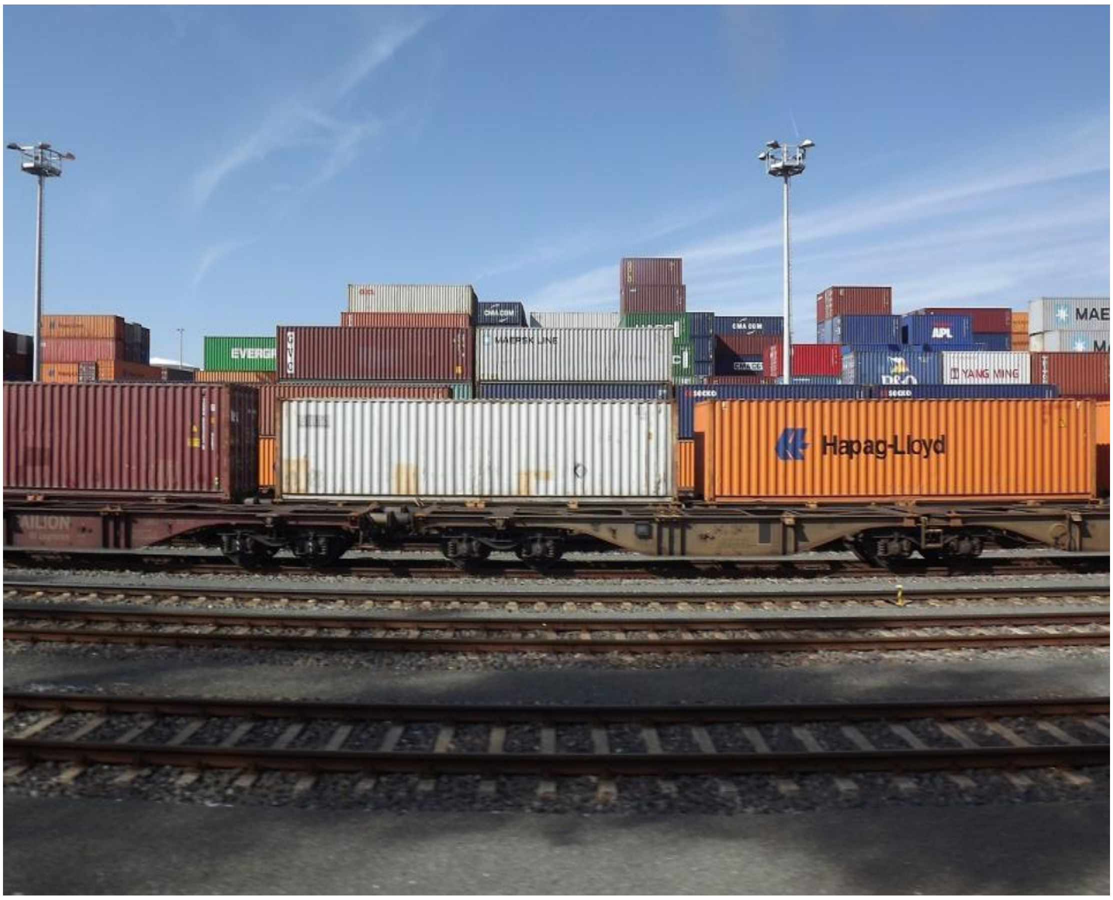
Railway Freight Identification Study (Egypt)

Optioneering report: V1
Date: 12 January 2020



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Glossary

Acronym	Meaning
APA/GPA	Alexandria Port Authority
EE	EL Etihad
EM	El Manashy
RoI	Return on Investment
TPD	Train Per Day
WCRB	Western Cairo Rail Bypass

Executive Summary

This report initially defines a 'route capability' for the rail infrastructure and then looks at various infrastructure interventions and operating models which can provide that capability.

Route capability

'Capability' is defined around two metrics:

1. Route capacity, ie the number of trains able to pass through the route every day.
2. Journey time, ie the time taken to traverse the route.

Future route capacity requirements are established by aggregating the future network demand for the DP6 traffic with existing freight and passenger flows. This establishes a requirement for 28 single direction trains per day on the El-Etihad section of the route and 64 on the El-Manashy section of the route (up to 2040, when further paths are required). Currently there are 32 paths available on the El-Etihad line and 144 on the El-Manashy line.

We also consider a 'stretch' route capacity requirements based on 'high' forecasted volumes for the new service and increases in the current freight and passenger services.

The required route capacity is therefore defined as:

	Baseline (tpd)	Stretch (tpd)
El-Etihad line	28	80
El-Manashy line	64	116
Current capacity	32	144

The difference in requirement between the two lines is due to the existing passenger service on the El-Manashy line as the El-Etihad line is currently freight only. The stretch volumes consider the introduction of a passenger service on the El-Etihad line and the doubling of the current passenger service on the El-Manashy line as well as growth in the freight traffic.

The required journey speed is established from a review of the Operating model. The baseline report defines a requirement for a daily 'out and back' rotation of the train set to provide a good customer service and an efficient use of rail resources. This is further developed in this report to define the following Operational model:

- Loading time at the Port — 4 hours
- Journey time Port – inland terminal — 6.5 hours
- Unloading/loading time at the inland terminal — 4 hours
- Journey time inland terminal – Port — 6.5 hours
- Contingency time within a 24 hour day — 3 hours

The current journey time is around 11 hours as the freight trains need to go through the very congested inner-Cairo rail network. This network can also only support an additional 3 return trains a day.

The service pattern is discussed. We suggest that the service is best operated on a 24 hour a day basis for 5.5 days a week, with the remaining 1.5 days being available for infrastructure and traction and rolling stock maintenance. On operational days we suggest that the initial 6 daily services to DP6 are planned to depart at 4-hour intervals through at the day and follow the same timetabled route. This development of a 'clockface' timetable will improve the service reliability and provide a very customer friendly solution, with haulage available throughout the day as soon as containers become available for transportation.

The report discusses the opportunity to move to longer trains through removing the present constraints on train length. The opportunity to increase train length to 100TEU capacity is identified.

Key responsibilities

The report identifies three key roles:

- Operator – provides and operates the traction and rolling stock to deliver the passenger/freight train service
- Infrastructure Manager – provides and operates the rail infrastructure. Also responsible for route timetabling
- Regulator – provides the regulatory framework within which the Operator(s) and IM(s) work and assesses their performance on a regular basis. May also be responsible for the management of industry technical standards and the investigation of safety incidents.

The report provides a commentary on both operational and safety performance. We suggest that these are underpinned by the establishment of performance indicators, and these indicators do not just measure 'outcomes', eg injury rates, but also factors which can influence operational and safety improvement in the future, for instance reviewing safety incidents and implementing safety improvement initiatives.

Options definition

The report presents, discusses and costs four different options (with some sub-options) for improving both the route capacity and the transit speed. These are summarised below.

Option 1	New line on EM route comprising doubling existing line plus 'third' line through stations. Signalling upgrade on all lines plus additional loop on EE line as option EE1.	
Option 2	Use only existing infrastructure	
Option 3	Use existing infrastructure + WCRB	
Option 4	El-Etihad options	EE1 - new loop
		EE2 - Signal upgrade
		EE3 - Improved line speed
	El-Manashy options	EM1 - Doubling line
		EM2 - Signal upgrade
		EM3 - Improved line speed
	Combination 1	Signal upgrade on both routes (EE2 + EM2)
	Combination 2	Etihad upgrade (EE1 + EE2)
	Combination 3	Signal upgrade on both routes (EE2 + EM2) plus new loop on Etihad line (EE1)

Option 1 comprises a new dedicated freight only line through the doubling of the existing El-Manashy line and the construction of a third line through the stations on the El-Manashy line to provide continuous running for freight trains. To enable this a signalling upgrade is required on the El-Manashy line. To provide sufficient capacity on the existing freight only El-Etihad line a signalling upgrade is required there, together with the provision of a new passing loop.

Option 2 is a ‘do nothing’ option using existing lines (Etihad, Manashy, Cairo High dam, & Baharia lines) **without** constructing the WCRB.

Option 3 builds on option 2 **with** the construction of the Western Cairo Railway Bypass (WCRB)

Option 4 involves modifying the existing infrastructure to improve route capacity and journey time. It has 6 sub-options and 3 combinations of these sub-options to provide the required route capability from the existing infrastructure through upgrading it + **build WCRB**.

<u>Option assessment</u>

The option assessment is undertaken in two parts. The initial technical assessment reviews the various options against the route capability requirements (journey time and line capacity (base & stretch)) and construction cost.

The final assessment is a broader assessment of the options which meet the technical requirements and includes a consideration of the various scenarios within each option.

The results of the technical assessment are shown below.

			Journey time (hrs)					Route capacity (single tpd))					Est. cost ($m)		Overall rating	Ranking	Commentary
			EE	EM	WCBR	Total	Rating	Provision	Base	Rating	Stretch	Rating	Option	Rating			
Option 1	New line on EM route comprising doubling existing line plus 'third' line through stations. Signalling upgrade on all lines plus additional loop on EE line as option EE1.		2.5	0.75	1.5	4.75	**15.3**	84/192	28/64	**16.8**	80/116	**5.5**	582	**1**	**39**	**4**	Meets all requirements, including stretch capacity requirements
Option 2	Use only existing infrastructure		4	1.5	-	11	-	6	28/64		6	-	0	-	**N/A**	-	11hr journey time doesn't meet requirement. Only 3 daily return trains possible so doesn't meet capacity requirements either.
Option 3	Use existing infrastructure + WCRB		4	1.5	1.5	7	-	32/144	28/64	**10**	80/116	-	167	-	**N/A**	-	Doesn't meet journey time requirement. Only just meets baseline capacity requirement on EE line (28 paths required, 32 available).
Option 4	El-Etihad options	EE1 - new loop	4	1.5	1.5	7	-	64	28	**13.6**	80	**3.4**	171	-	**N/A**	-	Doesn't meet journey time requirement
		EE2 - Signal upgrade	2.5	1.5	1.5	5.5	**13**	48	28	**12**	80	**1.8**	210	**10**	**37**	-	
		EE3 - Improved line speed	1.5	1.5	1.5	4.5	**16**	72	28	**14.4**	80	**4.8**	393	**5**	**40**	**3**	Includes EE2 cost
	El-Manashy options	EM1 - Doubling line	4	1.5	1.5	7	-	288	64	**10**	116	**5**	478	-	**N/A**	-	Doesn't meet journey time requirement
		EM2 - Signal upgrade	4	0.75	1.5	6.25	**10.8**	192	64	**10**	116	**5**	240	**9**	**34.8**	**6**	
		EM3 - Improved line speed	4	0.55	1.5	6.05	**11.5**	192	64	**10**	116	**5**	277	**8**	**34.5**	**7**	Includes EM3 cost
	Combination 1	Signal upgrade on both routes (EE2 + EM2)	2.5	0.75	1.5	4.75	**15.3**	48/288	28/64	**12**	80/116	**1.8**	283	**8**	**37.1**	**5**	Cost efficiencies through larger contract, no infrastructure changes. Provides significant
	Combination 2	Etihad upgrade (EE1 + EE2)	2.5	1.5	1.5	5.5	**13**	84/192	28/64	**16.8**	80/116	**5.5**	214	**10**	**45.3**	**2**	Small increment to option EE2 which significantly increases the route capacity.
	Combination 3	Signal upgrade on both routes (EE2 + EM2) plus new loop on Etihad line (EE1)	2.5	0.75	1.5	4.75	**15.3**	84/288	28/64	**16.8**	80/116	**5.5**	287	**8**	**45.6**	**1**	Meets all requirements, including stretch capacity requirements

Options 2 and 3 and two of the sub-options of option 4 do not meet the requirements for route capacity. All of the El-Etihad sub-options and one of the Combination options do not meet the aspiration ‘stretch’ capacity requirements. Option 1 is considerably more expensive than the other options, being almost twice as expensive as the next option. (It should be noted that these costs are construction cost estimates and an additional allowance must be made for design and project management costs).

