



Impact Assessment and Project Appraisal

Journal of the International Association for Impact Assessment

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Round table: What is the alternative? Impact assessment tools and sustainable planning

John F Benson

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Impact Assessment and Project Appraisal

Main articles in this issue

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Round table: What is the alternative? This paper takes a critical look at environmental impact assessment (EIA), espeplanning

John F Benson (University of Newcastle, UK)

Pages 261-280

Impact assessment tools and sustainable cially in the UK, and evaluates its strengths and weaknesses in terms of sustainable spatial planning. It concentrates on those elements considered crucial to a move towards sustainable planning, in particular the role of public participation, issues of alternatives and uncertainty, the problem of cumulative effects, the diversity of value systems, the issue of decision-making and the links from impact assessment into integrated environmental management. It concludes that the current European Union (UK) EIA system does not, and probably will not, without radical improvement, offer a tool for sustainable planning.

Responses from: Alan Bond; Andrew Brookes and Bram Miller; Yvette de Garis; William R Sheate; Paul Tomlinson; and Joe Weston; Riposte from John F Benson

the remarkable return

Netherlands)

Pages 281-291

Exposing weaknesses in interactive plan- Decision-making on transport infrastructure projects in the Netherlands has been of facing a remarkable wind of change in recent years. In the 1990s, academics and comprehensive policy analysis in The practitioners in policy analysis, public policy and planning all claimed that the traditional policy analysis methods were obsolete, yet they have experienced a sudden Martin de Jong (Delft University of Tech- resurgence since 2000 in the form of OEEI (Overview of Economic Effects of Innology, The Netherlands) and Harry Geer- frastructure), a refined application of CBA. This paper delves into why this new lings (Erasmus University Rotterdam, The version of CBA has become so politically successful despite predictions made to the contrary. In addition, it focuses on whether this resurgence may lead to 'econocracy', and, if so, how this can be prevented.

Steven Piper (US Department of the Inte-

Pages 293-302

Estimating the regional economic im- Land retirement is one option that can be used to address water shortages in agripacts of retiring agricultural land: cultural areas. The regional economic impacts of land retirement should be considmethodology and an application in Cali- ered when evaluating these proposals. This paper presents a methodology for estimating these impacts, including guidelines that should be considered during such an evaluation. A case study of an application in California indicates that the overall regional economic impacts of land retirement in agricultural areas will probably be negative, but the associated mitigating activities greatly reduce the magnitude of these impacts.

the British forest sector

Ian Gray (ProForest, UK) and Gareth Edwards-Jones (University of Wales, UK) Pages 303-312

A review of environmental statements in The results of a quality review of 89 environmental statements (ESs) pertaining to the British forest sector between 1988 and 1998 are presented. The standard of ESs was generally poor and they presented limited useful additional information to decision makers. A recurrent issue was the failure to adequately scope assessments, leading to unfocused baseline data collection, inadequate identification of impacts, and inappropriate or inadequate determination of impact significance. It is up to the Forestry Commission (competent authority) to bring about improvements by providing further guidelines, particularly on screening and scoping, and by introducing a consistent UK-wide ES review system for forestry projects.

and critical appraisal

Martin Birley (Shell International, The Netherlands)

Pages 313-321

Health impact assessment, integration There is little debate about what constitutes a good quality health impact assessment (HIA) or a good quality integration of health with environmental and social assessment (EIA, SIA). A critical appraisal process is required to assure the quality of each. The appraisal considers procedural and methodological components. It includes a comparison of the completed report with the terms of reference. It examines the competence and experience of the assessment team, the role of the steering committee and local community, the determinants of health, and the way in which integration is achieved. There are both parallel and sequential components to integration because the outputs of EIA and SIA are often inputs to HIA.

Impact Assessment and Project Appraisal

the international, refereed journal on trying to decide whether something is a good idea or not—from IAIA

All IAIA members receive this journal, and libraries can have it as a normal, subscription journal.

