--
5%	2002	R4	--	--	0.438	0.93	0.441	0.94	0.486	1.04	0.489	1.04
10%		R5	--	--	0.439	0.93	0.443	0.94	0.489	1.04	0.492	1.05
0%		R6	0.485	1.03	--	--	--	--	--	--	--	--
0%	2007	R7	--	--	0.443	0.94	0.447	0.95	0.490	1.04	0.492	1.05
0%		R8	--	--	0.444	0.95	0.449	0.95	0.492	1.05	0.494	1.05
0%		R9	0.488	1.04								
0%	2012	R10	--	--	0.447	0.95	0.451	0.96	0.493	1.05	0.494	1.05
0%		R11	--	--	0.448	0.95	0.452	0.96	0.495	1.05	0.496	1.06

* Ratio is calculated by dividing the share of each run by the share of the base year or Do-Nothing Case.

Table 6.11 Number of Passengers per Kilometer and Passenger-Km (x 1000) for Railway Lines in Case of 5%-5% Fare Raise in Different Planning Years using All-Income Model: Without Case

LINE CODE	LINK CODE	LNTH (KM)	Number of Passengers					Number of Passenger-Km (1000)				
			1995	1998	2002	2007	2012	1995	1998	2002	2007	2012
1	24	208	194,990	216,733	247,703	290,337	335,891	40,538	45,059	51,497	60,361	69,832
2	52	892	65,674	71,051	80,715	93,696	107,524	58,590	63,386	72,008	83,589	95,926
3	8	192	57,295	65,064	74,323	85,773	98,809	11,009	12,502	14,281	16,481	18,986
4	5	53	108,411	119,136	136,060	156,577	181,253	5,700	6,264	7,154	8,233	9,530
5	3	15	5,842	6,374	7,394	8,752	10,122	86	94	109	129	150
6	3	41	0	0	0	0	0	0	0	0	0	0
7	3	91	10,032	11,876	13,683	19,099	21,884	913	1,080	1,245	1,737	1,991
8	4	63	50,217	55,169	63,052	72,665	84,405	3,141	3,450	3,943	4,545	5,279
9	6	56	21,994	24,087	27,384	31,159	35,853	1,236	1,354	1,539	1,751	2,015
10	10	119	2,791	3,067	3,457	3,977	4,535	333	366	413	475	542
11	2	38	0	0	0	0	0	0	0	0	0	0
12	13	94	34,323	37,686	43,122	49,159	56,678	3,213	3,528	4,037	4,602	5,306
13	3	135	17,411	20,081	23,293	34,382	39,529	2,348	2,708	3,141	4,636	5,330
14	3	61	35,529	38,918	44,217	50,637	58,251	2,177	2,384	2,709	3,102	3,568
15	8	21	9,015	10,408	11,869	13,503	15,660	193	223	255	290	336
16	2	52	4,039	4,454	5,067	5,882	6,783	209	231	262	305	351
17	3	71	20,126	21,908	24,994	28,436	32,739	1,433	1,560	1,780	2,025	2,331
18	4	62	19,587	21,802	24,836	28,476	32,855	1,219	1,357	1,546	1,772	2,045
19	5	71	45,809	49,820	56,682	64,989	74,514	3,231	3,514	3,998	4,584	5,256
20	2	34	10,089	10,915	12,402	14,278	16,272	345	373	424	488	557
21	1	33	16,697	18,497	21,151	24,470	28,304	547	606	693	802	927
22	1	10	0	0	0	0	0	0	0	0	0	0
23	2	50	7,279	7,975	9,115	10,421	11,992	363	398	455	520	598
24	2	19	14,185	15,443	17,558	19,887	22,967	265	289	329	372	430
25	5	73	37,722	41,058	46,607	53,436	61,535	2,761	3,005	3,411	3,911	4,504
26	5	26	18,994	21,100	24,115	27,309	31,444	491	545	623	706	813
27	10	295	5,928	6,451	7,485	8,803	10,170	1,749	1,903	2,208	2,597	3,000
28	4	81	23,192	25,108	28,470	32,315	37,165	1,880	2,035	2,308	2,620	3,013
29	4	29	6,717	7,407	8,427	9,782	11,281	192	211	240	279	322
30	1	12	17,471	19,045	21,591	24,723	28,385	205	224	254	290	334
31	2	27	27,378	29,884	33,943	39,149	45,100	730	797	905	1,044	1,202
32	5	40	0	0	0	0	0	0	0	0	0	0
33	1	24	0	0	0	0	0	0	0	0	0	0
34	1	260	0	0	0	0	0	0	0	0	0	0
35	1	346	0	0	0	0	0	0	0	0	0	0
36	1	108	0	0	0	0	0	0	0	0	0	0
37	2	25	3,268	3,505	3,953	4,527	5,171	80	86	97	111	127
38	2	12	3,851	4,132	4,659	5,335	6,094	45	48	54	62	71
39	1	7	0	0	0	0	0	0	0	0	0	0
40	1	3	0	0	0	0	0	0	0	0	0	0
41	1	15	0	0	0	0	0	0	0	0	0	0
42	1	233	0	0	0	0	0	0	0	0	0	0
43	1	338	0	0	0	0	0	0	0	0	0	0
TOTAL	218	4431						145,224	159,583	181,919	212,419	244,671

Table 6.12 Number of Passengers per Kilometer and Passenger-Km (x 1000) for Railway Lines in Case of 7%-5% Fare Raise in Different Planning Years using All-Income Model: With Case 1

LINE CODE	LINK CODE	LNTH (KM)	Number of Passengers					Number of Passenger-Km (1000)				
			1995	1998	2002	2007	2012	1995	1998	2002	2007	2012
1	24	208	194,990	207,086	226,395	265,884	307,792	40,538	43,053	47,068	55,277	63,990
2	52	892	65,674	67,888	72,794	84,686	97,237	58,590	60,565	64,941	75,551	86,748
3	8	192	57,295	62,168	67,929	78,549	90,543	11,009	11,946	13,053	15,093	17,398
4	5	53	108,411	113,833	124,355	143,390	166,091	5,700	5,985	6,539	7,539	8,733
5	3	15	5,842	6,090	6,758	8,015	9,275	86	90	100	118	137
6	3	41	0	0	0	0	0	0	0	0	0	0
7	3	91	10,032	11,347	12,506	17,491	20,053	913	1,032	1,138	1,591	1,824
8	4	63	50,217	52,713	57,628	66,545	77,344	3,141	3,297	3,604	4,162	4,837
9	6	56	21,994	23,015	25,029	28,534	32,854	1,236	1,294	1,407	1,604	1,847
10	10	119	2,791	2,930	3,160	3,642	4,156	333	350	377	435	496
11	2	38	0	0	0	0	0	0	0	0	0	0
12	13	94	34,323	36,009	39,413	45,019	51,937	3,213	3,371	3,690	4,215	4,862
13	3	135	17,411	19,187	21,289	31,486	36,222	2,348	2,587	2,871	4,246	4,885
14	3	61	35,529	37,186	29,098	33,407	38,465	2,177	2,278	1,783	2,046	2,356
15	8	21	9,015	9,944	10,848	12,365	14,350	193	213	233	265	308
16	2	52	4,039	4,256	4,631	5,387	6,216	209	220	240	279	322
17	3	71	20,126	20,933	22,844	26,041	30,000	1,433	1,491	1,627	1,854	2,136
18	4	62	19,587	20,831	22,700	26,078	30,107	1,219	1,297	1,413	1,623	1,874
19	5	71	45,809	47,602	51,806	59,516	68,281	3,231	3,358	3,654	4,198	4,817
20	2	34	10,089	10,429	11,335	13,076	14,910	345	357	388	447	510
21	1	33	16,697	17,674	19,332	22,409	25,936	547	579	633	734	850
22	1	10	0	0	0	0	0	0	0	0	0	0
23	2	50	7,279	7,620	8,331	9,543	10,989	363	380	415	476	548
24	2	19	14,185	14,755	16,048	18,212	21,046	265	276	300	341	394
25	5	73	37,722	39,231	42,598	48,935	56,388	2,761	2,871	3,118	3,582	4,127
26	5	26	18,994	20,161	22,040	25,009	28,814	491	521	570	646	745
27	10	295	5,928	6,164	6,841	8,061	9,319	1,749	1,818	2,018	2,378	2,749
28	4	81	23,192	23,990	26,021	29,594	34,056	1,880	1,945	2,110	2,399	2,761
29	4	29	6,717	7,077	7,702	8,958	10,337	192	202	220	255	295
30	1	12	17,471	18,197	0	0	0	205	214	0	0	0
31	2	27	27,378	28,554	31,023	35,852	41,327	730	761	827	956	1,102
32	5	40	0	0	0	0	0	0	0	0	0	0
33	1	24	0	0	0	0	0	0	0	0	0	0
34	1	260	0	0	0	0	0	0	0	0	0	0
35	1	346	0	0	0	0	0	0	0	0	0	0
36	1	108	0	0	0	0	0	0	0	0	0	0
37	2	25	3,268	3,349	0	0	0	80	82	0	0	0
38	2	12	3,851	3,948	0	0	0	45	46	0	0	0
39	1	7	0	0	0	0	0	0	0	0	0	0
40	1	3	0	0	0	0	0	0	0	0	0	0
41	1	15	0	0	0	0	0	0	0	0	0	0
42	1	233	0	0	0	0	0	0	0	0	0	0
43	1	338	0	0	0	0	0	0	0	0	0	0
TOTAL	218	4431						145,224	152,479	164,335	192,313	221,651