The top five options are taken forward to the final assessment where three further criteria are examined: Construction risk and complexity, Suitability for adoption in a PSP model and Operational suitability and resilience.

Within each option three different operating scenarios are considered. These define different splits of responsibility for the provision of Operating and Infrastructure Management (IM) services between a PSP (Private Sector Provider) and ENR (Egyptian National Railways). The results of this evaluation are given below.

			Time	Capacity		Cost	Project complexity & risk		Suitability for PSP model		Operational suitability & resilience		Overall rating	Overall ranking
			Rating	Rating	Rating	Rating	HML	Rating	HML	Rating	HML	Rating		
Option 1		Scenario 1 - Private Operator	15.3	16.8	5.5	1	H	1	H	5	H	10	55	5
		Scenario 2 - Joint operation	15.3	16.8	5.5	1	H	1	M	3	M	5	48	12
		Scenario 3 - ENR Operator	15.3	16.8	5.5	1	H	1	L	1	H	10	51	10
Option 4	EE3 Improved speed	Scenario 1 - PSP DP6 trains, ENR balance & IM	16	14.4	4.8	5	M	3	L	1	M	3	47	15
		Scenario 2 - PSP freight, ENR passenger & IM only	16	14.4	4.8	5	M	3	M	3	M	3	49	11
		Scenario 3 - PSP freight & IM, ENR passenger only	16	14.4	4.8	5	M	3	H	5	H	6	54	7
	Combination 1 - Signal upgrade on both routes	Scenario 1 - PSP DP6 trains, ENR balance & IM	15.3	12	1.8	8	M	3	L	1	M	5	46	14
		Scenario 2 - PSP freight, ENR passenger & IM only	15.3	12	1.8	8	M	3	M	3	M	5	48	12
		Scenario 3 - PSP freight & IM, ENR passenger only	15.3	12	1.8	8	M	3	H	5	H	8	53	8
	Combination 2 - Etihad line upgrade	Scenario 1 - PSP DP6 trains, ENR balance & IM	13	16.8	5.5	10	M	3	L	1	M	4	53	8
		Scenario 2 - PSP freight, ENR passenger & IM only	13	16.8	5.5	10	M	3	M	3	M	4	55	5
		Scenario 3 - PSP freight & IM, ENR passenger only	13	16.8	5.5	10	M	3	H	5	H	7	60	2
	Combination 3 - Siugnal upgrade both lines plus new EE loop	Scenario 1 - PSP DP6 trains, ENR balance & IM	15.3	16.8	5.5	8	M	3	L	1	M	5	55	4
		Scenario 2 - PSP freight, ENR passenger & IM only	15.3	16.8	5.5	8	M	3	M	3	M	5	57	3
		Scenario 3 - PSP freight & IM, ENR passenger only	15.3	16.8	5.5	8	M	3	H	5	H	10	64	1

The highest ranked options are from Option 4 Combinations 2 and 3, with Scenario 3 in each Combination being the highest scoring scenario. Combination 3, scenario 3 scores over 5% more than the next option and 12% more than the third option, which is a significant difference. This combination includes sufficient capacity to meet the 'stretch' requirements and offers a considerably shortened journey time. Even greater capacity is available if the movement to longer 'unconstrained' trains is considered.

Option 1 scenario 1 is in joint fifth place, being held back by its very high capital cost and the significant complexity of building an entirely new line when other options deliver the required line capability through modifications to the existing infrastructure.

We note that if the Scheme moves forward with a Private Sector Partner (PSP) that the PSP will be the FOC and the IM for the new Western Cairo Bypass Route. If our recommendation for the uptake of option EE2 is agreed the PSP may also be funding this and become the principal user on the El-Etihad line, so we recommend that the PSP becomes the IM for the El-Etihad line as well (Scenario 3 operating model).

Our analysis shows that it is very difficult and very expensive to provide a dedicated freight line running in parallel with the existing El-Manashy line (option EE2). To truly have a dedicated freight line would require a 'third line' around the existing station passenger loops (which are at roughly 4km spacings) and in some places there is not enough width within the existing rail corridor to do this. Land would need to be purchased, buildings demolished, and new road crossings established.

We also do not believe that there is a need to provide a dedicated freight line in parallel with the El-Manashy line. There is more than enough route capacity now because of the short signalling sections due to the frequent station locations (approximately 4 to 7km apart). Better options for journey time improvement are possible on the El-Etihad route and we also think that the interface between the existing passenger trains and the freight trains can be mitigated through improved timetabling. The passenger trains run a roughly hourly service so by planning the entry of a freight train onto the line just in front of the next passenger train the freight train should have a clear run along the line.

It will be important for the PSP to have confidence that the service levels required from their planned investment are not compromised by non-performance on this mixed-use line by ENR. We suggest therefore that the PSP becomes the Infrastructure Manager for the El-Manashy line too. In this way the PSP has operational control of the entire route through the El-Etihad and El-Manashy lines and the new Western Cairo Railway Bypass.

It should be noted that if any signalling upgrades are undertaken then locomotive fitment will be required, and we have made an allowance for this in our cost model. Most of these trains will be provided by the PSP for their 'own' haulage but some of ENR's fleet will also need fitment to haul the other freight services using the El-Etihad line and for track maintenance purposes. It would be advantageous that any signalling system installed on either the El-Etihad line or El-Manashy line was similar to any signalling system installed on the new Western Cairo Railway Bypass to avoid the need for multiple signalling systems to be installed on the locomotives.

Our recommendations are based on our field experience and site visits undertaken during the assignment together with one meeting with ENR.

1- Demand review – TEUs & tonnes/ day

Constrained Train Demand

The below table is taken from table 8 of the baseline report and shows the demand requirements ('return train' movements) based on the current operating model used by ENR.

	2022[1]	2025	2030	2040	2050	2060
Total trains/day - Base	8	8	10	13	19	28
Total trains/day - High	10	12	14	22	37	62
Total trains/day - Low	6	6	6	7	9	11

Table 1: Demand requirements based on the current operating model used by ENR.
Source: baseline report

The current operating model used by ENR has a constrained train length with a maximum of 60 TEU on each train, based on the available traction and rolling stock.

Unconstrained Demand

There are two absolute constraints on train length: maximum trailing weight and train length.

For train with a single locomotive we suggest that the maximum train length should be considered as 2000T due to some of the gradients within the Cairo area. Heavier trains could be used if multiple locomotives were used but these solutions are less inefficient as the use of a second locomotive does not give twice the haulage capability.

Train length restrictions occur either at the terminal locations or within passenger loops on the route. The station loops are around 1000m long and trains could be split over several unloading lines at the ports for a 1000m long train could potentially be possible.

The baseline report states that the average weight of an import containers is 12T, and 7T for an export container. If we assume that a 60-foot container flat wagon is used which is capable of carrying 3 TEU then the gross laden weight of the wagon is 3 x12T + 19T tare weight of the wagon = 55T, say 60T for contingency. A 2000T tonne train would therefore be able to handle 33 wagons (100TEU).

A 33 wagon train will be around 715 m long (33 wagons x 21m + 22m for locomotive), well within the 1000m length restriction.

The table below shows the planned container volumes and how they translate to train demand, based on 100 TEU/train.

		2022	2025	2030	2040	2050	2060
TEU/Day	Low	177	195	230	320	446	620
	Base	337	387	489	781	1248	1992
	High	545	645	857	1509	2658	4683
Train/day (100 TEU = 1 train)	Low	1.8	2.0	2.3	3.2	4.5	6.2
	Base	3.4	3.9	4.9	7.8	12.5	19.9
	High	5.4	6.5	8.6	15.1	26.6	46.8

Table 2: planned container volumes, based on 5.5 working days, & 100 TEU/train.
Source: consultant calculations based on the rail forecast model, Baseline report

It can be seen that running these longer trains will significantly reduce the number of trains required to be run.

<u>Other Freight Trains</u>

The table below shows the expected tonnage for bulk materials each day to be transported from 2022 to 2060 (based on 5.5 working days/week) in tonnes. We have taken a prudent view that demand for rail movement of these bulk commodities will remain stable at the current average levels in the future.

Bulk/day (in tonnes)	Year 2022-2060 remain at average 2013/14- 2017/18 level
Molasses	146 tonnes
Petroleum	274 tonnes
clay	311 tonnes
coal	1389 tonnes
coke	144 tonnes
grains	1051 tonnes
clinker	0

Table 3: Forecast for Bulk/day, in tonnes(based on 5.5 days/week)
Source: Annex D- Rail Forecast model in baseline report

The total daily tonnage is 3315 tonnes. Based on 2000 tonnes gross laden weight trains (payload 1600 tonne) this equates to an average of two 'other' freight movements. For the purposes of the demand analysis which follows in this report we have used the constrained demand train requirements, which reflects the current constraints affecting the operation of ENR trains on the network.

We have sought to ensure that the infrastructure can meet the base case requirements for the next 10 years, i.e. the 2030 requirement for 10 return movements for the base case.

If planned infrastructure interventions in the future can meet this demand the movement to longer trains as outlined in the 'unconstrained' model will be very possible and will free up additional capacity.

2- Required Functionality

2.1 Existing & Required Line Capability

<u>Introduction</u>

This section of the report discusses the capability of the route from Alexandria Port to the future dry port location to meet the future haulage needs when the new services to DP6 have commenced. 'Capability' is defined around two metrics:

3. Route capacity, ie the number of trains able to pass through the route every day.
4. Journey time, ie the time taken to traverse the route.

Two sections of the route are examined (the El-Etihad line and El-Manashy line). For each section a contextual statement is given describing the route and then options are presented for improving the capacity and/or the journey time.