Integrating cumulative effects assessment into UK strategic planning: implications of the EU SEA Directive, W R Sheate (editor, *JEAPM* and Imperical College, UK) et al, March 2004.

Health impact assessment, integration and critical appraisal, Martin Birley (then at Liverpool School of Tropical Medicine, UK), December 2003.

Environmental indicator frameworks to design and assess environmental monitoring programmes, Tomás B Ramos (University of the Algarve, Portugal), March 2004. Exposing weaknesses in interactive planning: the remarkable return of comprehensive policy analysis in The Netherlands, Martin de Jong (Delft University, The Netherlands) et al, Dec 2003.

What's the alternative? Impact assessment tools and sustainable planning, John F Benson (editor, EIA Review), December 2003, with responses from people at University of East Anglia, Gifford and Partners, Thames Water, Transport and Road Lab, Oxford Brookes University, and others.

Plus case studies, and a regular Professional Practice section.

The practice of social impact assessment, two special issues edited by Rabel Burdge, June and Sept 2003, and including The carreer of SIA in a regional development bank, John Harrison (Winston-Salem, USA) et al; and

The social impacts of out-of centre shopping centres on town centres: a New Zealand case, Nick Taylor et al (Taylor Baines and Associates, NZ), and The practice of SIA in a developing country: a case in Bangladesh, Salim Momtaz (University of Newcastle, Australia), and Buy-in and social capital: byproducts of SIA, Dianne Buchan (Corydon Consultants Ltd, New Zealand).

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Professional practice

Environmental assessment of road alignments based on multicriteria scoping: a case study of Cairo—Ain Sukhna freeway

Khaled A Abbas

This research develops a multicriteria scoping framework by which alternative road alignments can be assessed, using the Cairo-Ain Sukhna freeway in Egypt as an example. Four alternative alignments were assessed using 60 comparative criteria covering technical, accessibility, economic and financial matters, development, safety and security, severance, social considerations, as well as natural and man-made environmental aspects. Baseline information was collected from maps, site visits and consultants' reports. A comparative analysis ranks the alternative alignments based on their potential impacts. Weightings, giving higher weights to environmental aspects, are applied to the rankings, and the best alternative is identified. The multicriteria scoping framework proved a sufficient tool for assessing alternative road alignments and for selecting the most environmentally preferable one.

Keywords: environmental assessment; road alignments; Egypt; mulitcriteria scoping

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T IS IMPORTANT for the economic and social development of societies to guarantee the efficient, effective and safe movement of people and goods through space and time dimensions. Transport mobility and accessibility are necessities for promoting sustainable growth. However, there are several deleterious outcomes resulting from the construction and operation of transport systems, namely congestion, increase in vehicle operating costs, energy consumption, and other environmental effects including traffic accidents.

It is widely acknowledged that transport systems have harmful impacts on the local, regional, national and global environments. These range from local air and noise pollution to harming the global life-support systems, consumption of non-renewable resources, endangering living conditions, deteriorating human health and causing safety problems. This entails planning, evaluation, design, construction, operation and maintenance of transportation infrastructure taking into consideration expected environmental issues.

This paper relates to developing a multicriteria scoping framework through which alternative road alignments can be assessed. The research demonstrates applicability of this process as a basis for selection of an environmentally preferable alignment for the Cairo—Ain Sukhna freeway in Egypt. This is based on comparing and assessing four alternative alignments using 60 comparative criteria, which are selected to cover technical, accessibility, economic and financial, development, safety and security, severance and social considerations as well as natural and man-made environmental aspects.

The research relies on available baseline information collected from maps, site visits and consultants' reports. A comparative analysis is used to rank the alternative alignments based on their potential impacts. This is followed by points weighting giving higher weights to environmental aspects. Such weightings are applied to the rankings and the best alternative is identified based mainly on its high scoring with regard to environmental friendliness as well as to other considered aspects.