Table 6.13 Number of Passengers per Kilometer and Passenger-Km (x 1000) for Railway Lines in Case of 7%-7% Fare Raise in Different Planning Years using All-Income Model: With Case 2

LINE CODE	LINK CODE	LNTH (KM)	Number of Passengers					Number of Passenger-Km (1000)				
			1995	1998	2002	2007	2012	1995	1998	2002	2007	2012
1	24	208	194,990	217,590	251,819	294,553	340,413	40,538	45,237	52,353	61,237	70,772
2	52	892	65,674	71,332	80,968	93,817	107,543	58,590	63,637	72,234	83,697	95,942
3	8	192	57,295	65,322	75,558	87,018	100,139	11,009	12,552	14,518	16,720	19,242
4	5	53	108,411	119,607	138,321	158,850	183,693	5,700	6,289	7,273	8,352	9,659
5	3	15	5,842	6,399	7,517	8,879	10,258	86	95	111	131	152
6	3	41	0	0	0	0	0	0	0	0	0	0
7	3	91	10,032	11,923	13,911	19,376	22,179	913	1,085	1,265	1,763	2,017
8	4	63	50,217	55,387	64,100	73,721	85,541	3,141	3,464	4,009	4,611	5,350
9	6	56	21,994	24,182	27,840	31,611	36,335	1,236	1,359	1,565	1,777	2,042
10	10	119	2,791	3,079	3,515	4,034	4,596	333	368	420	482	549
11	2	38	0	0	0	0	0	0	0	0	0	0
12	13	94	34,323	37,835	43,839	49,873	57,441	3,213	3,542	4,104	4,669	5,378
13	3	135	17,411	20,160	23,680	34,881	40,061	2,348	2,719	3,193	4,704	5,402
14	3	61	35,529	39,072	32,365	37,008	42,542	2,177	2,394	1,983	2,267	2,606
15	8	21	9,015	10,449	12,066	13,699	15,870	193	224	259	294	341
16	2	52	4,039	4,472	5,152	5,968	6,875	209	232	267	309	356
17	3	71	20,126	21,994	25,409	28,849	33,179	1,433	1,566	1,809	2,054	2,363
18	4	62	19,587	21,888	25,249	28,890	33,297	1,219	1,362	1,571	1,798	2,072
19	5	71	45,809	50,017	57,624	65,933	75,517	3,231	3,528	4,065	4,651	5,327
20	2	34	10,089	10,958	12,608	14,485	16,491	345	375	431	496	564
21	1	33	16,697	18,571	21,503	24,825	28,685	547	608	704	813	940
22	1	10	0	0	0	0	0	0	0	0	0	0
23	2	50	7,279	8,007	9,266	10,572	12,153	363	399	462	527	606
24	2	19	14,185	15,504	17,850	20,175	23,276	265	290	334	377	436
25	5	73	37,722	41,221	47,381	54,212	62,364	2,761	3,017	3,468	3,968	4,564
26	5	26	18,994	21,183	24,515	27,706	31,867	491	548	634	716	824
27	10	295	5,928	6,476	7,609	8,930	10,307	1,749	1,911	2,245	2,635	3,041
28	4	81	23,192	25,207	28,943	32,785	37,666	1,880	2,044	2,346	2,658	3,054
29	4	29	6,717	7,436	8,567	9,924	11,432	192	212	244	283	326
30	1	12	17,471	19,120	0	0	0	205	225	0	0	0
31	2	27	27,378	30,002	34,507	39,718	45,707	730	800	920	1,059	1,219
32	5	40	0	0	0	0	0	0	0	0	0	0
33	1	24	0	0	0	0	0	0	0	0	0	0
34	1	260	0	0	0	0	0	0	0	0	0	0
35	1	346	0	0	0	0	0	0	0	0	0	0
36	1	108	0	0	0	0	0	0	0	0	0	0
37	2	25	3,268	3,519	0	0	0	80	86	0	0	0
38	2	12	3,851	4,148	0	0	0	45	48	0	0	0
39	1	7	0	0	0	0	0	0	0	0	0	0
40	1	3	0	0	0	0	0	0	0	0	0	0
41	1	15	0	0	0	0	0	0	0	0	0	0
42	1	233	0	0	0	0	0	0	0	0	0	0
43	1	338	0	0	0	0	0	0	0	0	0	0
TOTAL	218	4431						145,224	160,214	182,789	213,048	245,141

Table 6. 14-1 Comparison among Railway Passenger-Km (x 1000) for Different Alternatives of Fare Raise in the Base Year (1995) and Targer Year (2012)