El-Etihad line

The El-Etihad line is a single line with passing loops at the (disused) stations along the route. The route capacity is set by the longest single track section which is between Al Nahda and Tafaroa' stations, where the distance is 28km. Other stations are 8 to 13km apart, as shown below.

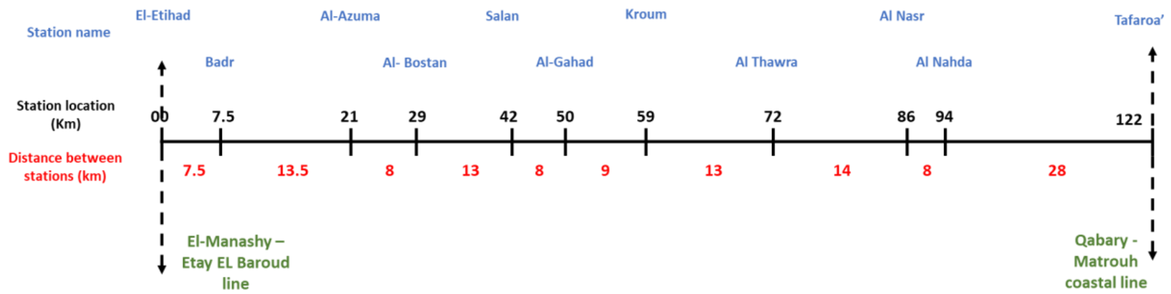

Figure 1: Schematic for Etihad line

The line speed is a maximum of 50km/hr and the baseline report defines a transit time through this longest track section of 45 minutes (38 km/hr average speed), which gives a route capacity of 32 single direction trains per day.

El – Manashy line

On this line the stations are much closer together with the longest track section between stations being 7km, as shown in the diagram below.

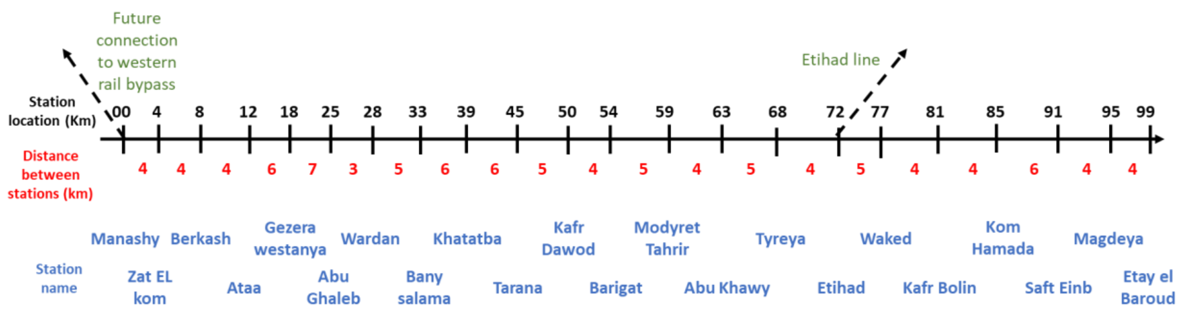

Figure 2: Schematic for Manashy Line

Although the stated maximum line speed in the received information from ENR is 100 km/hr, trains are unable to reach this speed due the short distance between the stations. The consultant assumes that the average speed through the 7 km longest section is 50 km/hr.

This gives a track occupation time of around 9 minutes for the longest 7km route section and therefore a route capacity of 6 trains/hour and 144 trains/day, ie 72 trains each way, each day. We note that this is very similar to the stated line capacity of 74 trains per day in the EBRD Railway Network Review published in May 2016.

With the current 36 passenger train movements a day (18 trains in either direction) there is route capacity for a further 36 freight trains a day, of which 4 are currently being used, so an additional 32 single directions journeys available.

<u>Required line capacity</u>

We have assumed that the initial minimum route capacity requirement on the El-Etihad line is for 28 single direction trains, based on:

- 10 return trains from table 8 of the baseline report (2030 requirement for prudence), requiring 20 single direction trains, plus
- 4 return freight trains for other purposes (8 single direction trains)

We have assumed that the minimum route capacity requirement for the El-Manashy line is for 64 single direction trains, based on:

- 28 single direction trains for freight (same as the El-Etihad line requirement), plus
- 18 return passenger trains, as per existing passenger service (note, no assumed growth in this service until at least 2030). This generates 36 single direction trains

<u>Stretch capacity</u>

To provide some contingency for growth beyond our core transport model we have considered some 'stretch' requirement, based on the following assumptions:

El-Etihad line

- 'High' 'new' freight train requirement: 14 return freight trains by 2030
- Commencement of passenger service: 18 return trains per day
- Doubling of existing 'other' freight train requirement: 8 return trains per day

This gives a total requirement of 40 return trains a day, or 80 single movements

El-Manashy line

- Doubling of passenger requirement on the El-Manashy line: 36 return passenger movements
- ‘High’ ‘new’ freight train requirement: 14 return freight trains by 2030
- Doubling of existing ‘other’ freight train requirement: 8 return trains per day

This gives a total requirement of 58 return trains a day, or 116 single movements

2.2 Required Performance

Operational performance

The overall reliability, availability and ‘quality’ of the rail service can be defined by:

- the amount of container moving capacity provided against the number planned (ie the amount of fully consisted trains provided against the number planned), and
- the on-time departure and on time arrival of these trains

If a ‘door to door’ service is planned then additional metrics are required around ports and inland terminal performance.

Capacity performance is affected by infrastructure failures and train performance failures.

Infrastructure failures can include:

- Non-availability of the network due to unplanned engineering possessions to maintain and renew the rail infrastructure
- Over-running engineering possessions
- The non-availability of the infrastructure through ‘failure’ by, for example:
  - Broken rails
  - Non-availability of staff for train management
  - Blocked line, possibly by a third party, eg broken vehicle on a level crossing
- The non-availability of the infrastructure through the failure of another service on the line which prevents the freight train from running

Train performance failures can include:

- The non-availability, or failure, of locomotives
- The non-availability, or insufficient availability, of wagons. It is very important that all trains are fully consisted, ie have the planned number of wagons within the train.
- The non-availability of drivers or ground staff to enable the trains to run.

Terminal performance failures can include:

- The non-loading/non-availability of containers onto the correct train. This may include a failure to move the containers from a ship to the railhead
- The inability to load/unload the train within the required timescales#
- The inability to deliver the ‘final mile’ road transport within the defined period (if this service is being provided)
- The inability to provide transportation documentation within the required timescales

This simple analysis shows that multiple parties are involved in ensuring that a high-quality service is provided to the customer. Performance regimes, supported by commercial incentives, are therefore required to be given to the Infrastructure Manager, train operator and terminal operator to ensure that the high-quality service can be provided.

Accurate, non-contestable, data is fundamental to the operation of any performance regime. This should include:

- Train consist details (locomotive type, wagon type and number)
- Train departure time from terminal
- Train arrival time into terminal
- Simple definition for the reason for any delay, preferably against a standard set of delay attribution codes, such as:
    - Locomotive failure
    - Delayed by another service
    - Infrastructure failure

As the project is moved into implementation how this information should be gathered needs to be considered. Wherever possible the data generation should be automatic and immediately available to the key interested parties. A combination of a (preferably electronically) signed consist sheet upon departure and a set of axle counters at the terminals is one way of providing this data.

The attribution of delay can sometimes be contentious and needs to be agreed by all parties preferably daily and at the worst weekly. Initially a single party, possibly the train operator, should undertake an initial delay attribution based off the data set which the other parties agree within the week.

Whilst 100% performance is the goal it should be recognised that no railway in the world had achieved this aim, and other modal forms will not be achieving 100% reliability either. We suggest that 95% performance targets are set for both the Infrastructure Manager, Train Operator and Terminal Operator. The combination of these indicates that the Client can expect to see 86% delivery on-time (95% x 95% x 95% = 86%).

It is important that delay mitigation measures are adopted to reduce delay. These can include:

Delay	Mitigation
Infrastructure Manager	
Unplanned possessions	Effective asset management regime, effective asset inspections processes
Over running possessions	Availability of additional resources to mitigate delay, availability of alternative routing
Infrastructure failure	Effective asset management regime, effective asset inspections processes, availability of alternative routing
Third party failure	Availability of alternative routing, availability of resources to repair/remove failed equipment
Train Operator	
Locomotive failure	Driver training for ‘first fix’, availability of ‘rescue’ locomotives
Wagon non-availability/failure	Effective asset management and inspection processes. Availability of sufficient wagons to support maintenance regime
Insufficient/sick staff	Availability of alternative resources
Terminal Operator	
Non loading	Clear process for container movement/storage within the Port/terminal. Sufficient/spare resources for movement.
Over long loading	Sufficient/spare resources for loading.

Final mile delivery failure	Effective container movement to the lorry. Routing/vehicle tracking software used.

Table 4: Mitigation measures adaptation

This table is an example of the mitigation measures which can be adopted. It is recommended that such a table is agreed with the various parties through the establishment of the project.

To monitor performance a series of performance indicators should be established. These could include:

Infrastructure Manager

- Hours per week of network non-availability for maintenance/renewal purposes (ie engineering possessions).
- Percentage of possessions which overrun their planned duration
- Lost services per month due to infrastructure failure
- Lost services per week due to third party interaction, eg passenger train failure, public interface such as suicide or police incident

Train operator

- Percentage of service run, or alternatively the number of cancellations
- Percentages of services fully consisted
- Percentage of service departing on time, and within 15 minutes (2 metrics)
- Percentage of service arriving on time, and within 15 minutes (2 metrics)

Terminal Manager

- Number of 'missed' (unloaded) containers
- Percentage of trains unloaded and reloaded within the available time period
- Percentage of final deliveries made on the stated delivery time

These figures should be updated on a monthly basis and tracked on a 'Moving Annual Average' basis to highlight improving and worsening trends. The Infrastructure Manager, Train Operator and Terminal Manager should meet at least on a quarterly basis to review these figures and discuss how improvements can be made.

Safety Performance

Clearly all parties involved in the transportation system have a responsibility for safety. Their performance should be measured against a suite of indicators which not only include the 'outcomes' of their safety performance (eg accident rates) but also the measures they are taking to establish a positive safety culture and the occupational health of their workforce. These will influence their safety outcomes in the future.