Alternative alignments for the freeway

Several studies are required for road projects. The first is the assessment of alternative alignments. This is to judge the environmental feasibility of alternative alignments with reference to their effects on components of the physical, biological, ecological, cultural, social, and man-made environments. Such a study is based on conventional alignment analysis procedure as well as on an environmental impact assessment (EIA), and a final selection is made of a preferred corridor.

The second study required for road projects is that concerned with examining geometric and structural standards. An EIA would judge the environmental feasibility of such standards. Finally, a fully-fledged EIA ought to be carried out to assess the environmental feasibility of the various phases involved in transport infrastructure projects. These include pre-construction (mobilisation), construction, operation and maintenance phases. The main environmental effects, and their relative intensities, that could be considered for such phases are shown in Table 1.

Recently reviewed research shows that multicriteria analysis can be used to evaluate route alignments, (Sadek *et al*, 1999; Li *et al*, 1999) and to compare road improvement projects (Frohwein *et al*, 1999). It has also been used in combination with cost–benefit analysis to come up with an overall assessment of the impacts of transport initiatives over different geographical regions and time periods (Tsamboulas and Mikroudis, 2000). This paper suggests a multicriteria scoping framework by which an environmental assessment of alternative

alignments for roads can be conducted. The approach, depicted in Figure 1, consists of six main steps. These are applied to assessing alternative alignments of the Cairo–Ain Sukhna freeway. The steps are:

Step 1: Deciding on alternative alignments Ain Sukhna is an existing resort on the Red Sea towards the east of Cairo, the capital of Egypt. It is characterised by a number of existing and planned tourist and industrial developments. The Egyptian Ministry of Transport stipulated that the existing Cairo—Ain Sukhna road could not be assimilated into a freeway and that a completely new alignment should be established.

In this context, the Ministry of Transport via the General Authority for Roads, Bridges and Land Transport, sought proposals in 1998 in open competition from qualified bidders for a new freeway (approximately 115 km). The Cairo–Ain Sukhna freeway was selected in accordance with the current policy of the Government of Egypt to promote build, own, operate and transfer (BOOT) road projects.

The importance of this road lies in the following:

- The new Cairo City, currently under development, is located on the Cairo ring road and is very accessible to the starting point of the intended Cairo—Ain Sukhna freeway. This city is meant to act as a main pole for attracting population and relieving pressure from the capital.
- A new city named Al-Amal City is also planned for development at the Cairo end of the intended freeway, about 30 km from the Cairo ring road.
- The Suez new industrial area is currently developing at the other end of the intended freeway towards Ain Sukhna. This is meant to act as an exporting pole for Egyptian products.

Four major alternative alignments were considered for the new Cairo–Ain Sukhna freeway (see Figure 2). All considered options start from the same point from the Cairo end. Three of these run to the north of the existing road and the fourth runs to the south. Each ends at a different point in relation to the new Suez industrial area.

Table 1. Potential intensity of environmental effects due to road projects

| Main phases | Environmental effects | | | | | | |
|--------------|-----------------------|-----------------|-----------------|-------------|-----------|---------------------|----------------------|
| | Air pollution | Sound pollution | Water pollution | Solid waste | Vibration | Visual intrusion | Traffic accidents |
| Mobilisation | High | High | Low | Low | High | None | Low |
| Construction | High | Very high | High | High | Very high | None | Low |
| Operation | Very high | High | High | Very high | High | High | High |
| Maintenance | High | Very high | High | High | Very high | High | High |

