Analysing the Economic and Operational Indicators for Railways: the Case Study of Egyptian Railways

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ABSTRACT. The aim of this study is analyzing the economic indicators affecting train operation in ENR. ENR has decreased in transport of passengers and goods due to failure in management, limited resources and decrease of fleet. The weight of freight transport decreased from 12.2 million ton in 2004 to 3 million ton in 2013. Also, number of passengers decreased from 450 million passenger in 2002 to 2007 million passenger in 2013.Thus, the authors studied the economic indicators affecting the operation for Egyptian National Railways and the tools used to analyze it. These analyses included operating performance and financial performance in terms of, passenger traffic, freight volume, overcrowding rate, No. of accidents, existing fleet, time delaying, revenues, costs and deficits. The authors also evaluated these performance indicators in terms of, labor productivity, pound productivity and trip productivity. Finally, the authors studied the mathematical equation, which used in ENR for calculation of ticket price.

Introduction.

Most railways became under state control (1960-1980 period) due to the deficits which began appear which lead to most governments nationalize their railways. Most railways created more flexibility in the organization of their service, reduce costs, adapt with new technologies. Profillidis [1] studied policies and legislations for some countries. Some countries have already privatized their railways operator such as (Japan, Sweden, etc.) for competitive with other transport modes. Other countries tended to liberalization of railways activities and separation of infrastructure from operation such as in Europe. The World Bank [2] analysed some performance indicators for Egyptian national railways which included ENR productivity and technical efficiency, financial operations, passenger and freight traffic, staff productivity and age distribution for (freight wagons, passenger wagons and locomotive). V Graham [3] studied performance indicators and comparative these indicators between different countries. Performance indicators divided to operating indicators and financial indicators. Operating performance indicators included traffic density, labour productivity, freight wagon productivity, passenger coach productivity and locomotive productivity. Financial performance indicators included the cost recovery ratio defined as the degree of coverage of total operating costs with total revenue, including state support and the viability ratio defined as the ratio of commercial revenue divided by total operating costs. Stenstrom [4] studied performance indicators for railway infrastructure, with

primary focus on the railway track, have been mapped and compared with indicators of European Standards. Performance indicators of railway infrastructure categorized into two groups; managerial and condition monitoring indicators. Infrastructure managers use performance measurement to study whether results are in line with set objectives, for predicting maintenance and reinvestments, decision support and benchmarking and business safety. Galar [5] studied it is not possible to measure everything with only quantitative or qualitative methods. Rather a combination of both methods must be used to create a measurement system that is as complete as possible. Qualitative measurement methods are good for measuring soft values, like employee satisfaction, and for checking conformity with quantitative indicators. Mads Veiseth [7] studied the measurement system should be extended to include measurement of effects of punctuality and regularity and of management processes that increases the focus on punctuality and regularity. Railway companies should try to link measurement of rail reliability with other performance measures in the companies. With these suggested extensions, the measurement system will become more balanced and complete [8], [9].

Railways are characterized with high capital cost, low relative return and long period required for recovering it, As a result, private sector is usually reserved about participation. There some problems, which face development of ENR. None measuring the economic and operating indicators that expressing the actual performance in ENR. The available data of operation and finance of ENR have not been analyzed or evaluated in a correct manner. The impact of the Egyptian revolution in 2011 on the productivity and performance of ENR has not been evaluated. So, this paper focuses on the following items:

1. Assessing the economic indicators that affecting the operation of railways and determining the parameters that affecting these indicators.

2. Analysing and evaluating the operation and financial performance indicators.

3. Analysing the strategy and methodology for calculation of ticket price in ENR, as a local operator of railway in Egypt.

4. Studying the negative effects of Egyptian revolution 2011 on the operating and financial performance of ENR, as it had a major effect on the productivity of the railways.

Data Collection

The analysis that has been carried out in this research is built on different data collected from Egyptian National Railways and the Central Agency for Public Mobilization and Statistics[10]. Data was collected from different sector such as (Goods sector ,Operational sector, financial sector, long and short-distance sector). Collected data for analysing the operating and financial indicators. Analysing this data will be carried out by using Excel and SPSS program. The collected data is classified into data for indicators such as revenues, costs, No.of passenger, transported tonnage, average travel distance, No.of labors and volume of the fleet as shown in below tables. After that, data for ticket pricing.

Other revenues are indicated to the state support and advertisement, while other costs are indicated to maintenance costs, the common service sector and costs of management.

Table 1. ENR revenues and costs (2008-2015)

Years	Passenger revenue LE million	Freight revenue LE million	Other revenues	Passenger Costs LE million	Freight Costs LE million	Other Costs
2007/2008	1116	149	200.2	772.6	135.2	1023.9
2008/2009	1432	201.5	411.9	1128	180.4	947.8
2009/2010	831.9	245.5	1387.6	1318	237.3	1082.3
2010/2011	1560.8	229.7	1227.2	1861	321	1027.1
2011/2012	1499.5	175.9	715	1642.6	307	1892.4
2012/2013	867	156.9	1082.2	1944	430.3	1901.4
2013/2014	467.3	178.9	1148.8	2650	460.5	2040.8
2014/2015	912.6	163.6	1179.8	3069.8	448.8	2971.1

Table 2. Passenger traffic (2002-2013)

YEARS	No.of Passenger	Passenger-Kilometers	Average travel	No.of Working Train
	Millions	Millions	Distance KM	Train
2001/2002	450.0	39083	86.9	416821.0
2002/2003	367.0	46185.0	125.8	426245.0
2003/2004	418.0	52682.0	126.0	413173.0
2004/2005	438.0	55187.0	126.0	412448.0
2005/2006	435.0	54884.0	126.2	416820.0
2006/2007	418.0	52624.0	125.9	385514.0
2007/2008	374.0	50181.0	134.2	365362.0
2008/2009	291.0	27899.0	95.9	370507.0
2009/2010	293.0	28097.0	95.9	382950.0
2010/2011	225.0	27252.0	121.1	401500.0
2011/2012	311.0	13550.0	43.6	389130.0
2012/2013	207	13704.0	66.2	400105

Table 3. Freight traffic (2002-2013)

YEARS	Total transported	Tonnage-Kilometers	Average travel	No.of Running Train
	Cargoes(Millions)	Millions	Distance KM	Train
2001/2002	11.9	4188	351.9	18750.0
2002/2003	11.2	4104.0	366.4	17648.0
2003/2004	12.2	4663.0	382.2	17645.0
2004/2005	10.9	4064.0	372.8	16136.0
2005/2006	10.4	3833.0	368.6	15157.0
2006/2007	7.8	2696.0	345.6	11093.0
2007/2008	6.0	2021.0	336.8	9213.0
2008/2009	5.0	1592.0	318.4	7208.0
2009/2010	5.7	1889.0	331.4	7962.0
2010/2011	6.6	1965.0	297.7	7962.0
2011/2012	4.0	1398.0	349.5	6700.0
2012/2013	3	1166.0	388.7	6000

Table 4. ENR fleet for (Freight wagons, Passenger wagons and locomotors)

The existing fleet of ENR(2015)			
Type	Total fleet	Lifespan	Exceed Lifespan
Locomotive	808	283	525
Air wagons	795	765	30
Long distance wagons	1039	393	646
Short distance wagons	1395	1285	77
Goods wagons	10718	5444	5274

Table 5. ENR staffing (2010-2015)

Years	2010/2009	2011/2010	2012/2011	2013/2012	2014/2013	2015/2014
Staff costs(LE)	1,099,809,779	1,484,662,654	2,031,767,841	2,427,706,157	2,623,340,000	2,694,854,266
No.of labors	63500	60490	60239	63267	60777	57077

The pricing principle in ENR is the "Full cost pricing principle" According to this principle; the tariff level is set so that total revenues from passengers and freight will recover total costs. The costs of

ENR are divided into direct costs and indirect costs. Where, direct costs are include long distance cost, short distance cost and Freight cost. While, indirect costs are include common services, technical support and Managing authority. The formula, which used by ENR for calculations is illustrated as follows:

1. Passenger ticket pricing

$$\text{Ticket cost} = \text{Seat price/km} + \text{Locomotive \%} + \text{Air condition \%}$$

$$Ticket\ cost = \sum \frac{\text{Long distance costs} \cdot \text{Assets ratio \%}}{\text{N}\cdot 360 \cdot 8 \cdot \text{v} \cdot \text{No.of Seats}} \quad (1)$$

2- Freight ticket pricing

$$\text{Ton.km cost} = \text{Ton price/km} + \text{Locomotive \%}$$

$$Ton.km\ cost = \sum \frac{\text{Freight costs} \cdot \text{Assets ratio \%}}{\text{N}\cdot 360 \cdot 8 \cdot \text{v}} \quad (2)$$

where Assets Ratio% = Assets of (vehicle or locomotive) / Total Assets (Total assets include Track, Signals, Vehicles, stations and locomotives)

360 – Convert from year to day

8 – Work hours for labors

V – Speed of Train

N – No. of operated cars or locomotives

Analysis and Evaluation

This section will illustrate the Economic Indicators affecting the operation for Egyptian National Railways. The researcher will study the strategy of pricing used in ENR, which affecting operating and financial performance for ENR. Then illustrate the negative effect of Egyptian revolution on productivity. Therefore, the researcher will suggest different methodology for tariff pricing to development operating and financial performance of railways.

Tariff Structure for Passenger and Freights

Tariff structure for passenger and freights is usually effect the operation indicator. The pricing principle in ENR is the "Full cost pricing principle" According to this principle. The tariff level is set so that total revenues from passengers and freight will recover total costs of passengers and freights.

Tariff Structure for Passengers

According to data from financial department of ENR for year 2014/2015. The research will take case study for Spanish train first class between Cairo and Alexandria to calculate ticket cost for passenger by using the above formula. Revenues of this Spanish train is estimated as 83,160 LE per day based on (6 train / day • 44 seat • 9 cars • 35 LE). Costs is estimated 64,152 LE based on (6 train / day • 44 seat Special wagon 9 cars • 27 LE). The cost recovery ratio is calculated at 1.3, showing high profitability also ENR has been suffering from deficits. But this tell us that tariff / cost for of this train is relatively high compared with other trains, i.e. normal and express trains for 2nd and 3rd class. It appear that Spanish trains are cross subsidizing other trains. There are many lines on which tariff seems to be lower than cost. For example, there are many low-income passenger on suburban and branch lines. Their tariff level is kept low in spite costs, which exceed the tariff. The deficits caused

by suburban lines seems to be cross subsidized by profitable lines in 1st class and 2nd class. This practice is not appropriate for competitive transport market.

Tariff Structure for Freights

The tariff is evaluated according to the value (market price) of a commodity. According to this principle, tariffs are set by the value of goods owned by the consignor. High value goods require higher tariffs. This principle is reasonable only when cost is less than tariff. Nevertheless, on some ENR lines, tariffs seem to be lower than costs. The same problems in passenger transport occur in freight transport. According to data from financial department of ENR for year 2014/2015. The researcher will take case study for (a special type of wagons) between Cairo and Alexandria to calculate ton.km cost for freights by using the above formula.

Steps to calculate ticket price for Spanish train first class between Cairo and Alexandria

$$\text{Assets of train \%} = \frac{\text{Assets of Spanish trains}}{\text{total assets}} = \frac{330,506,969}{7112330442} = 0.046\ \%$$

$$\text{Seat price} = \frac{\text{Total long distance cost} * \text{Assets of train \%}}{N*360*8*v*\text{No.of seats}} = \frac{3697476224*0.046}{192*360*8*80*44} = 0.09\ \text{LE/seat.km}$$

$$\text{1- Assets of Locomotive \%} = \frac{\text{Assets of locomotives}}{\text{total assets}} = \frac{1098411966}{7112330442} = 0.154\%$$

$$\text{Locomotive \%} = \frac{\text{Total long distance cost} * \text{Assets of locomotive \%}}{N*360*8*v*\text{No.of seats}*\text{No.of hauled cars per train}} = \frac{3697476224*0.154}{197*360*8*80*44*9} = 0.03\ \text{LE/seat.km}$$

$$\text{Assets of Air condition \%} = \frac{\text{Assets of power vehicles}}{\text{total assets}} = \frac{116531818}{7112330442} = 0.02\%$$

$$\text{Cost of Air condition \%} = \frac{\text{Total long distance cost} * \text{Assets of power vehivle \%}}{N*360*8*v*\text{No.of seats}*\text{No.of hauled cars per train}} = \frac{3697476224*0.02}{69*360*8*80*44*9} = 0.01\ \text{LE/seat.km}$$

Ticket cost = 0.09+0.03+0.01 = 0.13 LE / seat.Km

Calculate ticket cost $_{(\text{Cairo-Alex})}$ = Ticket cost· Travel distance = 0.13·208= 27 LE/seat.

Actual ticket price = 35 LE/seat.

Steps to calculate transport cost (Ton.Km) for special wagon between Cairo and Alexandria

Special wagon

$$\text{Assets of train \%} = \frac{\text{Assets of}}{\text{total assets}} = \frac{5718271}{4748950939} = 0.001\ \%$$

$$\text{Ton cost} = \frac{\text{Freight cost} * \text{Assets of train \%}}{N*360*8*v*\text{weight of loaded car}} = \frac{1157779501*0.001}{130*360*8*40*75} = 0.001\ \text{LE/ton.km}$$

$$\text{Assets of Locomotive \%} = \frac{\text{Assets of locomotives}}{\text{total assets}} = \frac{862760909}{4748950939} = 0.182\%$$

$$\text{Locomotive \%} = \frac{\text{Freight cost} * \text{Assets of locomotive \%}}{N*360*8*v*\text{Weight of loaded car}*\text{No.of hauled cars per train}} = \frac{1157779501*0.182}{137*360*8*40*75*25} = 0.007\ \text{LE/ton.km}$$

(Ton.km) cost = 0.007+ 0.001= 0.008 LE/ton.km = 0.008 L.E/ton.km

Calculate Ton.km cost $_{(\text{Cairo-Alex})}$ = Ticket cost• Travel distance = 0.008•208= 1.7 LE/ton.km.

Analysis and Evaluation of performance indicators

The pricing methodology in ENR is the full cost pricing principle. This principle leaded to deterioration in performance and productivity indicators of ENR. As shown in below sections

Development of Rail passenger traffic

The total number of passenger.km has oscillation during the study period. The annual average value is (38444) million passengers.Km. It is noted in (2008-2009) a marked deterioration in (passengers.Km), due to the effect of the financial crisis and then returned to a marked deficiency in (2012) because of Egyptian revolution. As illustrated in figure 1. If the railway operation continues with the same situation, it will cause a drop in the passenger.km and decreasing in revenues with continues deficits in the finances of the railway.

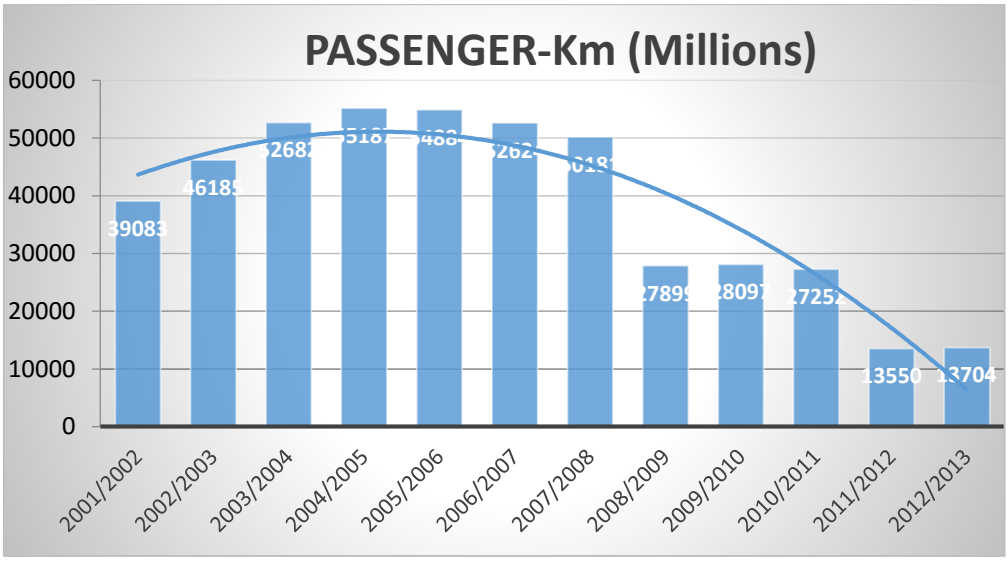

Fig. 1. Passenger Traffic.