LINE	Number of Passenger-Km (1000)						Increase (%) of Passenger-Km to Year 1995				
Alternative ->	Nothing	Without	Case 1	Case 2	Extra		Nothing	Without	Case 1	Case 2	Extra
Fare*->	0%-0%	5%-5%	7%-5%	7%-7%	10%-10%		0%-0%	5%-5%	7%-5%	7%-7%	10%-10%
Year ->	1995	2012	2012	2012	2012	2012	2012	2012	2012	2012	2012
1	40,538	67,146	69,832	63,990	70,772	70,973	66%	72%	58%	75%	75%
2	58,590	92,236	95,926	86,748	95,942	96,215	57%	64%	48%	64%	64%
3	11,009	18,256	18,986	17,398	19,242	19,296	66%	72%	58%	75%	75%
4	5,700	9,164	9,530	8,733	9,659	9,686	61%	67%	53%	69%	70%
5	86	144	150	137	152	152	67%	73%	59%	76%	76%
6	0	0	0	0	0	0	0%	0%	0%	0%	0%
7	913	1,914	1,991	1,824	2,017	2,023	110%	118%	100%	121%	122%
8	3,141	5,076	5,279	4,837	5,350	5,365	62%	68%	54%	70%	71%
9	1,236	1,938	2,015	1,847	2,042	2,048	57%	63%	49%	65%	66%
10	333	521	542	496	549	550	56%	62%	49%	65%	65%
11	0	0	0	0	0	0	0%	0%	0%	0%	0%
12	3,213	5,102	5,306	4,862	5,378	5,393	59%	65%	51%	67%	68%
13	2,348	5,125	5,330	4,885	5,402	5,418	118%	127%	108%	130%	131%
14	2,177	3,431	3,568	2,356	2,606	2,614	58%	64%	8%	20%	20%
15	193	323	336	308	341	342	67%	74%	59%	76%	77%
16	209	338	351	322	356	357	61%	68%	54%	70%	71%
17	1,433	2,242	2,331	2,136	2,363	2,369	56%	63%	49%	65%	65%
18	1,219	1,966	2,045	1,874	2,072	2,078	61%	68%	54%	70%	70%
19	3,231	5,054	5,256	4,817	5,327	5,342	56%	63%	49%	65%	65%
20	345	535	557	510	564	566	55%	61%	48%	63%	64%
21	547	892	927	850	940	942	63%	70%	55%	72%	72%
22	0	0	0	0	0	0	0%	0%	0%	0%	0%
23	363	575	598	548	606	608	58%	65%	51%	67%	67%
24	265	413	430	394	436	437	56%	62%	48%	64%	65%
25	2,761	4,331	4,504	4,127	4,564	4,577	57%	63%	49%	65%	66%
26	491	782	813	745	824	826	59%	66%	52%	68%	68%
27	1,749	2,885	3,000	2,749	3,041	3,049	65%	72%	57%	74%	74%
28	1,880	2,897	3,013	2,761	3,054	3,062	54%	60%	47%	62%	63%
29	192	309	322	295	326	327	61%	68%	54%	70%	71%
30	205	321	334	0	0	0	56%	0%	0%	0%	0%
31	730	1,156	1,202	1,102	1,219	1,222	58%	65%	51%	67%	67%
32	0	0	0	0	0	0	0%	0%	0%	0%	0%
33	0	0	0	0	0	0	0%	0%	0%	0%	0%
34	0	0	0	0	0	0	0%	0%	0%	0%	0%
35	0	0	0	0	0	0	0%	0%	0%	0%	0%
36	0	0	0	0	0	0	0%	0%	0%	0%	0%
37	80	122	127	0	0	0	52%	0%	0%	0%	0%
38	45	68	71	0	0	0	52%	0%	0%	0%	0%
39	0	0	0	0	0	0	0%	0%	0%	0%	0%
40	0	0	0	0	0	0	0%	0%	0%	0%	0%
41	0	0	0	0	0	0	0%	0%	0%	0%	0%
42	0	0	0	0	0	0	0%	0%	0%	0%	0%
43	0	0	0	0	0	0	0%	0%	0%	0%	0%
TOTAL	145,224	235,261	244,671	221,651	245,141	245,839	62%	68%	53%	69%	69%

* Percentage of fare raise for railway and competitive modes, respectivley.

Table 6. 14-2 Summary of Transport Demand Forecast of Railway Passengers for Different Alternative Cases in Different Planning Years

Alternative Case	Total Number of Daily Passengers (1,000)					Total Daily Passenger-Km (1,000)				
	1995	1998	2002	2007	2012	1995	1998	2002	2007	2012
Without	1,542	1,697	1,931	2,234	2,582	145,224	159,583	181,919	212,419	244,671
With Case 1	1,542	1,630	1,760	2,039	2,358	145,224	152,479	164,335	192,313	221,651
With Case 2	1,542	1,714	1,968	2,226	2,606	145,224	160,214	182,789	213,048	245,141
Base Case	1,542	1,680	1,893	2,169	2,482	145,224	157,846	177,829	205,633	235,261

6.6 TRANSPORT DEMAND FORECAST OF FREIGHT

In this section, ENR freight transport is presented. It should be mentioned that the methodology of forecasting freight is simpler than that of passengers. The methodology depends in principal on the growth factor method as can be seen in Figure 6.1. The computer files of freight obtained from ENR Computer Center were checked, cleaned and then complied to estimate the basic data required for further analysis. First of all, different commodities were re-coded according to the 30-commodity code system adopted by previous National Transport Studies in Egypt. Following is a description of the major steps adopted to forecast freight movement of ENR in different planning years.

6.6.1 Total Generation of Each Commodity

First, the tonnage, average distance and revenue O-D matrices of the base-year (1995) are constructed for each commodity type on the level of 29-semi governorate zoning system as can be shown in Appendix F 6.1 through F 6.3, respectively. Each appendix of Appendices F 6.1 through F 6.3 consists of 27 tables corresponding to the O-D matrices of the 26 commodities transported by ENR, while the O-D matrix of total commodities is presented in the 27th table. Tables 6.15 through 6.17 (in Appendix) show the O-D matrices of tonnage, average distance and revenue for total commodities. Then, the average distance (km), load (ton), ton-km (1,000), revenue (1,000 LE) and revenue per ton-km (L.E./1,000) for each commodity were estimated and shown in Table 6.18 for the base-year (1995). The following points can be drawn from Table 6.18:

- Six major commodities account for 77.3%, 65.9% and 77.7% of total tonnage, ton-km and revenue of freight activity of ENR, respectively. These commodities are iron ore, wheat, other construction materials, coal-coke, petroleum products and other cereals.

- Iron ore represents the major commodity transported by railways as it constitutes 19.6% of total tonnage, 20.6% of total ton-km and 34% of ENR freight revenue.

- Wheat occupies the second rank of ENR freight activity as it represents 14.7%, 12% and 17% of total tonnage, ton-km and revenue of freight, respectively. If the commodity of other cereals is incorporated with wheat, the percentages will be 21.2%, 16.9% and 21.9%, respectively.

- Other construction materials represent 13.7%, 6.5% and 4.9% of total tonnage, ton-km and revenue of freight activity, respectively. The small values of ton-km and revenue can be attributed to the average distance traveled, which is relatively short (191 km).

- Coal-coke commodity accounts for 13.3%, 11% and 8% of total tonnage, ton-km and revenue of freight activity, respectively, while petroleum products represents 9.5%, 10.9% and 8.9%, respectively.

- The overall average distance traveled by different commodities is 332.7 km, while the average revenue per ton-km is 3.65 PT.

The base year freight flow was projected into the future using the following steps:

- Based on the results of commodity study conducted by ENTS IV-Highways, the growth factor of each commodity was estimated using the data of 1992 (the base year of ENTS IV-Highways) and its forecast in 2012. Table 6.19 shows the average annual growth rate for each commodity transported by ENR in the column just before the last column. The freight share of ENR in 2012 (shown in Table 6.19) is based on the pre-determined method recommended by ENTS IV-Highways which was also adopted by ENTS II & III.

- Using the total tonnage of each commodity in 1995 from Table 6.18 and average annual growth ratio estimated from Table 6.18, future commodity flow was estimated as shown in Table 6.20. Then growth factors of each commodity were estimated by dividing total generation of each planning year by the total generation of the base year (1995) as shown in Table 6.20. For example, ENR freight activity in 2012 is expected to reach 3.56 times that of 1995.

6.6.2 Distribution of Each Commodity

The base-year O-D matrices of different commodities are expanded using the growth factors estimated in Table 6.20. Appendix F 6.4 presents the tonnage O-D matrices of different commodities in the target year 2012. Appendix F 6.4 consists of 27 tables corresponding to the O-D matrices of the 26 commodities transported by ENR, while the O-D matrix of total commodities is presented in the 27th table. Table 6.21 through 6.24 (in Appendix) show the projected tonnage O-D matrices of total commodities in 1998, 2002, 2007 and 2012, respectively.

6.6.3 Assignment of Each commodity

The accurate estimation of ton-km of each commodity necessitates the assignment of each commodity on ENR network from which the ton-km can be calculate on a link-wise basis. The assignment of total commodities is estimated by summing up the link volume (tons) for the 26 commodities as shown in Table 6.25 (in Appendix). The results of freight assignment of each commodity are aggregated on a line-wise basis as shown in Appendix F 6.5. Table 6.26 presents the average tonnage per one kilometer of each line (density) and ton-km for the 43 railway lines. It should be mentioned that the assignment results exclude the intra-semi-governorate movements. Therefore, the ton-km value (4,072,306,000) of the base year presented in Table 6.18 must be different from its corresponding value (3,899,249,000) of Table 6.26. In other words, intra-semi-governorate movement accounts for 4% of total ton-km. Figures 6.11 through 6.15 show the traffic assignment maps of railway total commodities on the railway network in the target year 1995, 1998, 2002, 2007 and 2012, respectively.