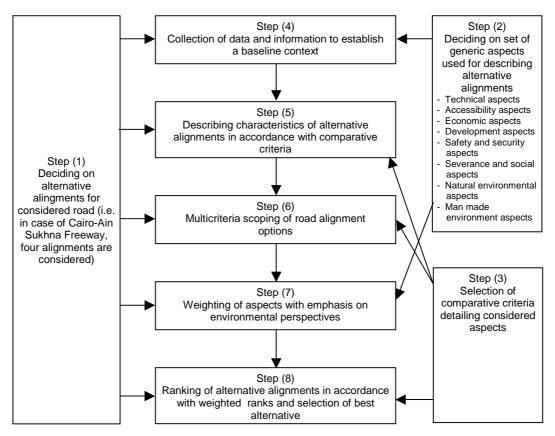


Figure 1. Multicriteria scoping framework for assessing alternative road alignments

Step 2: Deciding on a set of generic aspects Eight generic aspects were selected as constituting the main ingredients for ensuring the sustainability of the considered alignments. These included technical, accessibility, economic and financial, development, safety and security, severance and social, as well as natural and man-made environmental aspects. These were used to describe the alternative alignments. It is worth noting that the biological aspect was not included because of a lack of relevant baseline data.

Step 3: Selection of comparative criteria More than 60 comparative criteria were selected in an effort to detail the eight considered aspects describing alternative alignments (see Table 2).

Step 4: Collection of data to establish a baseline Data and information that were considered necessary for comprehensively assessing the possible impacts of alternative alignments were collected by means of site visits accompanied by thorough inspection of maps. Baseline information included:

- start and end points of considered alignments
- topographical information
- drainage and geology
- committed and planned development
- major utilities
- land use and availability.

Figure 3 shows details of existing natural and manmade environments in the vicinity of the considered alternative alignments. Step 5: Describing characteristics of alignments This step aimed to describe characteristics of alternative alignments. This involved examining all data and information collected to provide baseline data. Alternative alignments were judged in accordance with the 60 comparative criteria (see Table 2). Cells of the table were completed to reflect the judgement of alternatives in relation to each other.

Step 6: Multicriteria scoping of options For each of the considered criteria, comparative scoping was conducted to rank the alternative alignments horizontally based on their specific potential impacts (see Table 2). Rank 1 represents the best alternative in relative terms, while rank 4 represents the worst. This was followed by vertical scoping of all criteria representing a specific aspect. Overall judgements of alternative alignments with respect to each of the eight generic aspects were decided based on the accumulation of individual ranks given to the criteria describing that aspect.

Step 7: Weighting emphasising the environment The eight aspects were given different weighting points. It has to be noted that environmental and social aspects were intentionally given higher weights to bias them in relation to the other aspects, which are mainly economically related (see Table 3). Economically related aspects are assessed using costbenefit analysis, which attaches monetary values to perceived costs and benefits. Cost-benefit analysis is limited when it comes to attaching monetary values to social and environmental aspects. In this

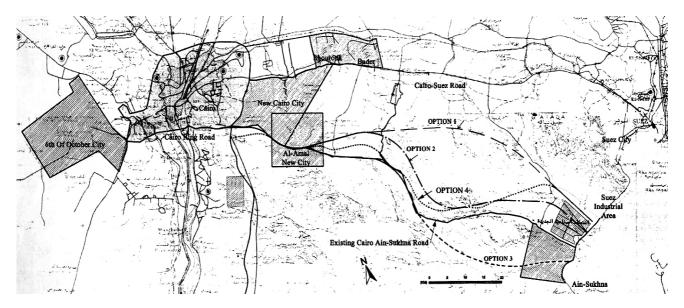


Figure 2. Four alternative alignments considered for Cairo Ain-Sukhna Freeway Source: Adapted from UGHD (1999)