These metrics could include:

Safety outcomes
- Number of fatalities per year
- Number of major injuries per year
- Number of minor injuries per year
- Number of signals passed at danger
- Number of derailments per year
- Number of collisions per year

Safety culture/Occupational Health
- Establishment of a Health and Safety Plan with clear objectives for improving safety
- Benchmark analysis of safety performance against international comparators
- Establishment of a safety department
- Number of safety inspections undertaken by senior management
- Risk analysis of safety issues to identify major risks and common themes
- Development and delivering of specific safety initiatives targeting key risks
- Fatigue management systems for safety critical staff
- Safety risk assessment of common undertaken tasks
- Mandatory use of appropriate safety equipment

Quality

At the highest-level service quality for the end user can be defined as:

- A safe service (operation achieving the safety performance regime as detailed above)
- A reliable service (an agreed percentage of goods arrived within the agreed timescales, in an undamaged fashion). This may need to include a consideration of the 'final mile' road delivery, if this is being undertaken by the Train Operator. Fundamental to the successful achievement of this goal are the appropriate availability of the rail network and the train's traction and rolling stock, and the reliable performance of all of these assets.
- Sufficient capacity available to move the end-user's requirements. This can sometimes be a difficult metric to achieve as rail capacity can be difficult to flex efficiently and the End user's demands could change significantly throughout the year, for instance through the seasonal movement of produce.

2.3 Existing & required Operational Models

Existing model

The 'existing situation' is the expected trip time and route capacity from Alexandria to DP6 using the existing lines without the construction of the Western Cairo Railway Bypass (WCRB). This involves the use of 4 different lines:

- El Etihad Line
- El Manashy-Itay Al Baroud Line
- Cairo –High Dam Line
- And Bahria Line

The train leaves the port and head towards El Qbary Station on the El Etihad Line. From there it continues to El Etihad Station where it would switch to the El Manashy - Itay Al Baroud Line and travel to Imbaba Station' Here it would switch to the Cairo – High Dam Line and travel to El Maraziq Station where it would switch to the Bahria Line to travel to the 6th of October Dry Port via El Tebien Station.

All freight trains are planned to operate on El Etihad Line to reach El Manashy – Itay Al Baroud Line as freight transport is prevented on the alternative Cairo – Alexandria 'main line' due to the continuous maintenance and the priority for passengers trains on the line.

The current journey times without constructing the bypass are shown below.

Based on the total distance (300 km) of the existing lines between Alexandria and the proposed Dry Port at 6th October and the maximum speed allowed specified in the railway network review report (DP6 studies), ENR have stated that they expect the freight train to take 11 hours (without loading & unloading time)to complete this trip starting from Alexandria Port and ending in 6th of October Dry Port

the Table below, is a breakdown of the trip time from Alexandria and El Dekheila Ports to 6th of October Dry Port.

Train Trip	Minute	Hour
Average of travel from El Qabary Station to El Etihad Station	-	4
Average of travel from El Etihad to Boulaq El Dakrour		4
Average of travel from Boulaq El Dakrour Station* to Km 64 on Bahria Line	-	3
Average of Loading and Unloading time	-	4
20% for Contingency		3
Total Trip Time in one direction including loading and unloading	-	18
**Boulaq El Dakrour Station is on Cairo – High Dam Line, 6.5 Km from Imbaba Station		

Table 5: Existing Journey time review without WCRB
Source: ENR railway network review report 2016, DP6 studies

The trip takes the envisaged 11 hours due to the fact that:

- There are operational restrictions.
- There is a limited availability of capacity on the lines.
- The bottle neck section from Imbaba Station to El Maraziq Station, where freight train are only allowed to pass at night between 1 – 6 AM.
- Most of the lines between the coastal ports and the Dry Port are single tracks
- Priority is given to passenger trains over freight trains to operate on the lines

Summary

Due to the above restrictions it is envisaged that only **three** daily container trains (Maximum of 25 wagons each) can operate each way between the 2 destinations. The main reason for the limitation put on the number of trains is the congestion area on Cairo – High Dam Line between Imbaba and El Maraziq Stations.

It will not be possible to achieve a 24 hour return journey from each set of wagons.

Required Operational Model

The future 'required' Operational model is considered next because it sets the context in which performance and capacity is discussed. We structure this section in three sub-sections:

1. Operational model
2. Safety management
3. Key responsibilities

The baseline report reflects international best practice by stating that at the very least each wagon set should go from the port to the inland terminal and back again within a 24 hour cycle. This is required for two reasons:

- Enables a 'same day' delivery from the Port to the Customer, a service proposition which can compete with road
- Enables efficient use of the rail assets, thereby leading to a delivery cost which is competitive with road

We consider that 4 hours is a reasonable period to allow to unload and reload the train at both the Port and DP6. In this period:

- the containers are unloaded and reloaded, requiring around 24 lifts 'off' and 'on' (based on 16 No. 40ft containers and 8 No. 20ft containers)
- Train shunting is undertaken, including any 'run-round' of the locomotive and splitting of the wagons to get under the craneage
- All necessary dispatch paperwork is prepared, and
- Local train movement to the WCBR and the El-Etihad line

Allowing for a 3 hour operational contingency period during each day to act as a buffer for delays 11 hours are needed for two loading and unloading cycles and the 3 hour contingency. Consequently, 13 hours is available for the journey time, leading to the following operating model:

• Loading time at the Port	4 hours
• Journey time Port – inland terminal	6.5 hours
• Unloading/loading time at the inland terminal	4 hours
• Journey time inland terminal – Port	6.5 hours
• Contingency time within a 24 hour day	3 hours

Current Challenges in APA

There are current challenges within the Alexandra Port Authority which have to be recognised:

Loading & unloading area:

Currently loading & unloading for containers in APA is performed through double handling. Further expansions should be considered in the APA loading & unloading areas and handling terminals to allow handling the increased estimated future demand.

Customs procedures in APA:

All inspections & customs procedures should be done at DP6 (final destination). In case of urgent need for scanning the containers, the full trains have to just pass through X rays for inspection.

Required Service Pattern

Our working assumption is that the services are running 24 hours a day for 5 and a half days a week, the remaining 1.5 days being used for infrastructure and traction and rolling stock maintenance.

In an unconstrained network the required 8 train per day service pattern would be to have regular departures at 3 hour intervals through the day, preferably following the same timetable path (known as a 'clockface' service, where trains depart and arrive at the same time within the hour throughout the day). This has the following benefits:

- Provide regular availability for container movements from the Port so containers can be moved as soon as they become available
- Provide a repetitious pattern throughout the day, simplifying operations
- Minimising the number of trains of passing movements by spacing trains out, as each passing movement will require one train to stop ion a loop.

The network is however constrained due to the existing passenger services on both the Coastal line and the El-Manashy line. However, these services are not very intensive, and it should be possible to achieve the roughly three hour spacing discussed above. With support from ENR the existing passenger service pattern could possibly be slightly adjusted to enable a 'clockface' freight timetable.

Key Responsibilities

Three roles need to be considered:

- Freight Operating Company
- Infrastructure Manager
- Rail Regulator

Freight Operating Company (FOC)

The FOC operators the train service. Their key responsibilities are:

- Provision of drivers:
  - Recruitment
  - Training
  - Competency management
  - Rostering

- Provision of locomotives and wagons:
    - Procurement
    - Servicing (including provision of suitable maintenance depots)
    - Rostering
- Timetabling
    - Liaison with the Infrastructure Manager to define access recognising other freight and passenger services and the non-availability of the line for inspection, maintenance and renewal purposes
- Management activities:
    - Safety management
    - Provision of information as required for safety or contractual reasons

Infrastructure Manager (IM)

The IM provides and operates the track infrastructure on which the FOC operates the system. Their key responsibilities are:

- Inspection, maintenance and renewal of the infrastructure
- Operation of the infrastructure
    - Signalling control
    - Operational management (incident management, delay response)
- Overall timetable planning
    - Co-ordination across all routes
    - Co-ordination of freight and passenger services

Rail Regulation

The Rail Regulator (RR) reviews the performance of the FOC and IM(s) and holds them to account. They can also independently undertake safety inspections of serious incidents to provide an independent review.

Required Safety Management

The responsibilities for safety management flow from the operational responsibilities outlined above.

The FOC is responsible for the safety management of train operation and the IM for the provision of the rail infrastructure. For commercial and delivery reasons these roles may be combined on section sections of infrastructure.

We suggest that all parties are required to provide safety metrics as detailed in the following section of this report.

Incident investigation needs to be undertaken at the appropriate level.

We would suggest that 'major' incidents' are independently investigated by an 'arm's length' safety body, which is possibly part of the Rail Regulator. 'Major incidents' are defined by their actual (or potential) outcomes, which are:

- Loss of life
- Serious injury
- High speed (>20 km/hr) derailment
- Signals passed at danger

- ‘Close call’ incidents with the public (inc trespassers) and rail staff
- Vehicle collision

2.4 National Transport and Railway Setup and Proposed Changes

Overview of the Regulatory and Legal Framework Governing Railway Sector in Egypt- Law No. 152 of 1980

The Egyptian National Railways Authority “ENR” was established by virtue of **Law No. 152 of 1980** “ENR Law” as the national authority entrusted with the management of the railways' utility and falls under the auspices of the Ministry of Transportation. According to ENR Law, ENR has the exclusive right to create and operate the national railway and to establish joint stock companies in order to achieve its purposes.

The ENR Law established a public monopoly. ENR was the sole entity permitted to construct, manage, operate, and maintain railway networks within the Egyptian territory. ENR could not delegate to private contractors the performance of specific duties on its behalf under typical concession agreements or introducing the possibility of ENR to incorporate joint venture. Article 2 of the ENR Law provided that:

"The authority is competent –exclusively- to establish and operate railway networks on the national scale”.

Amendments were first introduced to Law No. 152 of 1980 by Law No. 149 of 2006

(“Law 149/2006”) allowing concessions to be granted to private entities for the first time, however, it limited the scope of the concession to the establishment and operation of a new railway networks[1]”.

This meant that the existing network fell outside the scope of Law 149/2006. It also indicated that the role of the private sector was limited to the establishment and operation of these new networks, without extending this mandate to other aspects associated with the establishment and operation.

Furthermore, Law 149/2006 did not repeal ENR's monopoly. Whereas under article 2 of the ENR Law, ENR remained the sole and exclusive entity authorized to operate and manage the railway networks. In addition to establishing, managing, operating, and maintaining facilities and machines needed to provide its services; the possibility to grant concessions was merely an exception to the general rule stated in Article 2.

To conclude, the amendments introduced by Law 149/2006 allowed the private sector to build and operate new railway lines and networks at its own expense by entering into agreement with the Tendering Public Entity. In addition, the said amendments required from the private sector to maintain the new railway line during the Contract Period and at the end of this period; the new line shall be transferred to the State free of charge and in good condition. Given that, the Concession Period shall not be exceeding 30 years in all cases.

Amendments introduced to Law No. 152 of 1980 by Law No. 149 of 2006 are not sufficient to allow the private sector participation.

[1] 1 Article 1 of the Law 149/ 2006 “As an exception of Article 2 of this law [No. 152 of 1980], the public utilities liabilities/obligations may be granted to the investors, whether natural or legal persons, to construct/build and operate new lines and railway networks, without adherence to the provisions of Law No. 129 of 1947 concerning concessions of public utilities, and Law No. 61 for 1958 concerning Concessions relating to the Investment of natural resources and public utilities”.