Table 6.18 Statistics of Freight Activity of ENR Classified by Each Commodity Type in 1995**

Commodity Code	Name	Average Dist. (Km)	Load (1000 Ton)	Revenue (1000 LE)	Ton-Km (1000)	Rvnu/ Tonkm 0.001 LE
1	COIL	0	0	0	0	0
2	PETR	382	1,161	13,270	443,641	30
3	NGAS	0	0	0	0	0
4	CEMT	204	209	1,402	42,750	33
5	CMAT	171	1,556	7,295	266,112	27
6	PHOS	754	938	8,160	707,162	12
7	IORE	350	2,394	50,698	838,496	60
8	COAL	275	1,624	11,880	445,930	27
9	MNRL	0	0	0	0	0
10	WHET	272	1,795	25,493	487,882	52
11	CERE	251	797	7,309	199,883	37
12	FRUT	30	0	0	2	107
13	SCAN	61	259	986	15,841	62
14	FCRP	467	1	33	545	60
15	LSTK	0	0	0	0	0
16	APRD	295	224	1,651	66,166	25
17	AGPR	125	0	0	6	52
18	SGAR	483	584	5,218	281,931	19
19	FATS	80	0	0	4	55
20	AFED	523	0	6	203	31
21	BVRG	0	0	0	0	0
22	OFOD	400	91	780	36,361	21
23	CHEM	835	9	183	7,250	25
24	MTAL	667	1	14	423	34
25	TXTL	533	2	67	810	82
26	FRLZ	545	161	1,869	88,084	21
27	PULP	205	5	41	972	42
28	LUBM	245	22	195	5,342	37
29	MANU	306	14	206	4,208	49
30	MIXC	337	392	11,849	132,305	90
	Total		**12,239**	**148,604**	**4,072,306**	
	Average					**36**

** The results of this table are based on the computerized file obtained from ENR Computer Center.

Table 6.19 Estimated Growth Factors of Different Commodities Based on the Data of Years 1992 and 2012

Commodity		1992			2012			Avg Annual Growth	
Code	Name	Rwy*	Total*	Share	Rwy*	Total*	Share	Rwy	Total
1	COIL	0	0	0.0%	0	0	0.0%	0.0%	0.0%
2	PETR	1,208	12,735	9.5%	2,852	17,815	16.0%	4.4%	1.7%
3	NGAS	0	0	0.0%	0	0	0.0%	0.0%	0.0%
4	CEMT	341	27,194	1.3%	6,875	110,783	6.2%	16.2%	7.3%
5	CMAT	737	44,559	1.7%	11,170	204,023	5.5%	14.6%	7.9%
6	PHOS	649	800	81.1%	11,089	13,233	83.8%	15.2%	15.1%
7	IORE	2,502	2,502	100.0%	4,127	4,611	89.5%	2.5%	3.1%
8	COAL	807	1,821	44.3%	0	7,077	0.0%	0.0%	7.0%
9	MNRL	46	5,443	0.8%	60	13,616	0.4%	1.3%	4.7%
10	WHET	1,351	7,921	17.1%	2,557	17,283	14.8%	3.2%	4.0%
11	CERE	93	5,451	1.7%	240	12,372	1.9%	4.9%	4.2%
12	FRUT	0	13,965	0.0%	2	33,309	0.0%	0.0%	4.4%
13	SCAN	8	617	1.3%	0	905	0.0%	0.0%	1.9%
14	FCRP	0	466	0.0%	0	755	0.0%	0.0%	2.4%
15	LSTK	0	1,462	0.0%	0	2,338	0.0%	0.0%	2.4%
16	APRD	5	2,618	0.2%	9	4,047	0.2%	3.0%	2.2%
17	AGPR	1	5,292	0.0%	0	27,492	0.0%	0.0%	8.6%
18	SGAR	511	2,304	22.2%	6	3,263	0.2%	0.0%	1.8%
19	FATS	128	1,177	10.9%	1	3,961	0.0%	0.0%	6.3%
20	AFED	1	5,682	0.0%	28	26,490	0.1%	18.1%	8.0%
21	BVRG	0	455	0.0%	0	2,427	0.0%	0.0%	8.7%
22	OFOD	11	3,574	0.3%	22	5,582	0.4%	3.5%	2.3%
23	CHEM	0	6,239	0.0%	0	13,640	0.0%	0.0%	4.0%
24	MTAL	463	7,086	6.5%	5,088	16,359	31.1%	12.7%	4.3%
25	TXTL	0	2,097	0.0%	0	4,548	0.0%	0.0%	3.9%
26	FRLZ	241	3,932	6.1%	0	9,117	0.0%	0.0%	4.3%
27	PULP	0	1,870	0.0%	0	5,889	0.0%	0.0%	5.9%
28	LUBM	13	2,262	0.6%	152	4,068	3.7%	13.1%	3.0%
29	MANU	526	7,073	7.4%	1,396	20,915	6.7%	5.0%	5.6%
30	MIXC	0	1,756	0.0%	0	5,179	0.0%	0.0%	5.6%
	Total	9,642	178,353		45,674	591,097			
	Average			5.4%			7.7%	8.1%	6.2%

* Source of these columns: ENTS IV, VOL II, Table 13-4-5, pp 87.

Table 6.20 Total Generation of Freight (1000 Ton/Year) and Growth Factors for Each Commodity in Different Planning Years

COM Code	COM Name	Growth Ratio	Total Tonnage in 1995	Total Tonnage in 1998	Total Tonnage in 2002	Total Tonnage in 2007	Total Tonnage in 2012	Growth Factor in Year 1998	Growth Factor in Year 2002	Growth Factor in Year 2007	Growth Factor in Year 2012
1	COIL	0.0%	0	0	0	0	0	0.00	0.00	0.00	0.00
2	PETR	4.4%	1,161	1,321	1,569	1,945	2,410	1.14	1.35	1.67	2.08
3	NGAS	0.0%	0	0	0	0	0	0.00	0.00	0.00	0.00
4	CEMT	16.2%	209	328	598	1,268	2,686	1.57	2.86	6.06	12.85
5	CMAT	14.6%	1,556	2,340	4,030	7,952	15,691	1.50	2.59	5.11	10.08
6	PHOS	15.2%	938	1,436	2,533	5,149	10,469	1.53	2.70	5.49	11.16
7	IORE	2.5%	2,394	2,581	2,853	3,233	3,664	1.08	1.19	1.35	1.53
8	COAL	0.0%	1,624	1,624	1,624	1,624	1,624	1.00	1.00	1.00	1.00
9	MNRL	1.3%	0	0	0	0	0	0.00	0.00	0.00	0.00
10	WHET	3.2%	1,795	1,976	2,244	2,633	3,088	1.10	1.25	1.47	1.72
11	CERE	4.9%	797	918	1,110	1,407	1,783	1.15	1.39	1.77	2.24
12	FRUT	0.0%	0	0	0	0	0	1.00	1.00	1.00	1.00
13	SCAN	0.0%	259	259	259	259	259	1.00	1.00	1.00	1.00
14	FCRP	0.0%	1	1	1	1	1	1.00	1.00	1.00	1.00
15	LSTK	0.0%	0	0	0	0	0	0.00	0.00	0.00	0.00
16	APRD	3.0%	224	245	275	319	369	1.09	1.23	1.42	1.65
17	AGPR	0.0%	0	0	0	0	0	1.00	1.00	1.00	1.00
18	SGAR	0.0%	584	584	584	584	584	1.00	1.00	1.00	1.00
19	FATS	0.0%	0	0	0	0	0	1.00	1.00	1.00	1.00
20	AFED	18.1%	0	1	1	3	7	1.65	3.21	7.38	16.99
21	BVRG	0.0%	0	0	0	0	0	0.00	0.00	0.00	0.00
22	OFOD	3.5%	91	101	116	138	164	1.11	1.27	1.52	1.80
23	CHEM	0.0%	9	9	9	9	9	1.00	1.00	1.00	1.00
24	MTAL	12.7%	1	1	1	3	5	1.43	2.31	4.21	7.67
25	TXTL	0.0%	2	2	2	2	2	1.00	1.00	1.00	1.00
26	FRLZ	0.0%	161	161	161	161	161	1.00	1.00	1.00	1.00
27	PULP	0.0%	5	5	5	5	5	1.00	1.00	1.00	1.00
28	LUBM	13.1%	22	31	52	95	176	1.45	2.36	4.37	8.09
29	MANU	5.0%	14	16	19	25	31	1.16	1.41	1.80	2.29
30	MIXC	0.0%	392	392	392	392	392	1.00	1.00	1.00	1.00
	TOTAL		12,239	14,331	18,438	27,205	43,579				
								1.17	1.51	2.22	3.56
	RATIO OF 1995		1.00	1.17	1.51	2.22	3.56				