Development of Rail freight traffic

The total number of tonnage has oscillation during the study period. The annual average value is (2798) million tonnage. Km. It is noted in (2007-2008) a marked deterioration in (tonnage per Km), due to restructuring of the railway and then returned to a marked deficiency in (2012), because of Egyptian revolution. As illustrated in figure 2.

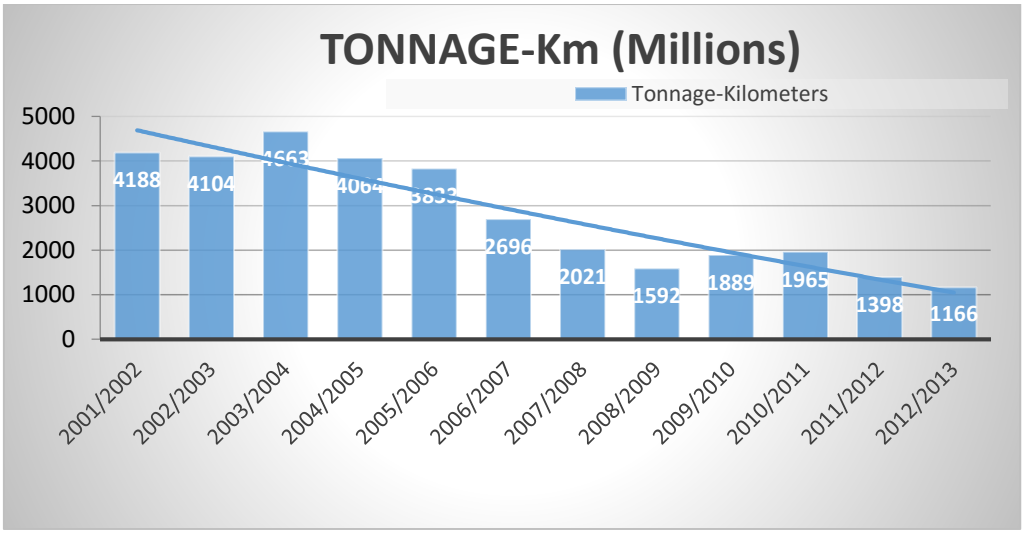

Fig. 2 .Freight Traffic.

Egypt railways Accidents

The total number of accidents has oscillation during the study period. The annual average value is (998.5) accident. As illustrated in Figure 3. If the railway safety continues with the same negative situation, it will cause increasing in the total number of accidents and decreasing number of passenger.

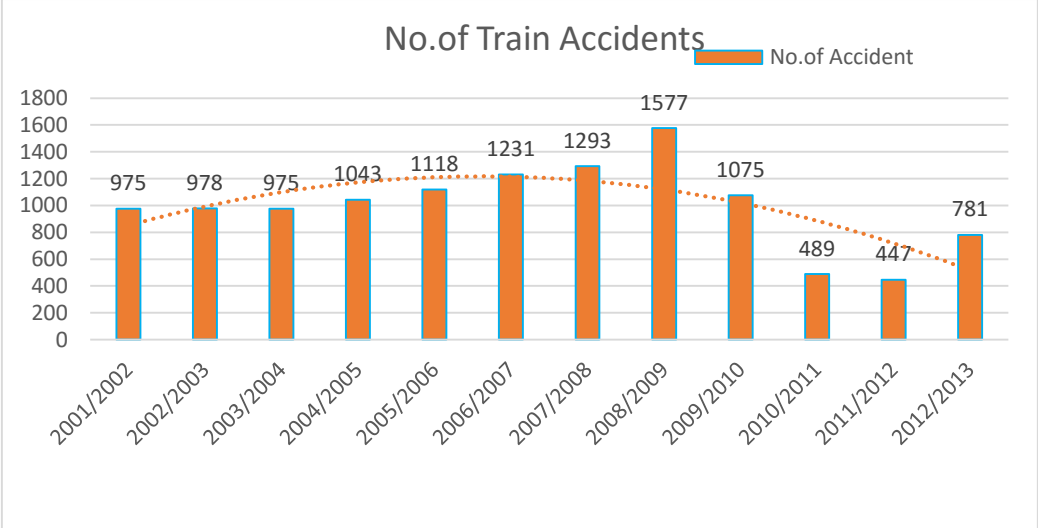

Fig. 3. Railway accidents (unit).

Overcrowding rate

Overcrowding rate means the average number of passengers who are competing for one vacuum. The rate of overcrowding has oscillation during the study period. It is noted in (2011-2012) a marked high growth in overcrowding rate, because of stopping of more lines. In the last 3 years the rate of overcrowding near equal 1 or more, which means no available space. As illustrated in Figure 4.

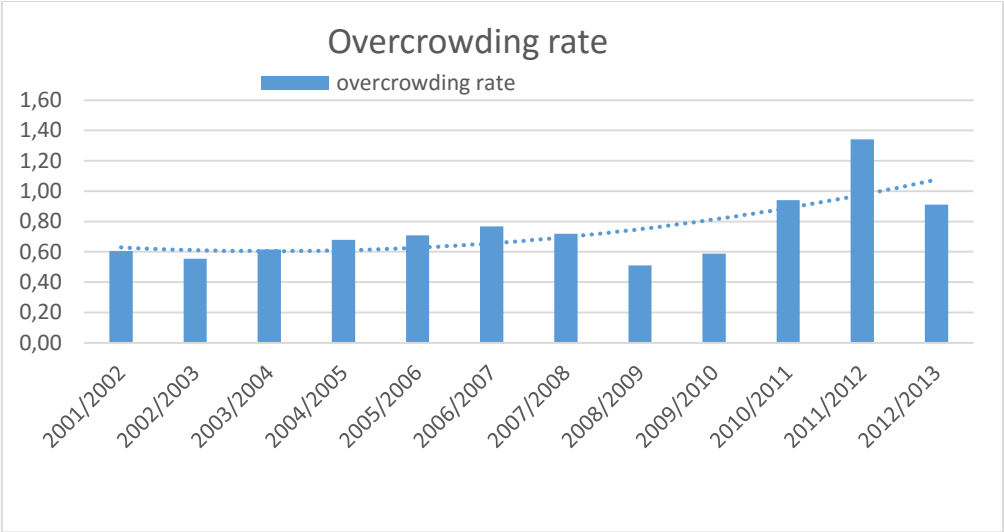

Fig. 4 .Overcrowding rate in ENR (passenger/available space/trip).

ENR Passenger Fleet

The coaches availability has oscillation during the study period. As shown in Figure 5. It is noted that No. of coaches in January 2012 equal 1476 and it became 1417 in December 2014 by lack of 4%, in the last 3 years a percentage of coaches availability not exceed about 70% of total fleet, due to lack of continuous maintenance and most of coaches exceeded the life span. Coaches availability in some month's reached to 50% of total fleet this reflect the increasing which occurred in rate of overcrowding.

Fig. 5. Coaches availability % for passenger short distance, (2012, 2013 and 2014).

ENR Freight Fleet

The coaches availability has oscillation during the study period ranging. As shown in Figure 6. It is noted that No. of coaches in January 2012 equal 10368 and it became 10167 in December 2014 by lack of 2%. In the last year a percentage of coaches availability not exceed about 65% total fleet , due to lack of continuous maintenance and most of coaches exceeded the life span. Coaches availability in some month's reached to 33.9% total fleet this refer to dropped which occurred in the volume of freights.

Fig. 6. Coaches availability % for freight, (2012, 2013 and 2014).