Proposed Changes to the law

The review of the regulatory and legislative framework does not seem to affect the monopolistic structure of the market: the extent of private sector participation is admitted by ENR only at a minimum level. Consequently, the market could not attract private sector, as shown in the following.

1. The private sector participation can take a wide range of forms varying in the extent of involvement and risk taken by the private party. The terms of participation have to be set out in a contract to outline the responsibilities of each party and clearly allocate risk.
2. On the basis of the current regulatory framework, Public-private partnership (PPP) in Egypt allows a private party to build and operate new railway lines and networks at its own expense through a project company for a duration of the contract that shall not exceed 30 years. The project company shall be therefore implemented as an Egyptian Joint Stock Company, so as to enable ENRA to maintain a 20% stock of capital. The investment discretion of the private party would be therefore limited.
3. Monopoly power reduces the efficiency of the market as a whole. The best way to regulate a natural monopoly is to allow other railway companies to access to rail infrastructure, allocating the costs of using the track to freight and passenger business units (track access charge) to public and private railway undertakings.
4. The existing Laws does not provide a regulatory framework for the access to the existing infrastructure, nor appropriate access pricing rules. The absence of access rights is actually the most important barrier to entry for newcomers and for long-term development provisions (also for freight transport services on existing connections).

3- Practical PSP

Practical PSP Commercial model for the operation of the PSP contract

The Egyptian railways currently operates in a vertically aligned way with ENR being both the FOC and IM. We recommend that there should be a publicly appointed Rail Regulator who is responsible, inter alia responsible for safety, road-rail competition, performance of the PSP and ENR and access to GPA.

In all options as regards freight it makes sense to consider the operation of the freight train services along the whole length of the route from 6th October to Port of Alexandria.

We therefore propose the following options for the role of the PSP can then be therefore concern:

(i) Separate contracts for construction and O&M for the infrastructure.

• Upgrade & construction for infrastructure to be ENR's responsibility

• Investment in traction and rolling stock (capital purchase, workshops, loading areas, station), and it's operation and maintenance O&M to be the PSP's Private operator responsibility.

With an option for the private sector to take As a sub-option the PSP could deliver the infrastructure works (according to ENR technical specifications) under ENR financing & supervision. ENR will lend the private sector the needed funding through WB loan/others for completing the line (including constructing the WCRB) and upgrading the existing infrastructure and systems for Etihad line, Manashy line and connection to GPA. The PSP could also be made responsible for the O&M of the track under contract to ENR.

ENR to grant concessions through PPP/others giving the private sector the right to use the infrastructure either through paying access charges to ENR, concession fees or revenue sharing.

(ii) Single Private Sector Partner (PSP) to be both the IM and a FOC for the whole route Manashy, El Etihad, & WCRB to eliminate bureaucracy and reduce the interaction between public entity (ENR) and private sector, encourage efficiency and to ensure timely safe operation. Until ENR is reformed and restructured to be ready to take full responsibility for IM, as ENR has no investments capabilities in the construction & upgrade for its infrastructure and has backlogs of more than 1200 km of track renewals. ENR would continue to operate the passenger service and historic freight services through a Track Access Contract issued by the PSP, acting as the route's IM. The Rail Regulator would approve these track access contracts and the included charging regime and access arrangements.

It seems very challenging for the private sector and ENR to work together on the same track and to have a balanced contract agreement for infrastructure/operation and the O&M of PSP trains. At the very least it will import significant risk into the PSP's train operation which is cannot control. We therefore recommend option 2 as this reduces the PSP's interface with ENR, and the related operational risk, and makes the PSP clearly and solely accountable for the effective running of the freight services.

We recommend a commonality of signalling systems across the network (or at least inter-operability). This will remove the need for multiple signalling systems to be installed in locomotives and simplify the future maintenance of the signalling systems.

4- Shortlist of options

To meet the future needs of the railway's customers to move freight to DP6 we have identified four high level options, and within each option several different operating scenarios:

<u>Option 1 (new line): New dedicated freight line from Alexandria to 6th of October</u>

Scenario 1: Private operator
Scenario 2: Joint operator (private operator and ENR)
Scenario 3: ENR operator

<u>Option 2: 'do nothing' option using the existing lines (Etihad, Manashy, Cairo High dam, & Baharia) WITHOUT constructing the WCRB.</u>

<u>Option 3: Existing Etihad + Existing Manashy lines + WCRB</u>

Scenario 1: ENR to operate total line from Alexandria to 6th of October with improving the contractual agreement, and private sector just to do marketing & management issues, loading & unloading, handling to allow end to end journey and System integration.

Scenario 2: Private operator for WCRB, Joint operator for Manashy & Etihad lines

<u>Option 4 (improve existing infrastructure): Upgrade Etihad & Manashy lines and build WCRB</u>

Scenario 1: ENR to operate passenger trains on Manashy line & four existing freight trains on Etihad line. Private sector to operate additional future freight trains and DP6 trains coming from Alexandria heading to 6th of October. ENR to be the Infrastructure Manager.

Scenario 2: ENR to operate passenger trains only. Private sector to operate existing 4 freight trains on Etihad and future additional trains. ENR to be the Infrastructure Manager.

Scenario 3: Private sector partner to operate the freight trains and become the Infrastructure manager for the entire route. ENR to operate the passenger trains on the El-Manashy route through a track access contract.

4.1 Option 1 – new dedicated freight line

Infrastructure Works & Land Expropriation

Option 1 provides a new dedicated freight line through the El-Etihad and El-Manashy rail corridor.

On the El-Manashy line this will involve the doubling of the existing line where it presently operates as a single-track railway with passing loops at the stations. A third line will be needed to be provided at the stations so that the freight trains can pass through whilst passenger trains are discharging passengers. Doubling of the lime will not be required on the El-Etihad line as it currently operates as a dedicated freight line.

Both lines will need the installation of new signalling.

We consider that, as a minimum, 9 metres width is required for an additional line based on: 3m separation to current running line, 3m width for the new line and 3m separation to the track boundary. To this should be added any additional width for embankments or fill where the track runs above or below the existing ground level, with possibly a 1:2.5 slope required (2.5m width required to raise the track level by 1m), dependent on local ground conditions and the fill material being used.

ENR report the following available space either side of the running line, the below data has been received from ENR and still needs official confirmation

From KM	To KM	Right (m)	Left (m)
1	10	9m - 13 m	12 - 30
10	20	9-33.5	10 - 13
20	30	9-15.75	14-30
30	50	16-16	29,5
50	60	10 - 30	29,5
60	70	30-30.75	29,5
70	80	10 - 20	29,5
80	90	20-21	29,5
90	To end	08 - 11	29,5

Table 6: El-Manashy line fencing offsets
Source: data received from ENR

This demonstrates that sufficient width to build a new line within the existing wayleave of the railway.

Finding a route for a third line through many of the stations may be difficult. Many stations have buildings or other constraints such as the river immediately adjacent to them and the option would require the purchase of land outside the existing land boundary. ENR report the following available space at the stations:

Manashy	19,669	33,50	36,5
Zat Kom	23	15,75	15,25
Nkla	24,700	15,75	14,25
Berkash	26,950	15,75	45
Atta	31,771	30,75	29,5
Atta Bald	34,540	30,75	29,50
Gezera Wastanya	37,500	15,75	29,5
Abu Ghaleb	43,978	15,75	29,5
Wardan	47,109	30,75	49,5
Bany Salama	**52,203**	**8,5**	**7**
Khatatba	58,021	43,5	60
Al Akhmas	62,700	28,25	25,25
Al Trana	64,500	28,75	29,25
Kafr Dawod	69,844	27	25,5
Bregat	73,695	20,75	54,25
Moderyet Tahrir	79,250	31,75	29,25
Abu Khawy	83,720	20,75	29,25
Tayreya	88,644	54	49,25
Tayerya Bald	90,545	11,30	31,25
Etihad	92,884	20,75	29,5

Table 7: Available space at the stations for Manashy Line
Source: data received from ENR

In principle sufficient width appear to be available for the construction of a new line with the exception of Bany Salama station, however each station would require an individual assessment to determine the practicality of construction a third through line.

This option would reduce the journey time to around 45 minutes if the line were built to 100 km/hr.

Operating Scenarios

The three scenarios define who is operating the trains. In scenario 1 the private sector company operates the freight trains, in scenario 2 the operation is mixed, with the private sector company operating the future freight trains to DP6 and ENR operating ‘other existing freight trains and in scenario 3 ENR operates the both existing and additional trains for DP6 freight trains.

4.2 Option 2 - 'do nothing'

This option is a 'baseline' option where the service would use only the existing lines (Etihad, Manashy, Cairo High dam, &Baharia lines) WITHOUT constructing the WCRB.

As discussed in section 2.4 the busy operation timetable and congested route around Cairo requires an 11 hour journey time and freight trains can pass only at night, between 1 am and 6 am. Outside these hours, and priority is given to passenger trains.

This limits the capacity of the existing track without constructing WCRB to 3 containers trains only in each direction per day, that is 6 trains total per day. According to the possible train configuration, the maximum capacity of these 6 trains is in the order of 375 TEUs per day.

4.3 Option 3 –Existing infrastructure for Etihad & Manashy + constructing WCRB

This option represents a 'do nothing' scenario on the El-Etihad and El-Manashy lines and so the existing line capabilities would apply. The Western Cairo Rail Bypass line is constructed.

The implementation of WCRB will result in:

- Avoiding the congested area of Central Cairo which would increase the line's train capacity both for freight and passengers.
- Reduce the overall travel time mainly attributed to the time for technical inspection
- Decreasing the travel distance between Alexandria and El Dekheila Ports and 6th of October Dry Port.
- Increasing the number of container trains to 9 trains daily in each direction.
- Decrease the pressure off Boulaq El Dakrour inspection yard which would decrease the waiting time and increase its efficiency.

The expected travel time of a freight train after constructing WCRB from Alexandria Port to DP6 will be around 7 hours

4.4 Option 4 – Infrastructure Change to Existing Lines + build WCRB

Option 4 builds upon the core infrastructure provided in option 2 (existing El-Etihad and El-Manashy lines plus the construction of the WCRB) and upgrades the existing lines to provide more route capacity and improve the journey time.

Three new options are identified on the El-Etihad line:

- EE1 – new passing loop
- EE2 – Signalling upgrade
- EE3 – Improve line speed

Three new options are identified on the El-Manashy line:

- EM1 – track doubling
- EM2 – Signalling upgrade
- EM3 – Improve line speed

These are detailed below.

Option EE1 – New Passing Loop

The track section between Al Nadha and Tafaroa station is more than twice as long as any other. Construction of a passing loop at the mid-point of this track section will enable two trains to occupy this section and pass each other within the new loop. This will immediately double the line capacity to 64 trains a day as the maximum track section occupation time will halve as there are no other track sections longer than 14 km.