Table 6.26 Tonnage Density of Total Commodities (1000 Tons) and Ton-Km (x 1000) for Each Line of ENR Railway Network in Different Planning Years

LINE CODE	LINK CODE	LNTH (KM)	Tonnage Density (1000)					Estimated Ton-Km (1000)				
			1995	1998	2002	2007	2012	1995	1998	2002	2007	2012
1	24	208	271	284	310	363	458	501,867	527,565	576,010	674,898	853,229
2	52	892	123	136	158	196	255	1,708,479	1,899,403	2,225,217	2,808,226	3,728,202
3	8	192	25	31	42	67	112	124,999	154,342	212,603	337,566	570,577
4	5	53	17	24	39	76	150	8,183	11,864	19,935	39,215	78,745
5	3	15	58	71	98	156	268	4,081	5,002	6,845	10,896	18,718
6	3	41	0	0	0	0	0	0	0	0	0	0
7	3	91	11	15	22	40	74	43,274	58,384	89,742	159,954	295,008
8	4	63	85	94	107	128	154	82,934	91,574	104,872	125,031	150,916
9	6	56	26	31	41	59	93	13,869	16,484	21,392	31,290	48,779
10	10	119	62	67	75	87	103	89,618	96,659	107,779	125,367	148,854
11	2	38	0	0	0	0	0	0	0	0	0	0
12	13	94	0	0	0	0	0	0	0	0	0	0
13	3	135	26	30	36	48	68	73,007	85,010	106,045	145,047	208,650
14	3	61	3	4	4	5	7	7,146	8,103	9,609	11,977	15,118
15	8	21	709	797	950	1,231	1,701	40,793	45,865	54,638	70,822	97,811
16	2	52	0	0	0	0	0	0	0	0	0	0
17	3	71	0	0	0	0	0	0	0	0	0	0
18	4	62	92	103	123	159	220	85,105	95,687	113,988	147,751	204,058
19	5	71	112	128	157	211	306	111,580	127,458	155,806	210,325	304,775
20	2	34	0	0	1	1	2	133	168	243	415	750
21	1	33	0	0	0	0	0	0	0	0	0	0
22	1	10	0	0	0	0	0	0	0	0	0	0
23	2	50	0	0	0	0	0	0	0	0	0	0
24	2	19	0	0	0	0	0	3	3	3	3	3
25	5	73	0	0	0	0	0	0	0	0	0	0
26	5	26	0	0	0	0	0	0	0	0	0	0
27	10	295	16	20	26	41	70	141,162	170,462	229,069	357,622	605,476
28	4	81	0	0	0	0	0	0	0	0	0	0
29	4	29	0	0	0	0	0	0	0	0	0	0
30	1	12	0	0	0	0	0	0	0	0	0	0
31	2	27	0	0	0	0	0	0	0	0	0	0
32	5	40	0	0	0	0	0	0	0	0	0	0
33	1	24	0	0	0	0	0	0	0	0	0	0
34	1	260	0	0	0	0	0	0	0	0	0	0
35	1	346	7	7	8	9	11	827,345	891,878	985,368	1,116,916	1,265,838
36	1	108	0	0	0	1	1	5,077	5,299	5,709	6,522	7,953
37	2	25	0	0	0	0	0	0	0	0	0	0
38	2	12	0	0	0	0	0	0	0	0	0	0
39	1	7	0	0	0	0	0	0	0	0	0	0
40	1	3	0	0	0	0	0	0	0	0	0	0
41	1	15	0	0	0	0	0	0	0	0	0	0
42	1	233	1	2	7	17	39	30,594	128,226	356,740	928,429	2,125,302
43	1	338	0	1	4	11	26	0	136,890	460,833	1,277,978	2,997,046
TOTAL	218	4431						3,899,249	4,556,325	5,842,445	8,586,249	13,725,808

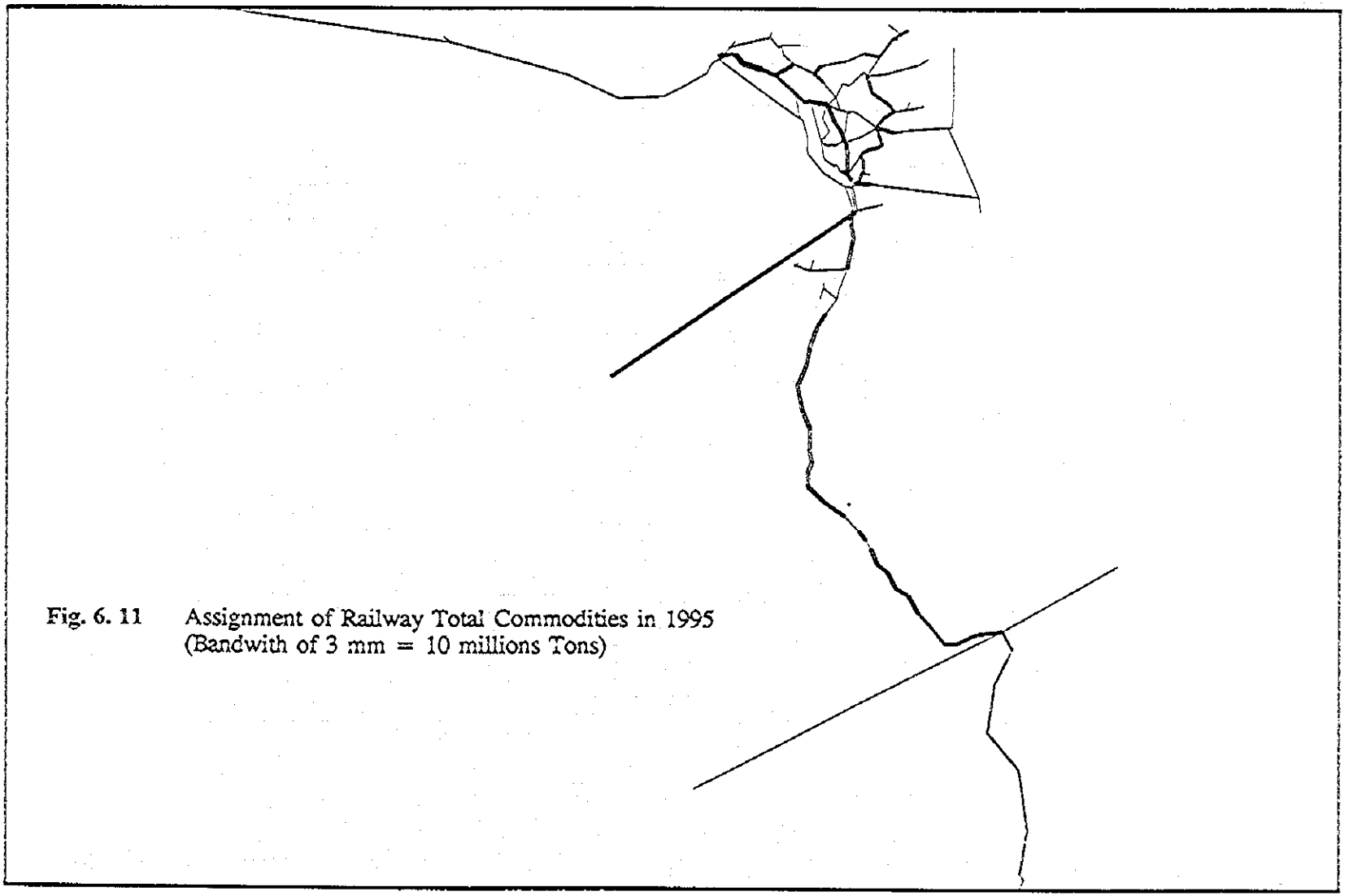


Fig. 6. 11 Assignment of Railway Total Commodities in 1995
(Bandwith of 3 mm = 10 millions Tons)