Times delaying

As shown in Figure 7. The trains which depart on time has the average value (83.8%), it is noted that delaying percentage of departure time is (14.2%) This large percentage reflect increasing in rate of overcrowding and decreasing in revenues. The average value of arrival time is (38.4%) with delaying percentage (61.6%). This large percentage reflects decreasing number of passenger, decreasing in revenues, increasing deficits

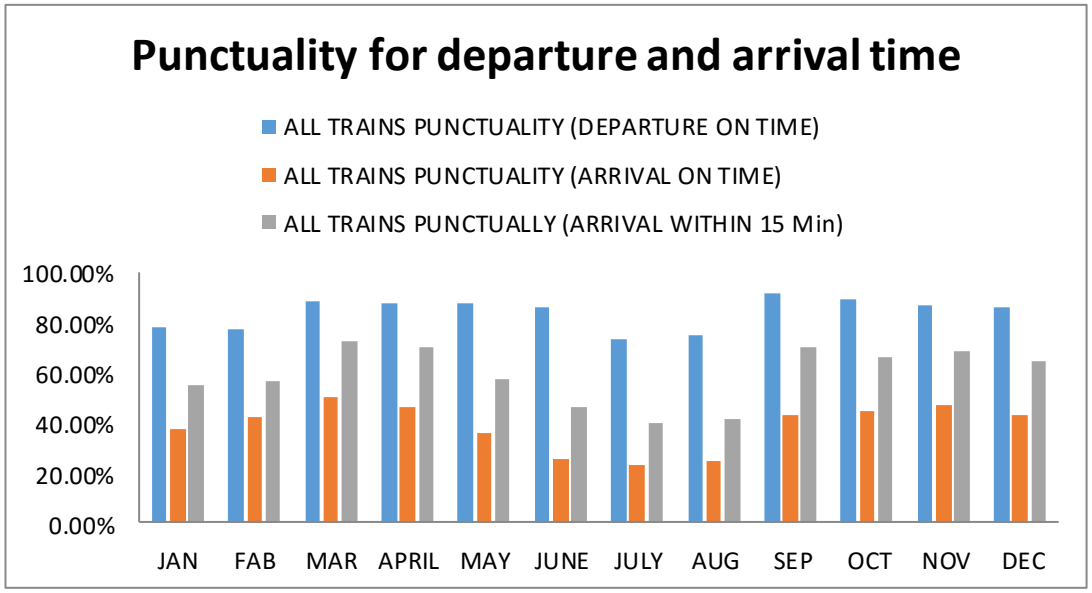

Fig. 7. Punctuality for departure and arrival time, (2012-2013).

Passenger revenues

The passengers revenue have oscillation during the study period. The average revenue for passengers during the same period is (1085.9) LE Million. It is noted in (2011and 2012), a marked growth in revenues comparing to 2010 in spite of constant passenger.km, due to increasing in tariff and then returned to a marked deficiency in (2013). This is because decreasing in passenger.km. As illustrated in Figure 8.

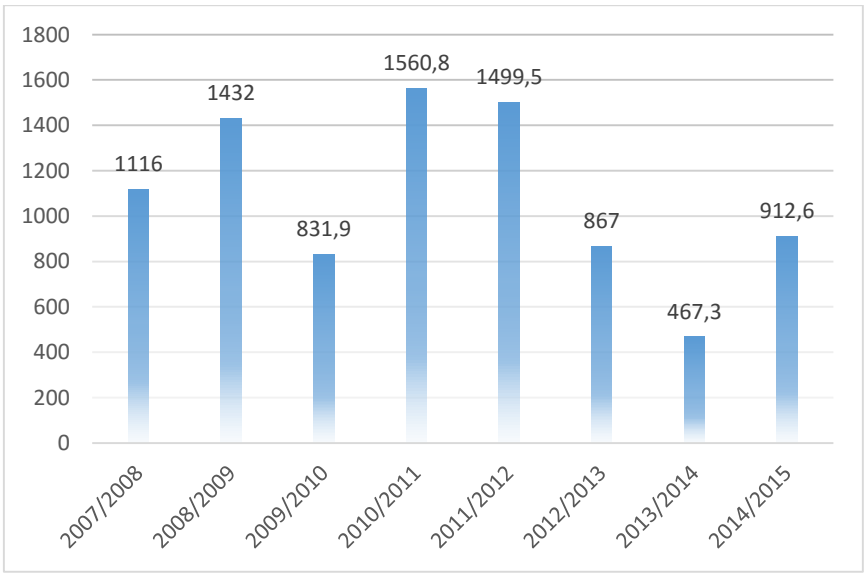

Fig. 8. Passengers revenues, (2008-2015).

Freight revenues

The freights revenue have oscillation during the study period. The average revenue for freights during the same period is (187.6) LE Million. It is noted in (2010 and 2011) a marked growth in revenues comparing to 2008, hence a decreasing in tonnage.km occurred, due to increasing tonnage price and then returned to a marked deficiency in (2012), as a result of decreasing in tonnage.km, as illustrated

in Figure 9. Freight revenue took a trend variable, thus it cannot predict with freights revenue in the future.

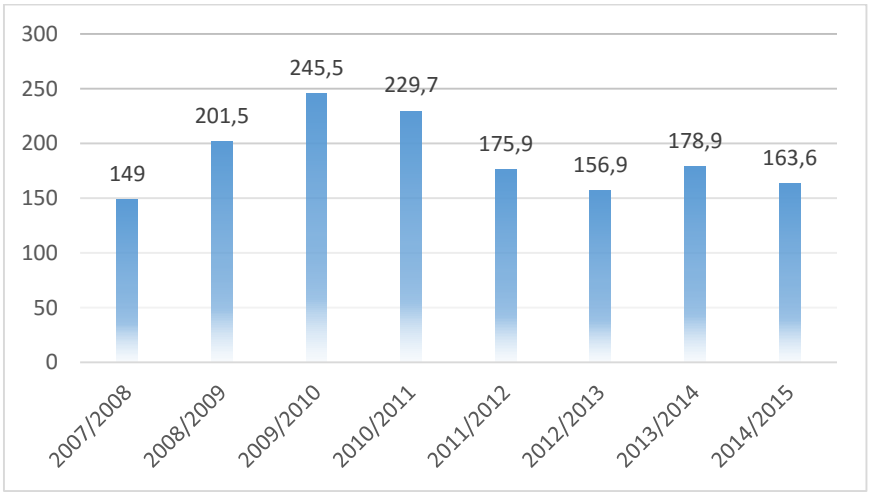

Fig. 9. Freight revenues, (2008-2015).

Operation and Maintenance costs for passenger traffic

The passengers cost have increased during the study period. The average cost for passengers during the same period is (1798.3) L.E million. It is noted in 2015 a marked growth in costs comparing to other years, as a result of increasing in fuel price and increasing in labor wages. As illustrated in Figure 10.

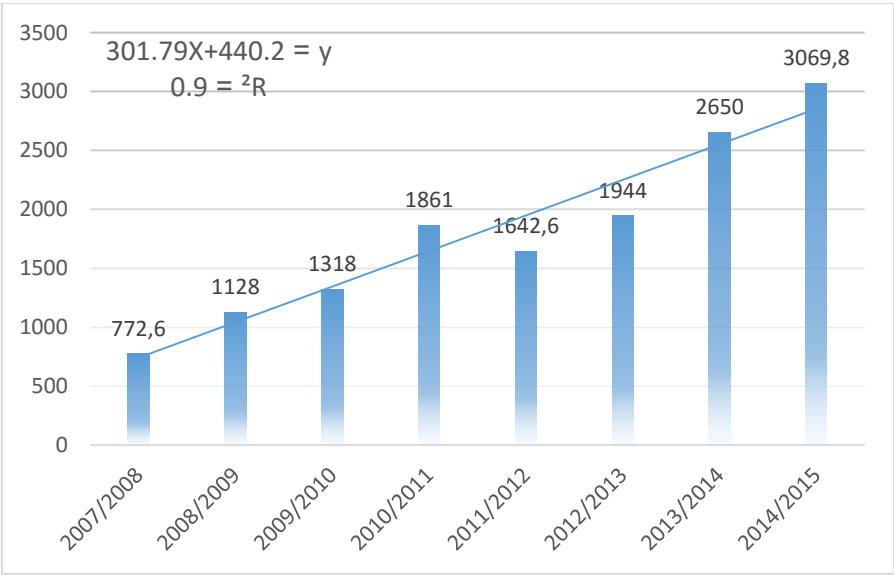

Fig. 10. Passenger costs, (2008-2015).