For costing purposes we have assumed that the loop will be a simple 1 kilometre piece of track connected to the existing single line by a set of points at either end. A walkway and shelter will need to be provided to enable the manual transfer of the token between incoming and outgoing trains.

Option EE2 – Signalling Upgrade

Currently, trains have to stop at each station to exchange a physical 'token' to enter the next track section. Upgrading the signalling system to a modern interlocked system with electronic lights will enable the trains to run through the stations at a higher speed, resulting in a higher average speed through the track section. This will significantly reduce the overall journey time and also increase the capacity of the route.

If average train speed could increase from 38km/hr (less in shorter sections) to 50 km/hr over the entire route length the journey time would reduce from the current up to 4 hours to less than 2.5 hours.

The route capacity would also increase as the sectional running times through the longest track section of 28km would reduce to 30 minutes, increasing the route capacity to 48 trains per day (2 per hour).

Combining option EE1 and EE2 would increase the route capacity to 96 trains per day as the shortest section would be 14 kilometres, taking 15 minutes to transit enabling 4 trains per hour.

We have assumed 8 signals within each signalling block between the stations. These compose of 4 signals on each line; one a departure signal, one an arrival signal, a distant signal to the arrival signal and a signal protecting a crossover to the adjacent line.

Option EE3 – Improve the Line's Design Speed

A faster line speed will reduce sectional running times. This will lead to a reduced end to end journey time and increased route capacity. However, this option will not bring significant benefits without the simultaneous introduction of a new signalling system as the need to stop at each station to exchange tokens will prevent the top line speed being achieved in all but the longest track sections.

If the line speed is increased to 100 km/hr the overall journey time will be reduced to around 1.25 hours, although some delay would occur from trains having to stop to allow trains through on the opposite line at crossing loops. Usually this would happen once on a journey; it is therefore assumed that an end to end journey time of 1.5 hours is more realistic.

To enable this it is assumed that half of the existing track will need to be re-laid to accommodate the larger track forces arising for the faster freight trains. The installation of the signalling upgrade detailed in option EE2 will also be required as there is no value in increasing the route's line speed if the train has to stop at every station to exchange a signalling token.

The route capacity will also increase as the sectional running times through the longest track section of 28km will reduce to just less than 20 minutes, increasing the route capacity to 72 trains per day (3 per hour).

Option EM1 - Doubling the Track between Stations

Doubling the track between the stations requires 'infilling' the track between the existing station loops to provide a continuous track in either direction. There is sufficient space within the existing rail corridor to achieve this.

This will double the route capacity of the line by separating northbound and southbound trains and avoid the need to use the station loops as passing loops between sections. This will also improve the overall resilience of the line by removing any cross dependency of the different services, so a delayed northbound train will not delay the southbound service.

If a robust timetable can be established this may be possible by enabling bi-directional running so that a southbound freight can overtake a southbound passenger by running on the northbound line. This requires the northbound track to be available (ie no northbound passenger or freight running). To enable this a signalling upgrade would be required (see option EM2) and the maintenance of suitable connections between the southbound and northbound lines.

Option EM2 – Signalling Upgrade

Currently trains have to stop at each station to exchange a physical 'token' to enter the next track section. Upgrading the signalling system to a modern interlocked system with electronic lights will enable the trains to run through the stations at a higher speed, resulting in a higher average speed through the track section. This will significantly reduce the overall journey time and also increase the capacity of the route for 'non stopping' freight trains.

There are 18 passenger trains in each direction each day, ie roughly one per hour. With careful timetabling and the installation of a new signalling system 'non-stop' running freight trains would be planned to 'catch up' with the passenger trains towards the end of the shared section rather than at the beginning. This would enable the majority of the journey to be undertaken at the full line speed of 100 km/hr rather than the lower average speed of a 'stopping' passenger train, which is assumed to be 50 km/hr. So, although we have taken the average journey time through the route to be 1.5 hours (72 km at 50 km/hr) this could be reduced to less than hour if appropriate timetabling were possible.

A freight train running at line speed will traverse the line significantly faster than a passenger train stopping at all stations. So considerable journey time can be gained if a freight train can 'overtake' the passenger trains by bi-directional running on the opposite line, which is entirely possible. End to end journey times of 45 minutes could then be achieved.

Using bi-directional running to enable overtaking is should be possible to get at least two freight trains per hour through the network, yielding another 48 trains per day of route capacity.

We have assumed 8 signals within each signalling block between the stations. These compose of 4 signals on each line; one a departure signal, one an arrival signal, a distant signal to the arrival signal and a signal protecting a crossover to the adjacent line.

Option EM3 – Improve the line's design speed

If trains were able to run at 125 km/hr over the entire route length the journey time would reduce from the current up to 1.5 hours to around 35 minutes, if a new signalling system were introduced so that the trains do not need to stop to exchange a signalling token and can 'overtake' on the opposite line.

To enable this it is assumed that half of the existing track will need to be re-laid to accommodate the larger track forces arising for the faster freight trains. The installation of the signalling upgrade detailed in option EM3 will also be required as there is no value in increasing the route's line speed if the train has to stop at every station to exchange a signalling token.

Route capacity could also possibly increase but it is prudent not to expect too much improvement over the route capacity improvements achieved through the implementation of the enabling signalling system.

Combinations for Option No. 3

These options can be combined to consolidate benefits. We have identified three potential attractive combinations:

Combination 1 – signal upgrade on both lines (options EE2 + EM2)

The installation of signalling will enable the 'non-stop' operation of trains across both networks, where at the moment trains need to stop at each station to exchange tokens. This will both increase journey time and route capacity, as well as improving operational efficiency and safety. There could also be benefits with combined this project with the installation of signalling on the new WCRB scheme as a common signalling system will be needed to prevent the installation of multiple signalling systems on to the locomotives.

Combination 2 – upgrade works only on the El-Etihad line (options EE1 and EE2)

The El-Etihad line has the least 'spare' route capacity due to it's longer track sections. This option provides 3.5 tph (~84tpd), based on the trains going through the shorter 14km track section at a full line speed of 50 km/hr.

Combination 3 – all line signalling upgrade plus loop extension on EE line (options EE1, EE2 & EM2).

This combination builds on the signalling upgrade combination (combination 1) by including the relatively low cost option EE1, which significantly increases the capacity of the El-Etiha line.

Operating Scenarios

The three scenarios define who is operating the trains and who is the Infrastructure Manager.

In scenario 1 the private sector company operates the freight trains whilst ENR operates the passenger services and the existing freight services. ENR is the Infrastructure Manager.

In scenario 2 ENR only operates the passenger trains and the private sector operates the freight trains. ENR is the Infrastructure Manager.

In scenario 3 the private sector company not only operates the freight trains but is also the Infrastructure manager for the entire route. ENR operates passenger trains on the El-Manashy route through a track access contract.

5- Option assessment and scoring

<u>Introduction</u>

The option assessment is undertaken in two parts. The initial technical assessment reviews the various options against the route capability requirements (journey time and line capacity (base & stretch)) and construction cost.

The final assessment is a broader assessment of the options which meet the technical requirements and includes a consideration of the various scenarios within each option.

5.1 Technical Assessment

Modification Costs

The estimated costs of constructing the options is shown below, with more detail being given in Appendix A.

Option	Description	New track (m)	Upgraded track (m)	New P&C	SEU	Loco fitment	WCRB	Total cost ($m)
1	Dedicated freight	72000		28	228	20	167	582
2	'No nothing'							0
3	'No nothing' + WCRB						167	167
4	EE1 - new loop	1000	0	2	0		167	171
	EE2 - Signal upgrade	0	0	0	80	20	167	210
	EE3 - Improved line speed	0	122000	20	0		167	393
	EM1 - Doubling line	60000			120	20	167	478
	EM2 - Signalling upgrade				120	20	167	240
	EM3 -improved line speed		72000	22			167	277
Combin.	1 - Signal upgrade, EE2+EM2)	0	0	0	200	20	167	283
	2 - EE route upgrade, EE1+EE2	1000	0	2	80	20	167	214
	3 - Comb 1&2, EE1+EE2+EM2	1000	0	2	200	20	167	287

Table 8: Estimated costs of constructing the options
Source: consultant estimation based on international standards

These costs represent 'construction' costs and an allowance of 20% should be added to them for design and project management costs.

Option 1 has the highest cost which is unsurprising as it requires a considerable amount of new track, points and crossing and signalling equipment. It also includes a $10m one-off provision for land purchase and compensation costs.

All of the new signalling options also include an allowance for the fitment of a signalling system into a locomotive.

Journey Time Improvement

The overall journey time associated with the various options is shown in the table below.

			Journey time (hrs)				
			EE	EM	WCBR	Total	Rating
Option 1	New line on EM route comprising doubling existing line plus 'third' line through stations. Signalling upgrade on all lines plus additional loop on EE line as option EE1.		2.5	0.75	1.5	4.75	**15.3**
Option 2	Use only existing infrastructure		4	1.5	-	11	-
Option 3	Use existing infrastructure + WCRB		4	1.5	1.5	7	-
Option 4	El-Etihad options	EE1 - new loop	4	1.5	1.5	7	-
		EE2 - Signal upgrade	2.5	1.5	1.5	5.5	**13**
		EE3 - Improved line speed	1.5	1.5	1.5	4.5	**16**
	El-Manashy options	EM1 - Doubling line	4	1.5	1.5	7	-
		EM2 - Signal upgrade	4	0.75	1.5	6.25	**10.8**
		EM3 - Improved line speed	4	0.55	1.5	6.05	**11.5**
	Combination 1	Signal upgrade on both routes (EE2 + EM2)	2.5	0.75	1.5	4.75	**15.3**
	Combination 2	Etihad upgrade (EE1 + EE2)	2.5	1.5	1.5	5.5	**13**
	Combination 3	Signal upgrade on both routes (EE2 + EM2) plus new loop on Etihad line (EE1)	2.5	0.75	1.5	4.75	**15.3**

Table 9: scoring for 4 options based on Journey time
Source: consultant estimation

Option 2 or sub-options EE1 and EM1 on their own will not achieve the required journey time of 6.5 hours.

The major time benefit can be achieved by Option EE2, ie the installation of a new signalling system on the El-Etihad line. This prevents trains having to stop to exchange tokens at each signalling section on the longest section of route, therefore offering the greatest potential saving. Enabling an average line speed of 50 km/hr would enable a journey time of 2.5 hours, saving 1.5 hours off the 4 hour journey time assumed, reducing the overall journey time to 5.5 hours. Further savings of 0.75 hour on each journey can be achieved by (EM3) signalling the El-Manashy line or (EM2) providing a dedicated freight line but these are at a much higher price.

It should be noted that the introduction of signalling will also require locomotive modification to all locomotives using the line. We understand that new locomotives are planned to be purchased for the new traffic going to DP6 so any signalling system can be designed into these locomotives. It should also be noted that some of the existing ENR locomotives will need to have the new signalling system installed to service the other freight flows using the route and for infrastructure renewal purposes.