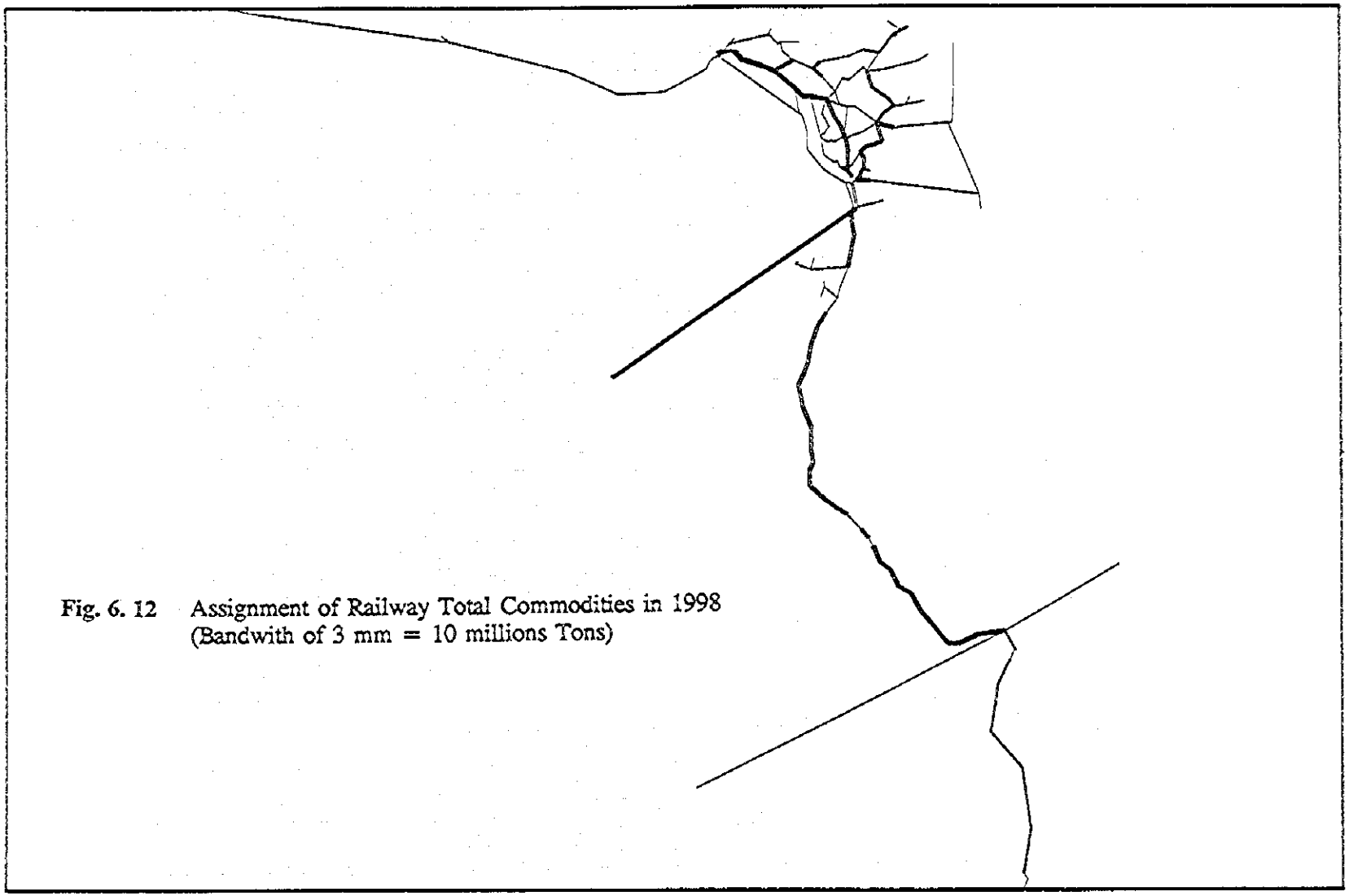


Fig. 6. 12 Assignment of Railway Total Commodities in 1998
(Bandwith of 3 mm = 10 millions Tons)

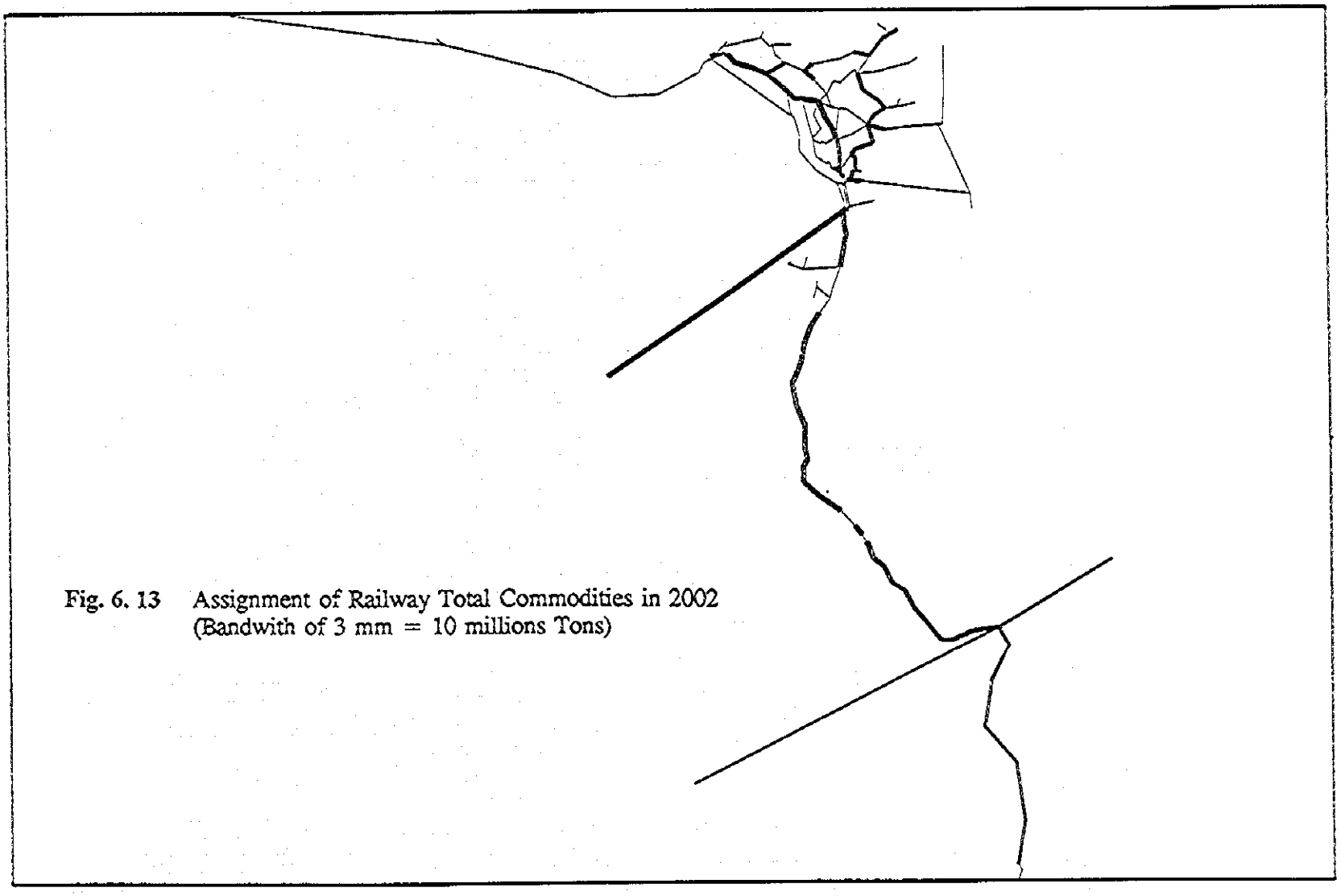


Fig. 6. 13 Assignment of Railway Total Commodities in 2002
(Bandwith of 3 mm = 10 millions Tons)