Operation and Maintenance costs for freight traffic

The freights cost have increased during the study period. The average cost for freight is (315) L.E Million. It is noted on 2014 a marked growth in costs comparing to other years, due to increasing in fuel price and increasing in labor wages. As illustrated in Figure 11.

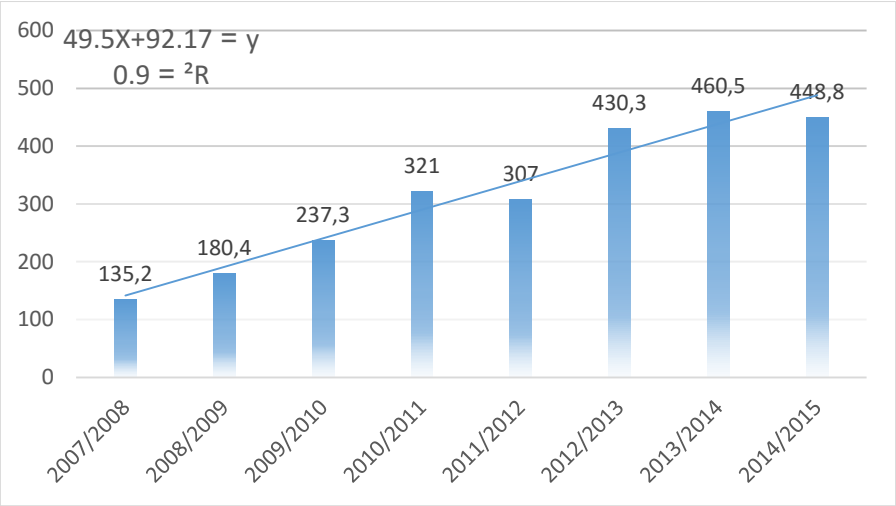

Fig. 11. Freight costs, (2008-2015).

Comparison between total revenues and total costs

The study period has continuous decreasing in revenues. It is noted that passenger revenues are more than freight revenues. This is due to decreasing in tonnage.km and non-concerning for freight operation. As shown in Figure 12. In the last years decreasing in revenues due to decreasing passenger.km and tonnage.km, while increasing costs due to increasing staff salary, increasing fuel price. As illustrated in figure 13.

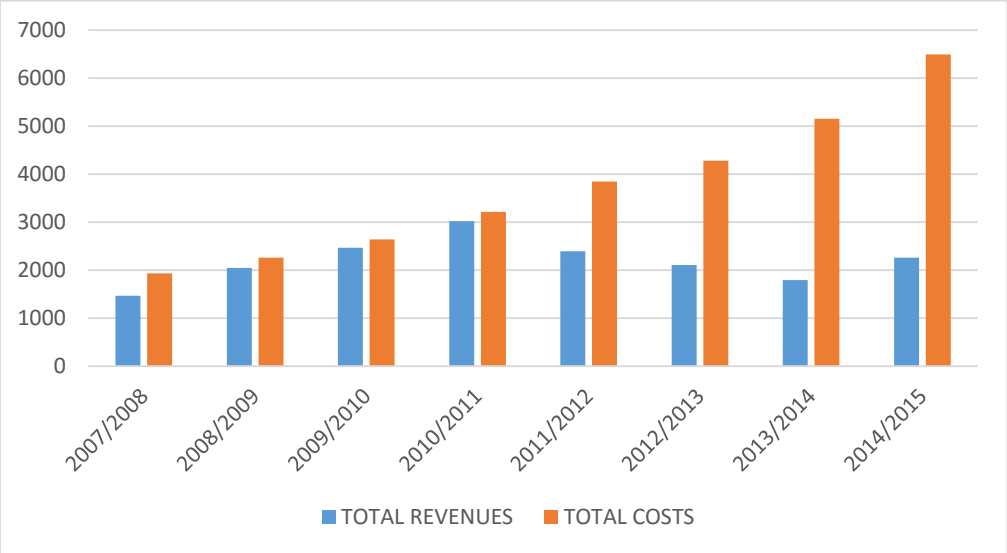

Fig. 13. Comparison between total revenues and costs, (2008-2015).

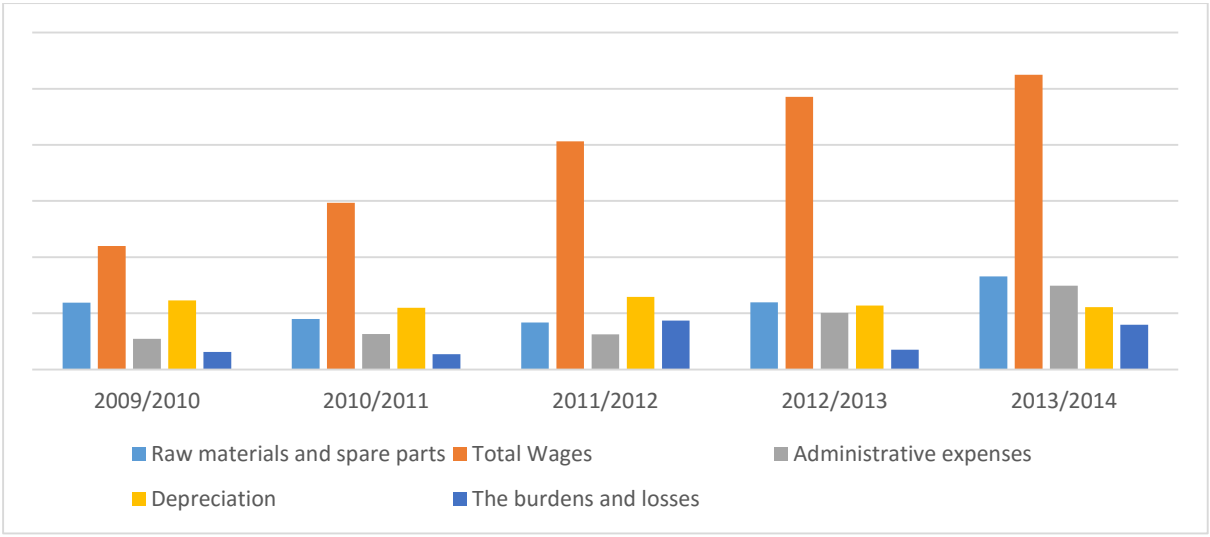

Fig. 14. Components of costs, (2010-2014).

Evaluation of performance indicators

Labor productivity

Productivity of labors for passenger.km has an oscillation during the study period with an annual average 221.2 (passenger.km per labor). The decreasing ratio between passenger.km to labors is a negative indicator for labor productivity. As shown in Figure 15. The productivity of labors wages for total revenues has an oscillation during the study period with an annual average 1.6 (LE), where increasing in this ratio is a positive indicator due to increasing revenues to wages. The bad year is 2013, due to increasing in labor wages comparing to total revenues. As shown in Figure 16.