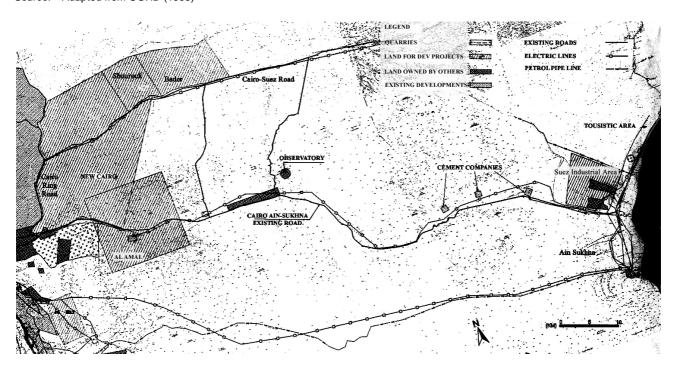


Figure 3. Natural and man made environments in vicinity of Cairo Ain-Sukhna freeway alternative alignments Source: Adapted from UGHD (1999)

context, the proposed multicriteria scoping approach is meant to act as a support to cost—benefit analysis. Still, with the benefit of hindsight, it might have been better to elicit such weightings from experts and decision-makers involved in this project using a Delphi approach.

Step 8: Ranking in accordance with weighted ranks Weightings were applied to the rankings given. Based on weighted ranks, a new rank order for the considered alignments was obtained. The best alternative, in terms of the chosen weights, could then be identified. This would be the alternative that scored high in most of the aspects and particularly the environmentally related ones. It can be seen from Table 3 that

alternative 4 achieved the highest weighted score of 82.5. This can be considered, from an environmental perspective, as the best alignment in relative terms.

It is obvious that two of the three alignments to the north of the existing road scored higher than the alignment considered to the south of it. It is also clear that the alignment that swept far to the north into desolate territory, where it is difficult and costly to provide infrastructure, had no advantage over routes closer to the existing road. The sweep to the north increased the overall length of the road, thus increasing construction and user costs. Drainage provision is also expected to increase as the alignment moved further north.