The new Western Cairo Bypass route will be signalled and if this has a different signalling system to the one installed on the El-Etihad line two different signalling systems may need to be fitted into the locomotives.

From this analysis we conclude that if the El-Etihad line is improved through the provision of a new signalling system and improved running speed this would provide sufficient benefit to enable a journey time reduction of at least 1.5 hours each way, and that this would be sufficient to enable the 24 hour return transit time required.

Western Cairo By-pass Route (WCBR)

This line is still to be built and we understand it is likely to be a single-track freight line with 3 stations. We assume that the design of the line will be enough to accommodate the base case train forecasts for the next 20 years.

Our understanding from the data received from ENR, (Cairo university study), the technical specification will be as follow:

- Length 49km
- Starts at KM 51 on Baharia Line, 15 km away from DP6
- Ends at km 32 on Itay Baroud Imabab line, 1.3 km away from Atta Station
- Single line allows moving both freight& passenger trains
- Diesel and embankment will be designed to allow electric trains in the future
- Signal: Electrical signals
- Maximum slope 11%
- Speed 140 km/h

The 49km route should be traversable in 30 minutes if the train runs at 100 km/hr, which is a more reasonable assumption for a freight train than the 140 km/hr design line speed. Allowing for a lower speed to transition to and from the El-Manashy line and Bahria line, and the need to possibly stop each train within a loop to allow another service we pass we consider an average line speed of 50 km/hr is more applicable, giving one hour’s transit time on the route. A further 30 minutes has been allowed for the short distance down the Bahria line and then access into DP6.

As per Cairo university report, the chosen alignment for bypass link (49 km) won’t require land expropriation.

Route Capacity Improvement

The overall route capacity associated with the various options is shown in the table below.

			Route capacity (single tpd))				
		E	Provision	Base	Rating	Stretch	Rating
Option 1	New line on EM route comprising doubling existing line plus 'third' line through stations. Signalling upgrade on all lines plus additional loop on EE line as option EE1.		84/192	28/64	**16.8**	80/116	**5.5**
Option 2	Use only existing infrastructure		6	28/64		6	-
Option 3	Use existing infrastructure + WCRB		32/144	28/64	**10**	80/116	-
Option 4	El-Etihad options	EE1 - new loop	64	28	**13.6**	80	**3.4**
		EE2 - Signal upgrade	48	28	**12**	80	**1.8**
		EE3 - Improved line speed	72	28	**14.4**	80	**4.8**
	El-Manashy options	EM1 - Doubling line	288	64	**10**	116	**5**
		EM2 - Signal upgrade	192	64	**10**	116	**5**
		EM3 - Improved line speed	192	64	**10**	116	**5**
	Combination 1	Signal upgrade on both routes (EE2 + EM2)	48/288	28/64	**12**	80/116	**1.8**
	Combination 2	Etihad upgrade (EE1 + EE2)	84/192	28/64	**16.8**	80/116	**5.5**
	Combination 3	Signal upgrade on both routes (EE2 + EM2) plus new loop on Etihad line (EE1)	84/288	28/64	**16.8**	80/116	**5.5**

Table 10: scoring for 4 options based on Route capacity

<u>El-Etihad line</u>

The baseline review identifies that there is route capacity is 32 trains per day, ie 16 in each direction, and this is consistent with the data from ENR which also states that the line capacity is 32 trains per day.

There is no passenger service on this line and only 4 return freight movements so there is capacity for another 24 each way freight journeys to be made . This is sufficient for the additional 16 movements a day (8 return trains a day) identified in the base case capacity forecast. By 2040 the service plan is due to increase to 13 trains a day and then further route capacity will be required. This could either be achieved by the introduction of the passing loop in Option EE1 or through the introduction of line speed improvements (options EE2 and EE3). As Option EE2 is recommended to improve the journey time this option will be sufficient for the provision of sufficient capacity increases without the need for option EE1.

To achieve the 'stretch' capacity options EE1 and EE2 need to be implemented. This will enable a route capacity of 96 journeys, 20% more than the stretch requirement for 80.

<u>El-Manashy line</u>

The baseline review identifies that there is a route capacity of 72 return trains each day. We note that this is very similar to the stated line capacity of 74 trains per day in the EBRD Railway Network Review published in May 2016.

With the current 36 passenger single direction train movements a day (18 return journeys) there is route capacity for 36 single direction freight trains a day, of which 8 are currently being used by the 4 daily return freight movements. This leaves adequate capacity available for the additional 8 planned services (16 trains).

This capacity is also sufficient to accommodate the 'stretch capacity requirement of 116 journeys.

Summary

The table below summarises the various options.

			Journey time (hrs)					Route capacity (single tpd))					Est. cost ($m)		Overall rating	Ranking	Commentary
			EE	EM	WCBR	Total	Rating	Provision	Base	Rating	Stretch	Rating	Option	Rating			
Option 1	New line on EM route comprising doubling existing line plus 'third' line through stations. Signalling upgrade on all lines plus additional loop on EE line as option EE1.		2.5	0.75	1.5	4.75	**15.3**	84/192	28/64	**16.8**	80/116	**5.5**	582	**1**	**39**	**4**	Meets all requirements, including stretch capacity requirements
Option 2	Use only existing infrastructure		4	1.5	-	11	-	6	28/64		6	-	0	-	**N/A**	-	11hr journey time doesn't meet requirement. Only 3 daily return trains possible so doesn't meet capacity requirements either.
Option 3	Use existing infrastructure + WCRB		4	1.5	1.5	7	-	32/144	28/64	**10**	80/116	-	167	-	**N/A**	-	Doesn't meet journey time requirement. Only just meets baseline capacity requirement on EE line (28 paths required, 32 available).
Option 4	El-Etihad options	EE1 - new loop	4	1.5	1.5	7	-	64	28	**13.6**	80	**3.4**	171	-	**N/A**	-	Doesn't meet journey time requirement
		EE2 - Signal upgrade	2.5	1.5	1.5	5.5	**13**	48	28	**12**	80	**1.8**	210	**10**	**37**	-	
		EE3 - Improved line speed	1.5	1.5	1.5	4.5	**16**	72	28	**14.4**	80	**4.8**	393	**5**	**40**	**3**	Includes EE2 cost
	El-Manashy options	EM1 - Doubling line	4	1.5	1.5	7	-	288	64	**10**	116	**5**	478	-	**N/A**	-	Doesn't meet journey time requirement
		EM2 - Signal upgrade	4	0.75	1.5	6.25	**10.8**	192	64	**10**	116	**5**	240	**9**	**34.8**	**6**	
		EM3 - Improved line speed	4	0.55	1.5	6.05	**11.5**	192	64	**10**	116	**5**	277	**8**	**34.5**	**7**	Includes EM3 cost
	Combination 1	Signal upgrade on both routes (EE2 + EM2)	2.5	0.75	1.5	4.75	**15.3**	48/288	28/64	**12**	80/116	**1.8**	283	**8**	**37.1**	**5**	Cost efficiencies through larger contract, no infrastructure changes. Provides significant
	Combination 2	Etihad upgrade (EE1 + EE2)	2.5	1.5	1.5	5.5	**13**	84/192	28/64	**16.8**	80/116	**5.5**	214	**10**	**45.3**	**2**	Small increment to option EE2 which significantly increases the route capacity.
	Combination 3	Signal upgrade on both routes (EE2 + EM2) plus new loop on Etihad line (EE1)	2.5	0.75	1.5	4.75	**15.3**	84/288	28/64	**16.8**	80/116	**5.5**	287	**8**	**45.6**	**1**	Meets all requirements, including stretch capacity requirements

Table 11: scoring for 4 options based on journey time, route capacity, & estimated cost all together

There are four assessment criteria which are scored as follows:

1- Journey time: 6.5 hours is the required minimum. Options not achieving this are not taken forward and are shown as red within the table (option 2, EE1 and EM1). Options which achieve this 6.5 hour baseline are scored at 10 and then 3 extra points are given for each additional; hour of time saving.

2- Route capacity (base): this is considered to be 28 tpd on the El-Etihad line and 64 tpd on the El-Manashy line (expressed as 28/64 on options which address both lines). Option 2 is only just to achieve this requirement on the El-Etihad line (32 tpd). Options which achieve this requirement are scored at 10 and then at extra point is allocated for each set of additional 10 tpd about this. All El-Manashy options are scored at '10' as there is significant available capacity on this line.

Route capacity (stretch): this is considered to be 80 tpd on the El-Etihad line and 116 tpd on the El-Manashy line (expressed as 80/116 on options which address both lines). Option 2 and some other options are not able to achieve this requirement). Options which achieve this requirement are scored at 5 (half as valuable as achieving the 'base' requirements) and then ant extra point is allocated for each set of additional 10 tpd about this. For those options not able to achieve the stretch figure a score lower than 5 is given depending on how close to the stretch figure they are. All El-Manashy options are scored at '5' as there is significant available capacity on this line.

3- Cost: this is based on the construction cost defined in Appendix A. the lower cost is scored as 10 and the highest cost scored as 1, with intermediate costs scored on a pro-rata basis in between.

The best scoring options can be seen to be combinations 2 and 3 within option 4. These options are a signalling upgrade and the installation a loop on the El-Etihad line (combination 2, ranked number 2) and then this option combined with a signalling upgrade on the El-Manashy line (combination 3, ranked number 1). Combination 2 is relatively cheap as the El-Etihad line whilst longer than the El-

Manashy line has fewer signalling blocks as there are less stations. The installation of a loop in option EE1 is relatively cheap and gives significant benefits in capacity as one signalling section is twice the length of any others. Combination 1 ranks best as the upgrade of the signalling systems on both lines enables a further significant reduction in the journey time. It should be noted that the cost of combination 3 may well be reduced if signalling unit rate installation costs can be reduced by having a larger project covering two lines, but this benefit is not taken in this calculation.

The third ranked option is to increase the line speed on the El-Etihad line, although this option does not quite achieve the stretch requirements for train capacity.

The fourth ranked option is Option 1, the provision of a new dedicated freight line. This option is significantly more expensive than any other option, with a capital cost nearly twice the next highest costed scheme.

Option 3 does not achieve the required journey time and only just meets the base capacity requirements. It does not meet the stretch capacity requirements.

Option 2 does not achieve the required journey time or the base capacity requirements.

The top five ranked options are now taken forward into the final stage of the evaluation.

6- Final Evaluation

Introduction

The final evaluation is undertaken using 4 criteria:

- Technical score, this is carried over from the technical evaluation
- Project complexity and risk. This is scored out of 5 on a High/Medium/Low allocation, which low risk projects scoring 5
- Suitability for PSP adoption. This is again scored out of 5 on a High/Medium/Low allocation, which high suitability projects scoring 5
- Operational suitability and resilience. This is scored out of 10 as it will have a long-term effect, and again scored on a High/Medium/Low allocation, which high suitability projects scoring 10

It should be noted that scoring is undertaken on a comparative basis to emphasis the difference between projects rather than an absolute basis. So, for example, whilst all projects may be considered high risk, some are more high risk than others, which leads to a medium rating for the less high-risk projects. The technical merit of the project from the initial assessment has considerable weight, being responsible for around two thirds of the scoring.