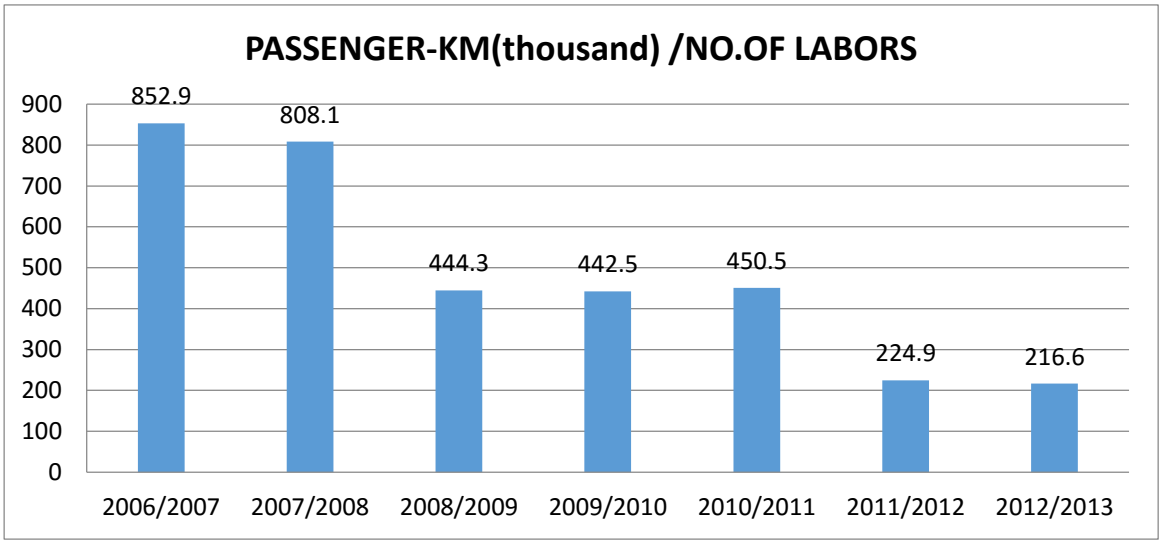

Fig. 15. Labour productivity for passenger.km, (2007-2013).

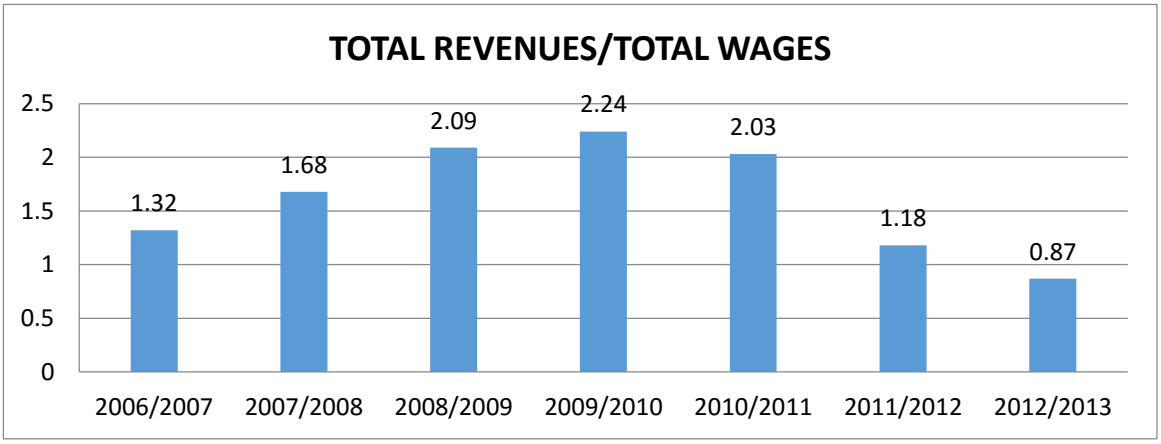

Fig. 16. Labor productivity for total revenues, (2007-2013).

Fuel productivity

Productivity of fuel for operating revenues has an oscillation during the study period with an annual average 9.9 (LE). The increasing in this ratio is a positive indicator, due to increasing revenues to fuel costs. As shown in Figure 17.

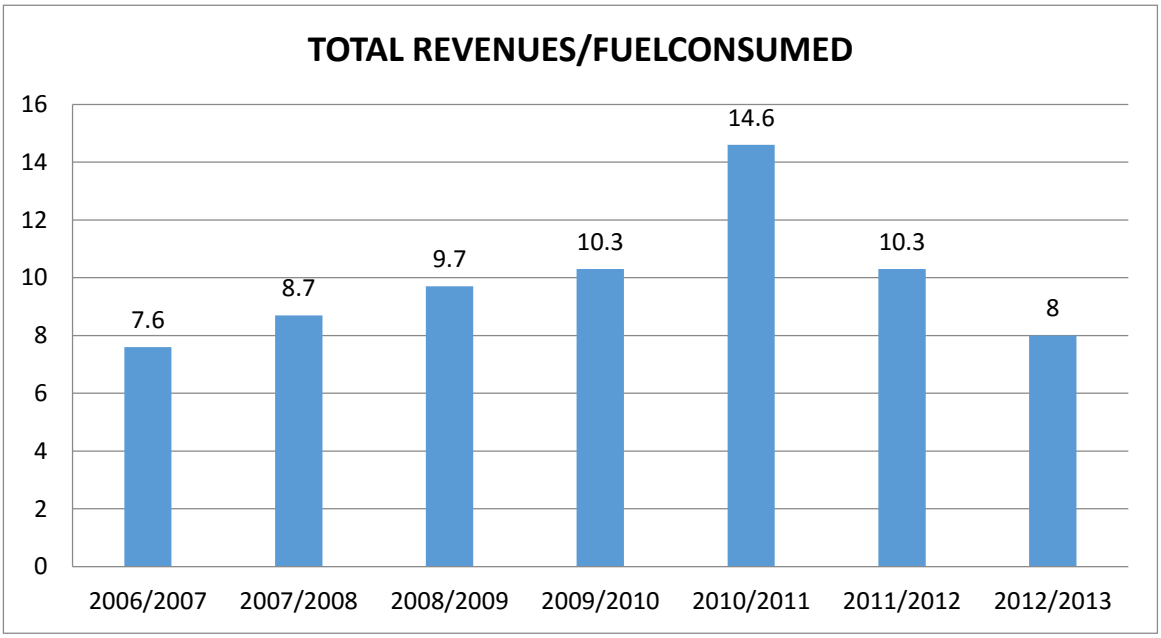

Fig. 17. Fuel productivity for total revenues, (2007-2013).

Pound productivity

Productivity of revenues to costs has decreased during the study period with an annual average 0.7 (LE). If this ratio is less than 1.0 It is a negative indicator, where reflect inability of revenues to cover costs. The study periods are a bad years, due to increasing financial deficit. As shown in Figure 18.

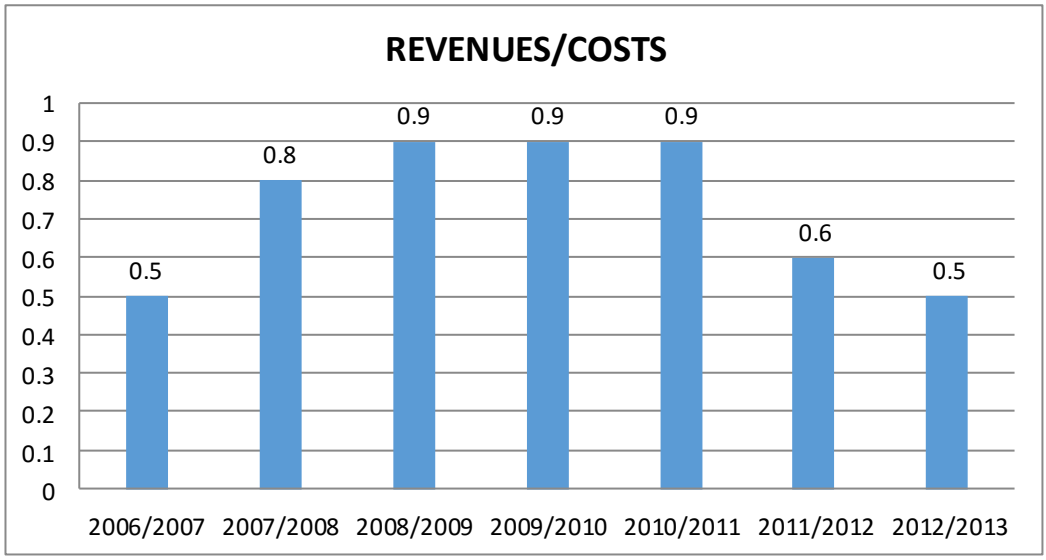

Fig. 18. Pound productivity for total revenues, (2007-2013).