The available land in the new Suez industrial area

| | Alternative alignments | | | | |
|---|---|--|---|--|--|
| Comparative criteria | Alternative (1) mostly far north of existing road ending towards edge of new Suez industrial zone | Alternative (2) north of existing road and penetrating new Suez industrial zone | Alternative (3) south of existing road | Alternative (4) in proximity to existing road, ending towards edge of new Suez industrial zone | |
| (1) Technical aspects Total length Route directness based on map visual inspection | Longer (3) Mostly direct (1) | Long (2) Number of directional changes (3) | Longest (4) Mostly direct (2) | Shortest 115 Km (1) Number of directional changes (4) | |
| Terrain of road Availability of construction materials | | Mostly flat (1) Available in nearby | Relatively difficult (hilly sections) (3) Available in far | Mostly flat (1) Available in nearby | |
| (sand, gravel, limestone, etc) Rail road crossings Crossing points for main existing roads | quarries (3) None Almost none (1) | quarries (1) None Few (3) | quarries (3) None Almost none (1) | quarries (1) None Few (3) | |
| Crossing points for secondary roads Drainage provision | Lot of construction works due to a no. of | Almost none (1) Relatively less construction works (2) | Almost none (1) Lot of construction works due to a no. of | Almost none (1) Least construction works in relative terms (1) | |
| Relocation of existing utilities | wadi formations (3) Far from existing road, hence minimum utilities relocation (1) | Near existing road, hence high potential for relocation of existing utilities (3) | wadi formations (3) Far from existing road, hence minimum utilities relocation (1) | Near existing road, hence high potential for relocation of existing utilities (3) | |
| Overall ranking of technical criteria | 2 | 2 | 4 | 1 | |
| (2) Accessibility aspects Start point (connection) | Connection to New Cairo (ring road) (1) | Connection to New Cairo (ring road) (1) | Connection to New Cairo (ring road) (1) | Connection to New Cairo (ring road) (1) | |
| End point (connection) | North boundary of new Suez development zone (2) | Penetrates new Suez development zone (1) | South of new Suez development zone (4) | North boundary of new Suez development zone (2) | |
| Linkage to existing road network in the area (Cairo side) Linkage to existing road network in the area (Ain Sukhna side) | Connecting to ring road (1) Connecting to Suez– Ain Sukhna coastal road (1) | Connecting to ring road (1) Connecting to Suez– Ain Sukhna coastal road (1) | Connecting to ring road (1) Connecting to Suez– Ain Sukhna coastal road (1) | Connecting to ring road (1) Connecting to Suez–Ain Sukhna coastal road (1) | |
| Linkage to existing road network in the area (existing Cairo–Ain Sukhna road) Accessibility to existing | Long connections to existing Cairo–Sukhna road (3) Relatively low (3) | Shorter connections to existing Cairo–Sukhna road (1) High (1) | Long connections to existing Cairo–Sukhna road (3) Relatively low (3) | Shorter connections to existing Cairo–Sukhna road (1) High (1) | |
| developments along existing Cairo –Ain Sukhna road Overall ranking of accessibility criteria | 3 | 1 | 4 | 2 | |
| (3) Economic/financial aspects Expropriation costs | Low as far from developments on existing road (1) | Some potential to pass through existing developments (3) | Low as far from developments on existing road (1) | Some potential to pass through existing developments (3) | |
| Construction costs | Hilly terrain & long (3) | Relatively flat & shorter (2) | Hilly terrain & long (3) | Relatively flat and shorter (1) | |
| Drainage costs Maintenance costs based on distance/terrain | Very high (3) (3) | High (1) (2) | Very high (3) (3) | High (1) (1) | |
| Environmental costs during operation (traffic emissions & noise) | Based on distance & terrain (3) | Based on distance & terrain (2) | Based on distance & terrain (3) | Based on distance & terrain (1) | |
| Users' financial costs Kilometre based tolling, vehicle operation costs (VOC) & travel time costs (TTC) | (3) | (2) | (3) | (1) | |
| Users' economic operation costs based on distance and terrain (VOC & TTC) | Increase in VOC and time costs (3) | Relative savings in VOC and time costs (2) | Increase in VOC and time costs (3) | Relative savings in VOC and time costs (1) | |
| Overall ranking of economic/financial criteria | 3 | 2 | 3 | 1 | |
| (4) Development aspects Agriculture development potential Industrial development potential | Low possibility Potential (3) | Low possibility High potential (2) | Low possibility Potential (3) | Low possibility Highest potential (1) | |

(continued)

Table 2 (continued)