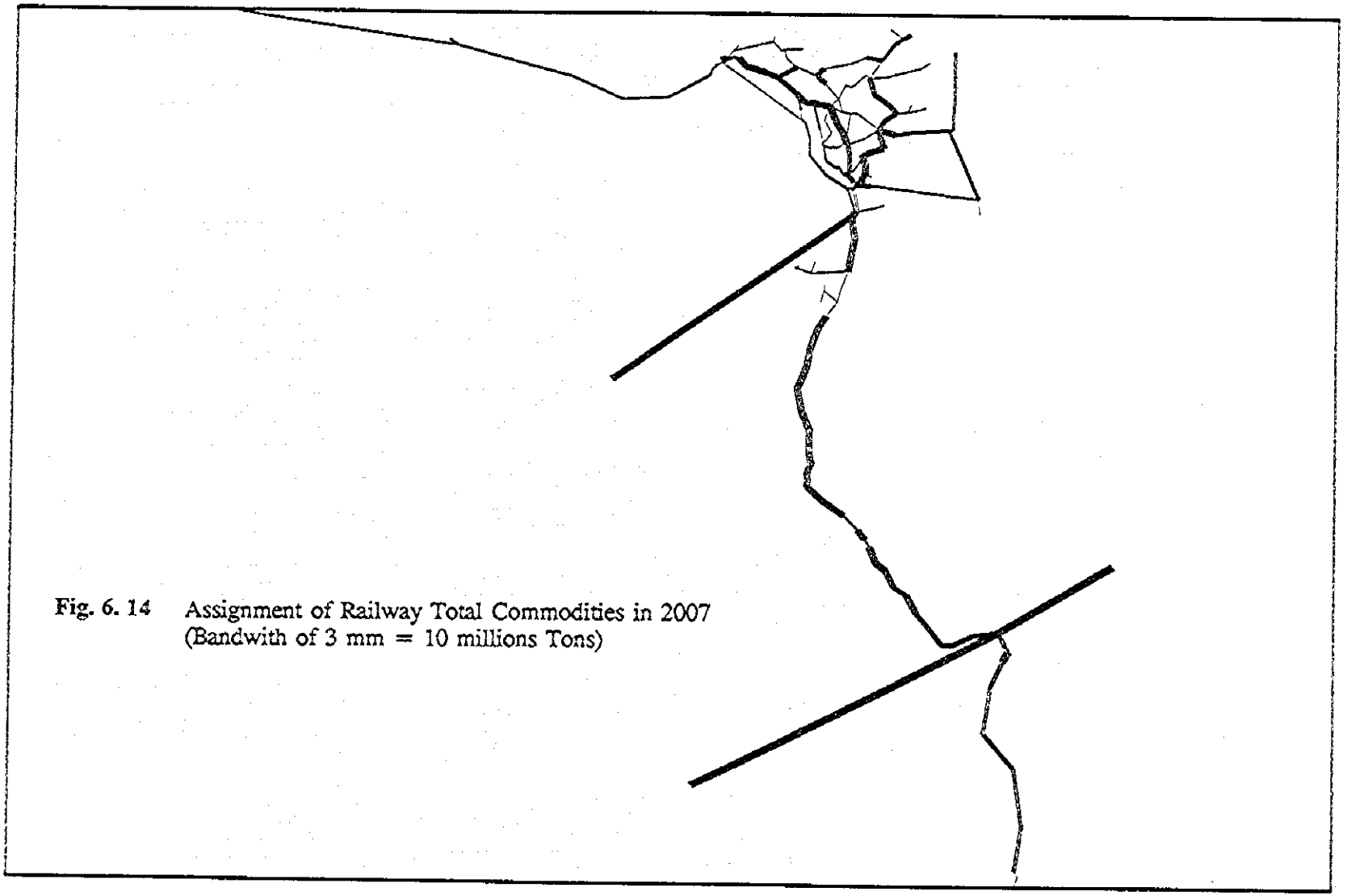


Fig. 6. 14 Assignment of Railway Total Commodities in 2007
(Bandwith of 3 mm = 10 millions Tons)

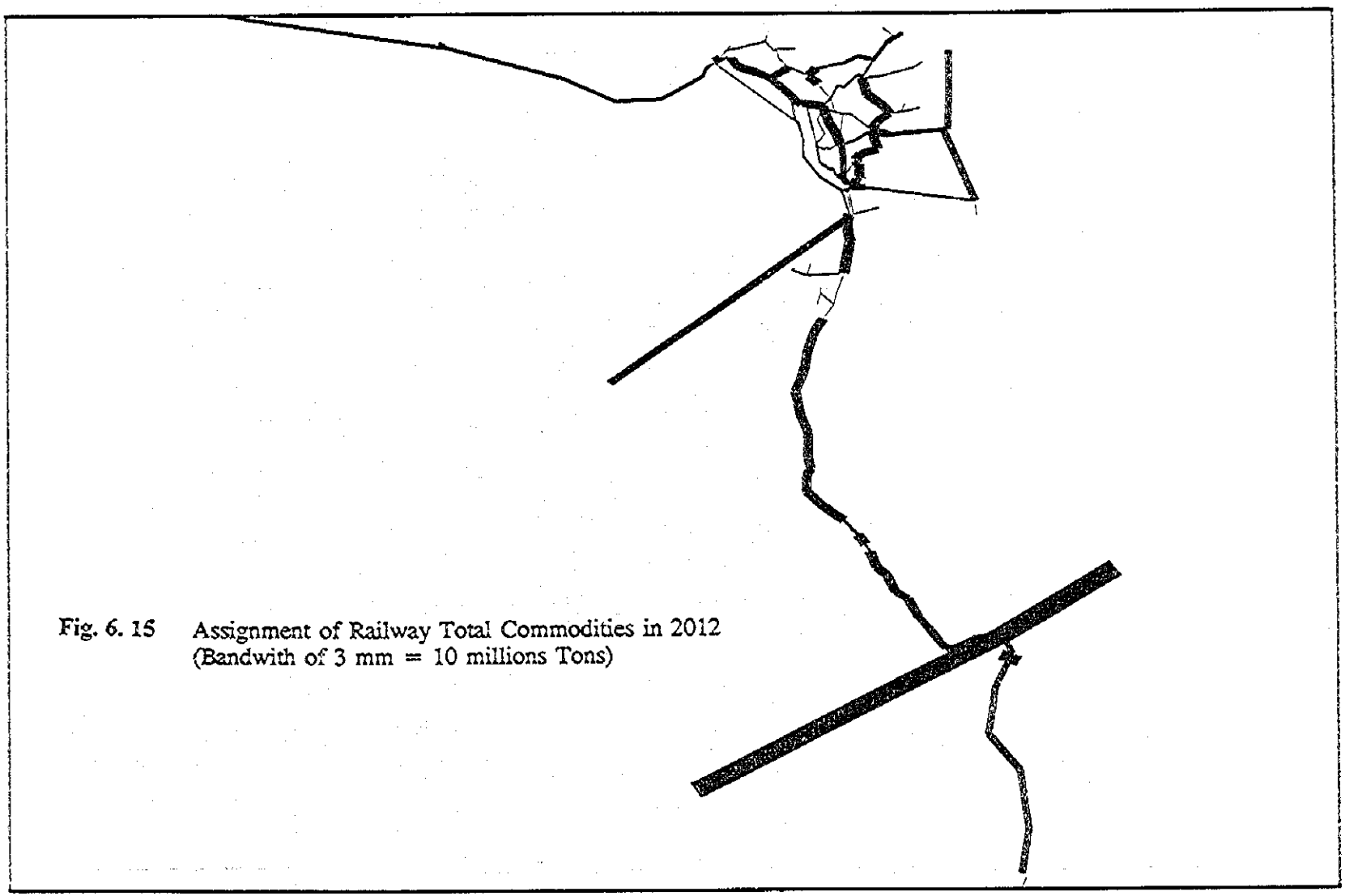


Fig. 6. 15 Assignment of Railway Total Commodities in 2012
(Bandwith of 3 mm = 10 millions Tons)