Effects of Egyptian Revolution in 2011

It was found that the Egyptian revolution had affected both of passenger and of freights, so the researchers studied the negative effect of Egyptian revolution on transportation indicators and revenues. The researchers observed that number of (passenger.km) / year reduced from 27252 million in 2011 to 13550 million in 2012. Although, increasing the number of passenger from 225 million to 311 million at the same year. But, the increasing rate of passenger number wasn't suitable for the reduction in travel distance, where travel distance was decreased from 121 (km/passenger) to 43 (km/passenger). The reduction in (passenger.km) was occurred, as a result of stopping operation of more lines. Thus, an increase-overcrowding rate from .94% to 1.34 %. The percentage of accidents was high, although passenger-kilometer was reduced, as illustrated in table 6.

Table 6. Passenger Transportation Indicators, (2011-2013).

Passenger Transportation Indicators			
	2010/2011	2011/2012	2012/2013
No. Of Passenger (Millions/year)	225	311	207
Passenger-Kilometers (Millions/year)	27252	13550	13704
Average Travel Distance (Km/passenger)	121.1	43.6	66.2
No. Of Trips	401500	389130	400105
No. Of Accidents	489	447	781
Percentage of Accidents to Passenger-Km	1.8	3.3	5.7

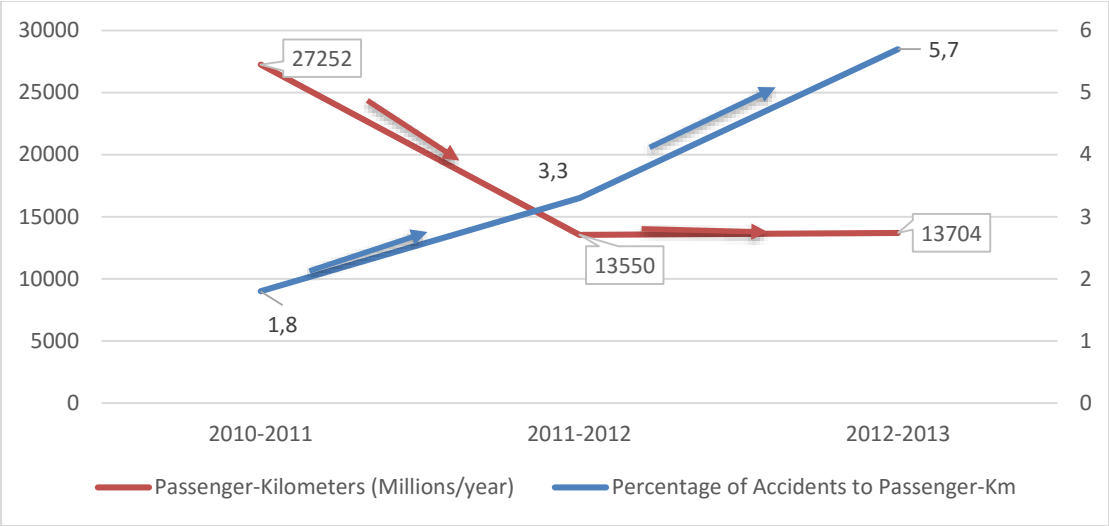

Fig. 19 .Passenger.km & Percentage of accidents, (2011-2013)

For freight transportation, it was noticed that tonnage.km decreased from 1965 million in 2011 to 1398 million in 2012, also tonnage transported decreased from 6.6 million to 4 million at the same year as shown in table 7. The reduction in (tonnage.km) was occurred, as a result of stopping operation of more lines and non-concerning of ENR with freight transportation.

Table 7. Freight Transportation Indicators, (2011-2013)

Freight Transportation Indicators			
	2010/2011	2011/2012	2012/2013
Tonnage Transported (Millions/year)	6.6	4	3
Tonnage-Kilometers (Millions/year)	1965	1398	1166
Average Travel Distance (Km/passenger)	297.7	349.5	388.7
No. Of Trips	7962	6700	6000

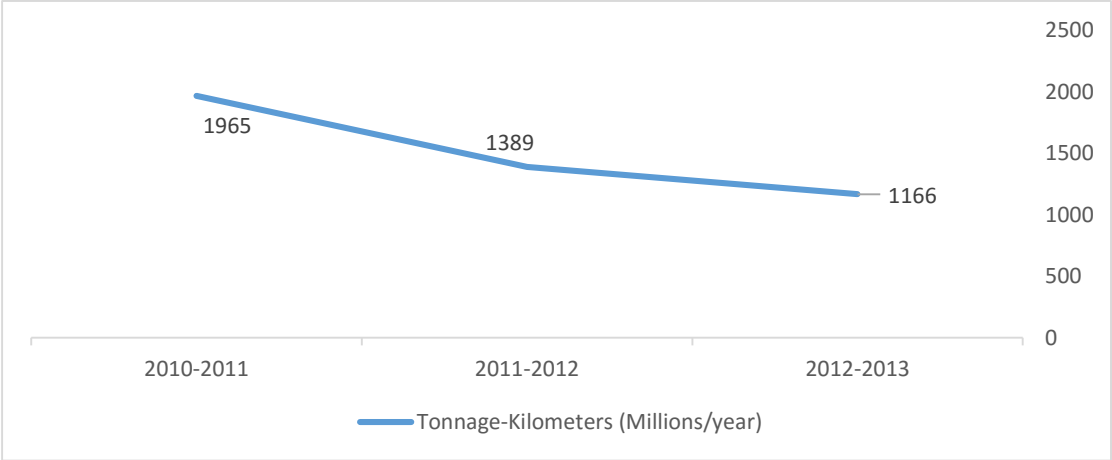

Fig. 20. Tonnage.km, (2011-2013).

The operating revenues for passenger and freights decreased from 1560.8 million LE in 2011 to 867 million LE| in 2013 and 229.7 million LE to 156.9 million LE at the same year as respectively. The total revenues decreased from 3017.7 million LE in 2011 to 2106.1 million LE in 2013. The reduction was occurred, lead to increase the deficit from 191 million LE in 2011 to 2169 million LE in 2013. The increasing in total wages were the main reason for increasing the deficit as illustrated in table 8. Although decreasing labor productivity.

Table 8. Freight and Passenger Revenues, (2011-2013).

Freight and Passenger Revenues			
	2010/2011	2011/2012	2012/2013
Operating Revenues (Millions LE) for passenger	1560.8	1499.5	867
Operating Revenues (Millions LE) for freight	229.7	175.9	156.9
Total wages	1484.7	2031.8	2427.7
Total Revenues (Millions LE)	3017.7	2390.4	2106.1
Total Cost (Millions LE)	3209.1	3842	4275.7
Total Net (Millions LE)	191.4	1451.6	2169.6

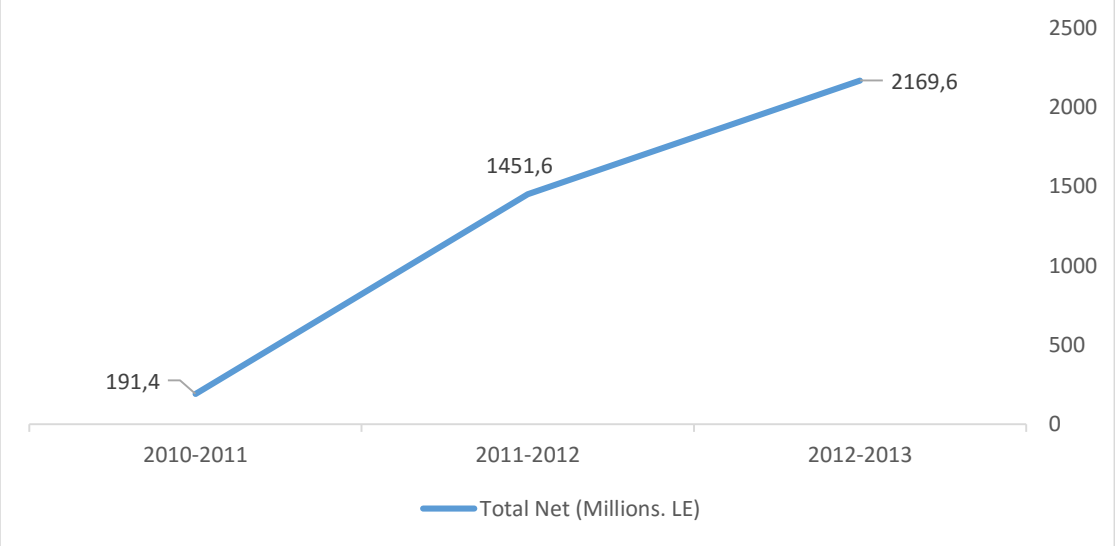

Fig. 21. Total deficit, (2011-2013).