Results

The overall scoring of the options is detailed below.

			Time	Capacity		Cost	Project complexity & risk		Suitability for PSP model		Operational suitability & resilience		Overall rating	Overall ranking
			Rating	Rating	Rating	Rating	HML	Rating	HML	Rating	HML	Rating		
Option 1		Scenario 1 - Private Operator	15.3	16.8	5.5	1	H	1	H	5	H	10	55	5
Option 1		Scenario 2 - Joint operation	15.3	16.8	5.5	1	H	1	M	3	M	5	48	12
Option 1		Scenario 3 - ENR Operator	15.3	16.8	5.5	1	H	1	L	1	H	10	51	10
Option 4	EE3 Improved speed	Scenario 1 - PSP DP6 trains, ENR balance & IM	16	14.4	4.8	5	M	3	L	1	M	3	47	15
Option 4	EE3 Improved speed	Scenario 2 - PSP freight, ENR passenger & IM only	16	14.4	4.8	5	M	3	M	3	M	3	49	11
Option 4	EE3 Improved speed	Scenario 3 - PSP freight & IM, ENR passenger only	16	14.4	4.8	5	M	3	H	5	H	6	54	7
Option 4	Combination 1 - Signal upgrade on both routes	Scenario 1 - PSP DP6 trains, ENR balance & IM	15.3	12	1.8	8	M	3	L	1	M	5	46	14
Option 4	Combination 1 - Signal upgrade on both routes	Scenario 2 - PSP freight, ENR passenger & IM only	15.3	12	1.8	8	M	3	M	3	M	5	48	12
Option 4	Combination 1 - Signal upgrade on both routes	Scenario 3 - PSP freight & IM, ENR passenger only	15.3	12	1.8	8	M	3	H	5	H	8	53	8
Option 4	Combination 2 - Etihad line upgrade	Scenario 1 - PSP DP6 trains, ENR balance & IM	13	16.8	5.5	10	M	3	L	1	M	4	53	8
Option 4	Combination 2 - Etihad line upgrade	Scenario 2 - PSP freight, ENR passenger & IM only	13	16.8	5.5	10	M	3	M	3	M	4	55	5
Option 4	Combination 2 - Etihad line upgrade	Scenario 3 - PSP freight & IM, ENR passenger only	13	16.8	5.5	10	M	3	H	5	H	7	60	2
Option 4	Combination 3 - Siugnal upgrade both lines plus new EE loop	Scenario 1 - PSP DP6 trains, ENR balance & IM	15.3	16.8	5.5	8	M	3	L	1	M	5	55	4
Option 4	Combination 3 - Siugnal upgrade both lines plus new EE loop	Scenario 2 - PSP freight, ENR passenger & IM only	15.3	16.8	5.5	8	M	3	M	3	M	5	57	3
Option 4	Combination 3 - Siugnal upgrade both lines plus new EE loop	Scenario 3 - PSP freight & IM, ENR passenger only	15.3	16.8	5.5	8	M	3	H	5	H	10	64	1

Table 12: Final evaluation (technical assessment & operating scenarios)

The highest ranked options are from option 4, Combinations 2 and 3, with Scenario 3 being the highest scoring scenario. Combination 3, scenario 3 scores over 5% more than the next option and 12% more than the third option, which is a significant difference. This combination includes sufficient capacity to meet the 'stretch' requirements and offers a considerably shortened journey time. Even greater capacity is available if the movement to longer 'unconstrained' trains is considered.

Option 1, scenario 1 is in joint fifth place, being held back by its very high capital cost and the significant complexity of building an entirely new line when other options deliver the required line capability through modifications to the existing infrastructure.

Discussion

Project Complexity

Due to its scale option 1 is considered the most complex and risky project to construct. It will involve the construction of the most track and through lines at all of the El-Manashy stations, as well as a signalling upgrade through the route. It is therefore considered a 'High' complexity project and scored at 1.

All other options are considered 'Medium' risk and scored at 3.

PSP Suitability

The scoring in this criterion is driven by the Operating scenario. Scenarios which improve the control of the PSP and reduce its dependence on ENR are scored the most highly.

It is scored in the following table.

	scenario 1	scenario 2	scenario 3
Scenario definition	PSP : DP6 trains, ENR balance and infrastructure manager	PSP all freight; ENR passenger and IM only	PSP all freight and IM: ENR passenger only
RoI : PSP	Low: obliged to invest in trains but little control of infrastructure, signalling, and movements of non DP6 freight, which may limit train productivity Score: 1	Medium: (ii) autonomy to set priorities between DP6 and non DP6 freight traffic. Not in control of infrastructure Score : 2	High: maximum potential for high return as can invest in trains with (i) full control of infrastructure giving capability to maximise productivity and (ii) autonomy to set priorities between DP6 and non DP6 freight traffic Score 5
RoI: ENR	Low: ENR incurs all IM costs: IM revenue from DP6 trains paid by PSP and passenger train costs and revenue Score 1:	Medium ENR incurs all IM costs: IM revenue from DP6 and other freight trains paid by PSP and passenger train costs and revenue Score 2:	Medium: ENR incurs no IM costs. But reduced operation involving and passenger train costs and revenue only. Passenger services may be given lower priority. Score 2

Earnings for ENR	High: earnings from non DP6 freight and passenger services and IM activities score: 3	Medium: earnings from passenger services and IM activities score:2	Low: earnings from passenger services only score 1
Risk to PSP	High: no control of infrastructure; control of DP6 freight only score 1	Med: no control of infrastructure: control of all freight trains (can prioritise container trains to DP6) score :3	Low: control of all freight train movements and Infrastructure manager score: 5
Risk to ENR	high: IM risks and risks as provider of non DP6 freight and passenger services score : 1	medium: IM risks and risks as provider of passenger services score: 1.5	low: engaged in passenger train services only score: 3
Availability of private finance	Low availability; no control of infrastructure and operating DP6 freight trains only (mirrors risk profile): Score: 1	Medium availability; no control of infrastructure (mirrors risk profile): Score: 2	High availability; strongest context for PSP participation (mirrors risk profile): Score: 5
total score	8	12.5	21
total score (maximum = 5)	2	3	5

Table 13: Suitability of PSP Model
Source: consultant evaluation

Consequently, in option 3 scenario 3 is scored as a ‘High’ as the PSP is managing the infrastructure as well as operating the trains. This also gives it control of the timetable. Scenario 1 is scored as a ‘Low’ as the PSP is dependent on ENR for the provision and management of the infrastructure and also for the possibly conflicting operation of the other freight trains.

The same logic is applied top scoring the scenarios within Option1. Scenario 1 scores highest where the PSP runs the trains, scenario 3 the lowest where ENR runs the trains.

Operational Suitability and Resilience

The scoring in this criterion is driven by both the Operating scenario and the presence of a modern signalling system. Scenarios which improve the control of the PSP and reduce its dependence on ENR are scored the most highly. Also, scenarios in which are a modern signalling system is installed are scored most highly. It is considered that the presence of a modern signalling system significantly improves the operational flexibility and resilience of the operation of the railway.

This is the section with the most ‘relative’ scoring of options. All of the Option 3 scenario 3 options have significant PSP control and are all allocated as ‘High’ suitability. However, the individual scoring of the options varies from 10 to 6 as Combination 3 has the benefit of modern signalling and a reduced signalling sections on the El-Etihad line whereas improving the line speed on the El-Etihad line (Option EE3) has none of these benefits.

In Option 1 scenarios 1 and 3 which have a single Operator are scored as ‘High’ and Scenario 2 which has joint operation is scored as ‘Medium’.

Appendix A – Estimated construction costs

Option	Description	New track (m)	Upgraded track (m)	New P&C	SEU	Loco fitment	WCRB	Total cost ($m)	
									SEU = Signalling Equivalent Unit
1	Dedicated freight	72000		28	228	20	69	484	
2	'No nothing'							0	
3	'No nothing' + WCRB						69	69	
4	EE1 - new loop	1000	0	2	0		69	73	
	EE2 - Signal upgrade	0	0	0	80	20	69	112	10 blocks, 8 SEU in each block, plus new centre
	EE3 - Improved line speed	0	122000	20	0		69	295	Half of existing P&C to be replaced. EE2 reqd
	EM1 - Doubling line	60000			120	20	69	380	New line, except through existing stations. 4 SEU @ stns
	EM2 - Signalling upgrade				120	20	69	142	15 blocks, 8 SEU in each block, plus new centre
	EM3 -improved line speed		72000	22			69	179	Half of existing to be replaced
Combin.	1 - Signal upgrade, EE2+EM2)	0	0	0	200	20	69	185	
	2 - EE route upgrade, EE1+EE2	1000	0	2	80	20	69	116	
	3 - Comb 1&2, EE1+EE2+EM2	1000	0	2	200	20	69	189	
	Unit cost ($,000)	4	1.5	0.8	500	50			Track & earthworks
	Unit cost ($,000)				2000				New signalling centre
	Unit cost ($,000)				10000				EM2 land purchase & compensation costs

Six cost elements have been used:

1. Provision of ‘new’ track at $4000/m. This includes an allowance for some earthworks and drainage work.
2. Provision of refurbished track where existing lines are upgraded, at $1500/m
3. Signalling costs are expressed as $500,000 per ‘Signalling Equivalent Unit’ (SEU). This is the commonly used European benchmarking unit representing a signal location and supporting interlocking equipment. We have assumed 8 SEU within each station block: 4 within the station area (2 at either end of two platforms) and four on the line (approach and distant signal at both ends of the section)
4. We have allowed a one off cost of $2m for the provision of a new signalling centre
5. We have allowed a one off cost of $10m for land purchase and third party compensation for acquiring additional land for option EM2
6. We have allowed $50K for the fitment of the new signalling systems to a locomotive

These figures are based on European benchmarks obtained by the Consultants.

These costs represent ‘construction’ costs and an allowance of 20% should be added to them for design and project management costs.

The cost of constructing the Western Cairo Railway Bypass is taken as USD mio 167 as detailed in Cairo University Study, received by ENR

List of References

No.	Name:
1	Cairo University study for western WCRB
2	APA official website
3	Data received from ENR for Manashy line fencing offsets, and available spaces at stations
4	Site visit results
5	Baseline figures for future TEUs & tonnage/day
6	International benchmarking of NR's maintenance and renewal costs, Institute of Transport Studies, June 2008
7	European Technical Standards for Interoperability (TSI)
8	Rail way Network review, DP6 studies 2016
9	Annex D-Rail forecast model, baseline report