6.7 ROUGH ESTIMATION OF PASSENGER VOLUME OF METRO LINE

It is not intended to analyze the Metro lines (either the existing regional line or under-construction line) in detail. On the other hand, this sub-section aims at shedding some light on the expected number of passengers using the regional line (Helwan - Marg) and the second Metro line (Giza - Shoubra El Kheima), among which Cairo - Shoubra section commenced in October 1996 and other one is still under-construction. It should be noted that the regional Metro line is defined as line number (6) in the Egyptian National Railways Network. Future number of passengers using Metro lines are estimated based on some assumptions and available data mainly derived from a study titled "Greater Cairo Region Transportation Master Plan Study in The Arab Republic of Egypt, Main Report, 1989, JICA). The basic data and assumptions are:

- Actual number of passengers using regional line are shown in Table 6.27.

- The expected number of passengers using the second Metro line is estimated to be 650,000 pass/day or 237,250,000 pass/year. This figure is based on a Report of National Authority for Tunnel, "Greater Cairo Metro Urban Line No. 1 - Upgrading of Studies, Contract 21/M, First Report, Phase 1B, Transport Planning-Civil Works".

- Number of trips of public transport in Greater Cairo Urban Area is estimated to be 4,194,318 and 5,293,515 trips in years 1987 and 2000, respectively. This resulted in an average annual growth ratio of 1.8%. This growth ratio (1.8%) is assumed to be valid up to year 2012.

- Induced traffic volume resulting from connecting regional Metro line and the second Metro line is assumed to be 0.

Table 6.28 summarizes the basic steps of forecasting the number of passengers using both Metro lines for different years from 1995 - 2012. Total number of passengers using regional line is 328.3 million in 1995 and expected to reach 444.6 million in 2012. As for the second line, total number of passengers is expected to be 117.6 and 293.9 million in 1997 and 2012, respectively.

Table 6.27 Actual Number of Passenger of Metro (Line No. 1)

Year	Number of Passengers (Million/year)	Growth Ratio (%)	Passenger Kilometers (Million/year)	Growth Ratio (%)	Average Travel Distance (km)
1987/88	48.868		733		15.0
1988/89	72.490	48.3	1,015	38.5	14.0
1989/90	127.997	76.6	1,792	76.6	14.0
1990/91	146.455	14.4	2,041	13.9	13.9
1991/92	280.528	91.5	3,928	92.5	14.0
1992/93	305.749	9.0	4,280	9.0	14.0
1993/94	311.948	2.0	4,367	2.0	14.0
1994/95	328.306	5.2	4,596	5.2	14.0

Source: ENR Commercial Department

Table 6.28 Estimation of Future Number of Passengers for Metro Line No. 1 and No. 2

(*)

Effect of Aver. Travel Dist. by Connect of No. 1 & No.2	Ratio of Travel Dist. to Operating L. in Line No. 1
After Connect. Plus 10%	14 / 42 = 0.333

(*) Incorporated here
Passenger Movement for
Both No.1 and No.2
(From No.1 to No.2)
(From No.2 to N0.1)

Year	Estimated Future Number of Passengers for Line No.1 and No.2									Assumed Average Travel Distance (Km) For Line 1	Assumed Average Travel Distance (Km) For Line 2	Estimated Passenger Kilometers For Line 1	Estimated Passenger Kilometers For Line 2	Estimated Total Passenger Kilometer of Line 1 and Kine 2
	Line No.1			Line No.2					Total of No.1 & No.2 Passenger Volume					
	Estimated Passenger Volume	Assumed Induced Traffic by Connecting No.1 & No.2	Estimated Passenger Volume	Information of Number of Passenger in 2000	Estimated Passenger Volume	Operating Length	Factor of Operating Length (f)/15.3	Estimated Passenger Volume						
	(Million/Year)	(0%)	(Million/Year)	(Million/Year)	(Million/Year)	(Km)	After 02/03=1.0	(Million/Year)	(Million/Year)	14.0		(Million/Year)	(Million/Year)	(Million/Year)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
			(a) + (b)				(f) / 15.3	(e) x (g)	(c) + (h)		(f) x 0.333	(c) x (j)	(h) x (k)	(l) + (m)
1994/95	328.3		328.3						328.3	14.0		4,596.3	0.0	4,596.3
1995/96	334.2		334.2						334.2	14.0		4,679.0	0.0	4,679.0
1996/97	340.2	0.0	340.2		224.9	8.0	0.52	117.6	457.8	15.4	2.7	5,239.6	313.6	5,553.1
1997/98	346.4	0.0	346.4		228.9	10.9	0.71	163.1	509.5	15.4	3.6	5,333.9	592.6	5,926.5
1998/99	352.6	0.0	352.6		233.1	10.9	0.71	166.0	518.6	15.4	3.6	5,429.9	603.3	6,033.1
1999/2000	358.9	0.0	358.9	237.3	237.3	10.9	0.71	169.0	528.0	15.4	3.6	5,527.6	614.1	6,141.7
2000/01	365.4	0.0	365.4		241.5	10.9	0.71	172.1	537.5	15.4	3.6	5,627.1	625.2	6,252.3
2001/02	372.0	0.0	372.0		245.9	10.9	0.71	175.2	547.1	15.4	3.6	5,728.4	636.4	6,364.8
2002/03	378.7	0.0	378.7		250.3	18.2	1.00	250.3	629.0	15.4	6.1	5,831.5	1,518.4	7,350.0
2003/04	385.5	0.0	385.5		254.8	18.2	1.00	254.8	640.3	15.4	6.1	5,936.5	1,545.8	7,482.3
2004/05	392.4	0.0	392.4		259.4	18.2	1.00	259.4	651.8	15.4	6.1	6,043.3	1,573.6	7,616.9
2005/06	399.5	0.0	399.5		264.1	18.2	1.00	264.1	663.5	15.4	6.1	6,152.1	1,601.9	7,754.1
2006/07	406.7	0.0	406.7		268.8	18.2	1.00	268.8	675.5	15.4	6.1	6,262.9	1,630.8	7,893.6
2007/08	414.0	0.0	414.0		273.6	18.2	1.00	273.6	687.6	15.4	6.1	6,375.6	1,660.1	8,035.7
2008/09	421.5	0.0	421.5		278.6	18.2	1.00	278.6	700.0	15.4	6.1	6,490.4	1,690.0	8,180.4
2009/10	429.0	0.0	429.0		283.6	18.2	1.00	283.6	712.6	15.4	6.1	6,607.2	1,720.4	8,327.6
2010/11	436.8	0.0	436.8		288.7	18.2	1.00	288.7	725.5	15.4	6.1	6,726.1	1,751.4	8,477.5
2011/12	444.6	0.0	444.6		293.9	18.2	1.00	293.9	738.5	15.4	6.1	6,847.2	1,782.9	8,630.1