The proposed pricing strategy

The principle of individual cost pricing based on costs and revenues of each line. This principle to improve the economic indicator for ENR. Individual costing system by line is used to know the financial status of each line. Individual revenue calculation system by line is used to know contribution of each line to the financial improvement and also, for estimating profitability by line. Tariff per Km must reduce as travel distance lengthens. Where, tariff for long distance is cheaper per Km than short distance travel. The strategy of ticket pricing cost depend on separation infrastructure from operation, where total cost don't include infrastructure cost.

Passenger ticket pricing:

Ticket cost = Seat price.km + Locomotive cost + Air condition cost

$$Ticket\ cost\ (\mathrm{X}) = \sum \frac{\text{Total cost of line}}{\mathrm{N}*360*\mathrm{T}*\mathrm{v}*\text{No.of Seats}} \tag{3}$$

where 360 – Convert from year to day;

T – work hours for operation;

V – speed of train;

N – No. of operated cars or locomotives.

Total cost of line include (operating and maintenance cost of Line)

$$\text{Seat price. km} = \frac{\text{Cost of vehicles}}{\mathrm{N}\cdot 360\cdot \mathrm{T}\cdot \mathrm{v}\cdot \text{No.of Seats}} \tag{4}$$

$$\text{Locomotive cost} = \frac{\text{Cost of locomotives}}{\mathrm{N}\cdot 360\cdot \mathrm{T}\cdot \mathrm{v}\cdot \text{No.of Seats}\cdot \text{No.of hauled vehicles}} \tag{5}$$

$$\text{Air condition cost} = \frac{\text{Cost of Air condition}}{\mathrm{N}\cdot 360\cdot \mathrm{T}\cdot \mathrm{v}\cdot \text{No.of Seats}\cdot \text{No.of hauled vehicles}} \tag{6}$$

$$Ticket\ Price\ (\mathrm{Y}) = \mathrm{X}\cdot \mathrm{L} + q + \frac{\text{Profit Margin}}{\mathrm{L}} \tag{7}$$

where X – ticket cost;

L – Travel Distance;

q – Quality of service.

Freight ticket pricing

Ton.km cost (X) = Ton price.km + Locomotive cost

$$Ton.km\ cost(\mathrm{X}) = \sum \frac{\text{Freight costs of commodity}}{\mathrm{N}\cdot 360\cdot \mathrm{T}\cdot \mathrm{v}} \tag{8}$$

$$\text{Ton price. km} = \frac{\text{Cost of vehicles}}{\mathrm{N}\cdot 360\cdot \mathrm{T}\cdot \mathrm{v}\cdot \text{weight of load car}} \tag{7}$$

$$\text{Locomotive cost} = \frac{\text{Cost of locomotives}}{\mathrm{N}\cdot 360\cdot \mathrm{T}\cdot \mathrm{v}\cdot \text{weight of load car}\cdot \text{No.of hauled vehicles}} \tag{9}$$

$$Ton\ Price\ (\mathrm{Y}) = \mathrm{X}\cdot \mathrm{L} + A + \frac{\text{Profit Margin}}{\mathrm{L}} \tag{10}$$

where L – travel distance;

A – additional charges such as (Cost of treatment at station, cost for processing loading and unloading, fee for contract document, costs for insurance of cargoes for damages and loss).

Summary. The authors used the collection data for analyzing the operating and financial indicators. And then conclusion the reasons deterioration of the railway, which summarized in the following point:

1. ENR has decreased curve in all the performance indicators both of passenger and freights, because of the following points:

a) Increasing Overcrowding rate in recent years, as a result of exceeding the most of the existing fleet the lifespan.

b) Increasing delay time in recent years, such that it reached to 62% from time of total trips, due to poor operation management and lack of maintenance.

c) Decreasing total passenger.km due to increasing number of accidents and negligence in train's maintenance.

d) Decreasing revenues due to decreasing passenger.km and state support for some ministers with no refund.

e) In recent years, it is noted that total cost is more than total revenues, thus it leads to increasing deficits.

f) Decreasing in total tonnage.km with increasing costs comparing to revenues, which has become a burden on the railway.

g) Low productivity for staffing due to decreasing passenger.km, tonnage.km and labor wages become larger than total revenues.

h) Reduction in Rolling Stock, where existing fleet is 50% of the required fleet, both of (Locomotives, passenger wagons and freight wagons).

i) Passenger revenue is more than freight revenues due to Lack of attention to the volume of freights.

2. The formula, which used by ENR for calculations Tariff for passengers and freights are not accurate formulae. It is a roughly method due to missing some factors such as:

a) Tariffs should base on individual cost principle.

b) Tariffs should base on cost and revenues of each lines.

c) The average tariffs per ton-km should include the following additional charges.

d) Cost of treatment at station.

e) Fee for contract document.

f) Costs for insurance of cargoes for damages and loss.

g) Cost of round trips must include empty wagons for return trip.

h) Profit margin and Risk costs

The average tariffs per ton-km must include added charges (Cost of treatment at station, additional charges for every commodity, cost for processing loading and unloading for every 10 kg, fee for contract document, costs for insurance of cargoes for damages and loss).

The deficits caused by suburban lines seems to be cross subsidize by profitable lines with passenger in 1-st class and 2-nd class. The same problems in passenger transport occur in freight transport.

Recommendations

The researcher studied the causes of decline in the performance of the railway, so it will submit the necessary recommendations to develop the performance of the railway, which summarized in the following point:

1. In order to raise the operational efficiency of passenger and freights. Creating a new freight corridor to solve different speeds between freight and passenger trains, possibility of railways to achieve door-to-door leads to increasing tonnage.km. Passenger transportation must construct a new line for speed trains to reduce travel time and increasing traffic, using a new technology to make it more comfortable and safe, reducing delays to reduce the rate of overcrowding, cutting poor lines which don't have high traffic and increasing running fleet.

2. Legalizing a new technology to reduce costs of rail service.

3. Renewal, maintenance of rolling stock and infrastructure should be provided to meet the client requirements.

4. Clear definition of public service obligations in the passenger sector. Any ministry wants to reduce tariff, it should have refund lost income to the railway operator.

5. Creating relations between rail operators and clients such as (special advantages and free tickets for clients who are frequent users of rail service, cards offering unlimited for users of rail services reduction in tariffs for the elders more than 60 or 65 years old, travel of groups).

6. Reducing of poor lines or unprofitable service. ENR should focus on profit activities.

7. ENR must cut in number of labors and develop clear policy with time frame for achieving average staff productivity levels. This policy needs to base on a traffic volume.

8. ENR must combine between two scenarios; first scenario is Separation infrastructure from operation and passenger from freights. Second scenario is Modernization of infrastructure with important investment. These parts can be covered by (private sector). This will aim at focus on parts of railway activities, reducing the effect of government in the fields and reducing public subsidies.

9. Governmental transport policy should place a railway and road on an equal footing in terms of financial contribution of infrastructure and not control in the transportation tariffs. This will generate enough sources to cover the requirements of infrastructure operation and this will allow users to make socially ideal choice between the models.

10. Governmental transport policy should prevent heavy vehicle from using roads and converted it to railway to reduce roads maintenance, number of accidents, increase tonnage.km and the exploitation of the large fleet located in ENR.

11. ENR must care and develop freight sector and provide facilities to increase freight volume. Using advanced technology to increase the speed of loading and unloading.

12. ENR must use this basic of strategy in pricing :-

a) Establishment of individual costing system by line to know the financial status of each line and to be used for rational tariff decision. Costing by line is very important for estimating profitability by line.

b) Establishment of individual revenue calculation system by line to know contribution of each line to the financial improvement of ENR. Calculation of revenue by line is especially important for estimating profitability by line.

c) Tariff per Km must reduce as travel distance lengthens. Where, tariff for long distance is cheaper per Km than short distance travel.

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