| Comparative criteria | Alternative (1) mostly far north of existing road ending towards edge of new Suez industrial zone | Alternative (2) north of existing road and penetrating new Suez industrial zone | Alternative (3) south of existing road | Alternative (4) in proximity to existing road, ending towards edge of new Suez industrial zone | |
|--|---|--|--|--|--|
| | High potential (1) | High potential (1) | High potential (1) | High potential (1) | |
| of road Housing development towards end of road | High potential (1) | Potential (3) | Potential (3) | High potential (1) | |
| Housing development along route Tourism development at start & along road | Low potential (3) Low potential | Potential (1) Low potential | Low potential (3) Low potential | Potential (1) Low potential | |
| | High potential (1) | Low potential (4) | High potential (1) | High potential (1) | |
| Commercial/recreational development towards start of road | High potential (1) | High potential (1) | High potential (1) | High potential (1) | |
| Commercial/recreational development towards end of road | Potential (1) | Low potential (4) | Potential (1) | Potential (1) | |
| Commercial/recreational development along road | Low potential | Low potential | Low potential | Low potential | |
| Mining development at start & end of road | Low potential | Low potential | Low potential | Low potential | |
| Mining development along road Overall ranking of development criteria | Potential (1) 2 | Potential (1) | Potential (1) 3 | Potential (1) 1 | |
| (5) Safety and security aspects Traffic safety based on directness & desolation | (1) | (3) | (1) | (3) | |
| Security | North desolate territory (4) | Vicinity of existing Cairo–Sukhna road (1) | South desolate territory (3) | Vicinity of existing Cairo–Sukhna road (1) | |
| Flash flood | susceptible to flooding (3) | minimum susceptibility to flooding (1) | wadi plain & more susceptible to flooding | less susceptible to flooding (2) | |
| Overall ranking of safety & security criteria | 3 | 1 | (4) | 2 | |
| (6) Severance & social aspects Destruction/removal of man-made culture | Limited | Limited | Limited | Limited | |
| Passing through/adjacent to ceme- teries (near Cairo side) | -Yes (4) | Yes (4) | Yes (4) | Yes (4) | |
| Human resettlement Split of communities Employment opportunities Overall ranking of severance & social criteria | Minimum if any (1) Split of Al Amal City Yes (1) 1 | Minimum if any (1) Split of Al Amal City Yes (1) 1 | Minimum if any (1) Split of Al Amal City Yes (1) 1 | Minimum if any (1) Split of Al Amal City Yes (1) 1 | |
| (7) Natural environment aspects Passage through wadis Sections build on unused land Sections build on existing road tracks | Passing many catchment areas (3) mostly (1) NA | Passing about 70 catchment areas (1) most (3) some link roads (1) | Passing many wide catchment areas (4) mostly (1) NA | Passing about 70 catchment areas (1) most (3) some link roads (1) | |
| Land take | Minimum (1) | Minimum (3) | Minimum (1) | Passage through owned | |
| Fuel energy consumption (based on distance & terrain) | High travelled kilometres per journey (3) | kilometres per journey | High travelled kilometres per journey (3) | land (3) 115 travelled kilometres per journey (1) | |
| Exhaust emissions during operation (air quality) | Longest road & more travelled kilometres (3) | (2) Longer travelled kilometres per journey (2) | Longest road and more travelled kilometres (3) | Travelled kilometres per journey 115 km (1) | |
| Exhaust impact during operation | Desolate area and ends north of Suez industrial area (2) | Vicinity of existing road ending inside Suez industrial zone (4) | Desolate area and ends north of Suez industrial area (1) | Vicinity of existing road ending north of industrial zone (3) | |
| Noise emissions during operation | Longest road & more travelled kilometres (3) | Longer road & travelled kilometres per journey (2) | | Travelled kilometres per journey 115 km (1) | |
| Noise impact during operation | Desolate area and ends north of Suez industrial area (2) | | Desolate area and ends north of Suez industrial area (1) | Vicinity of existing road ending north of industrial zone (3) | |
| Visual intrusion for travellers on proposed & existing Cairo–Ain Sukhna roads | Minimum (1) | Maximum due to penetration of Suez industrial zone (4) | Minimum (1) | Maximum (3) | |

(continued)

| Comparative criteria | Alternative (1) mostly far north of existing road ending towards edge of new Suez industrial zone | Alternative (2) north of existing road and penetrating new Suez industrial zone | Alternative (3) south of existing road | Alternative (4) in proximity to existing road, ending towards edge of new Suez industrial zone |
|---|---|--|--|--|
| Visual intrusion for man made settlements | Minimum (1) | Maximum due to penetration of Suez industrial zone (4) | Minimum (1) | Maximum (3) |
| Water quality of wadis | | Affected by construction | | Affected by construction of crossing structures (1) |
| Soil contamination due to traffic emissions, spillage and erosion | Minimum (3) | Minimum (2) | Minimum (3) | Minimum (1) |
| Overall ranking of criteria related to natural environment | 3 | 4 | 1 | 1 |
| (8) Man-made environmental aspe | ects | | | |
| Passing adjacent to military sites | Far (1) | Yes (3) | Far (1) | Yes (3) |
| Passing through/adjacent to industrial areas | No (1) | Yes (adjacent to three cement companies) (3) | No (1) | Yes (adjacent to three cement companies (3) |
| Passing through/adjacent to residential developments | Yes Al Amal City | Yes Al Amal City | Yes Al Amal City | Yes Al Amal City |
| Passing through /adjacent to quarries | No (1) | Yes (through) (4) | No (1) | Yes (adjacent) (3) |
| Passing adjacent to garbage areas | No (1) | Yes (3) | No (1) | Yes (3) |
| Passing adjacent/over pipelines | No (Far) (1) | No (far) (1) | Yes (near) (4) | No (far) (1) |
| Passing under existing high voltage electrical transmission lines | No (1) | Yes (3) | No (1) | Yes (3) |
| Overall ranking of criteria related to man-made environment | 1 | 4 | 2 | 3 |

also influenced approach alignments to Ain Sukhna. Southern approaches to the region could not penetrate industrial areas under development and had the additional burden of being located in a wadi plain that is susceptible to flooding. Northern alignments seemed more favourable generally in terms of providing better opportunity to acquire suitable land for more development projects close to existing development proposals.

Conclusions

This paper was mainly concerned with adapting the EIA process into a multicriteria scoping framework by which an environmental assessment of alternative alignments for roads can be conducted. The adapted approach consists of eight steps. These were applied to assess alternative alignments of the Cairo–Ain Sukhna freeway in Egypt. This freeway

is meant to act as an alternative parallel to the existing Cairo—Ain Sukhna road connecting the capital Cairo, the new city of Cairo, and the planned Al Amal city to the new Suez industrial zone located at Ain Sukhna on the Red Sea.

The approach started by deciding on four major alternative alignments for the freeway. This was followed by deciding on a set of generic aspects to be used for describing these alignments. These included technical, accessibility, economic and financial, development, safety and security, severance and social, as well as natural and man-made environmental aspects. In the third step more than 60 comparative criteria were selected in an effort to detail the eight aspects describing alternative alignments. This was followed by collection of data and information that were considered necessary for comprehensively assessing the possible impacts of the considered alternative alignments.

The fifth step was concerned with examining and

Table 3. Relative weightings for generic aspects characterising alternative alignments

| Generic aspects | Relative weightings | Alternative (1) | Alternative (2) | Alternative (3) | Alternative (4) |
|---------------------------------|------------------------|--------------------|-----------------|--------------------|--------------------|
| Technical aspects | 10 | 2 | 2 | 4 | 1 |
| Accessibility aspects | 10 | 3 | 1 | 4 | 2 |
| Economic & financial aspects | 10 | 3 | 2 | 3 | 1 |
| Development aspects | 10 | 2 | 4 | 3 | 1 |
| Safety and security aspects | 10 | 3 | 1 | 3 | 2 |
| Severance & social aspects | 15 | 1 | 1 | 1 | 1 |
| Natural environment aspects | 15 | 3 | 4 | 1 | 1 |
| Man-made environment aspects | 15 | 1 | 4 | 2 | 3 |
| Final score (weighted rankings) | 100 | 67.5 | 60 | 61.25 | 82.5 |

Note: Rank 1 = 1, Rank 2 = 0.75, Rank 3 = 0.5, Rank 4 = 0.25

scrutinising all collected data and information and presenting, in a tabular format, the judgement of alternatives in relation to each other. This was followed by a multicriteria scoping of road alignment options, where for each of the considered criteria, comparative scoping was conducted to rank the alternative alignments based on their specific potential impacts. Overall ranks for each aspect were then produced based on the accumulation of individual ranks given to the criteria for that aspect.

In step seven, weighting of aspects, with emphasis on environmental perspectives, was conducted. This was followed by applying the weightings to the overall ranks and obtaining a weighted score for each alternative alignment. Based on this approach, it was concluded that alternative alignment 4 achieved the highest weighted score of. 86.25. This can thus be considered as the best environmental alignment for the freeway.

Finally, it can be concluded that the multicriteria scoping framework, suggested in this research, proved a sufficient tool for assessment of alternative road alignments as well as a basis for making decisions pertaining to selecting the most environmentally preferable alignment.

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