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Hosting Mega Event - Drive towards Sustainable Planning for Public Transport - Case Study: Metro Line Route 2020

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Abstract

Hosting mega event is an opportunity for hosting country to attract investment in construction of new building and facilities required for the event and upgrading of its infrastructure and transportation network. This research paper explores the conceptual elements adopted by Roads & Transport Authority of Dubai to deliver the effective planning of an environmentally sustainable public transport system that is required for hosting Dubai Expo 2020. During the planning phase of new transportation metro railway line, ridership and continuity of the service after event period, which will last for only 6 months from Oct 2020 to April 2021, was the main focus in the selection process of route alignment. The selected route alignment for new line provides a mass transportation solution for existing and new development areas in addition to Dubai Expo site. It is envisaged that Expo 2020 will become a catalyst for new development in a previously underdeveloped part of Dubai's metropolitan area, and the new metro railway line is of intrinsic importance in underpinning the long-term vision for this urban area. Different alignment options were examined against selection criteria that consisted of the following elements: transportation & future developments or transit oriented development (TOD), route insertion, constructability and sustainability to ensure integration within existing and future urban areas.

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1. Introduction

Mega-events such as the Olympic Games, FIFA World Cup or World Fair EXPO are large-scale events that draw the interest of massive numbers of people from all walks of life. They are intended to encourage local and regional economic development by attracting investment, tourism and media attention for the host city. Host cities generally attach great importance to factors such as the event's economic implications, event-related income, urban development and regeneration, building and upgrading infrastructure, providing a transportation system capable of transporting the expected numerous visitors to and from the event location and the development of tourism.
Hosting a mega event is a great opportunity for the hosting country to foster development and raise its international profile, as the event enhances its reputation and most crucially, accelerates the improvement of infrastructure, transportation networks, housing capacity and related urban development. Moreover, it generates employment (both during the event and post event) and improves the global business and investment environment of the country. Many researchers stated that most cities, countries and regions aim to make strategic use of mega-events to develop infrastructure and push urban renewal, often through leveraging funds that would not be available otherwise (Grix, 2013), (Hiller, 2000), (Hiller, 2000) & (Smith, 2012). Often these funds can be leveraged from beyond the local jurisdiction to include national and sometimes international support.

2. Mega Events: Definition and Classifications

The term 'mega-event' appeared fairly recently in academic studies and its first use can be traced to the 37th Congress of the Association Internationale d'Experts Scientifiques du Tourisme in Calgary in 1987 with the theme 'The Role and Impact of Mega-Events and Attractions on Regional and National Tourism Development' (Müller, 2015).

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The multi-billion-dollar spending on mega-events has an immediate impact on host cities and regions, on both population and the built environment. These impacts can be seen in hosts constructing or upgrading stadia, conference facilities, roads, railway and metro lines and hotels or power stations. Different types of facilities, building, and infrastructure are required for different types of mega event. Hence, this will determine, or at least influences, the type of investment responses. For example, sports events (i.e. World Soccer Cup and the Olympics) will have a focus on sports facilities and the infrastructure needed to support the functioning of those sports venues, whereas, expos are more culturally based and nuanced to suit more generalised community needs and interests.

Martin Müller in his (Müller, 2015) tried to address the question 'What is a mega-event, he stated that the distinction between an event and a mega-event is essentially one of size. Müller referred to a systematic approaches adopted by previous researchers to defining the term mega event and distinguish between different events in term of size based on a multi-dimensional, point-based classification model to distinguish between different size scale events. The approach consisted of four key dimensions namely: visitor attractiveness; mediated reach; cost; and transformative impact.

As for visitors' attractiveness, some researchers have defined mega-events primarily as tourist attractions (Ritchie & Yangzhou, 1987). Other have suggested a minimum of one million visitors to make an event qualify as a mega-event (Marris, 1987). Measuring the number of visitors directly is difficult. In the absence of primary surveys, the number of tickets sold can be a proxy for estimating attendance for ticketed events (Ritchie & Yangzhou, 1987).

When comparing the cost and volume for media coverage of a recent and old mega event, it is notably increased in recent events. From Montréal 1976 to London 2012, the value of broadcasting rights for the Summer Games has risen from USD 34.9 million to USD 2569 million in nominal terms or almost 23 times in real terms. This is striking

testimony to the evolution of the global attention economy, but also to the commercialisation of large events. (Müller, 2015)

Organising mega-events placed massive fund demand as they typically cost hundreds of millions if not billions of US dollars. That is, money that goes into infrastructure required for hosting the event, such as transport or venues, but also into the cost of organising the event itself, such as salaries, temporary overlays or security. Associated with cost is complexity.

3. Impact of Mega Event on Hosting City: Previous Examples

A mega event as large-scale global event typified by mass popular appeal and global significance is a potential opportunity to catalyze major urban redevelopments and could impact the environment, economy and sustainability of future development of the hosting city. Researchers have stated that hosting a mega event provides an incentive and opportunity for city elites to restructure their cities in an increasingly competitive environment. The mega event have often been described as a lucrative tool for place promotion and marketing and as a key link between the local and the global (Surborg, et al., 2008) and (Short, 2008). For instance, South Korea is an example of utilizing the opportunity of hosting a mega event as effective pathways to mega urban redevelopment (i.e. such as developing a new national capital Songdo) in a tight timeframe. China has examples of this approach being taken as well.

Since mega events are tightly interwoven with urban economies and urban development or redevelopment schemes, the ways in which cities harness a mega event and create their own legacy can best be understood by looking at their motives, the type of legacy that they anticipate and the implementation processes that connect the vision with the expected results (Chen & Spaans, 2009).

Owing to its use of the Olympic legacy, increased capital flows and its improved attractiveness as a city, Barcelona was able to boost its economic growth, enhance its image and transform itself into a globally competitive city. Barcelona's success is one indication of the significance that the Olympic Games can have for urban development practices and urban policy in host cities, and, equally, the importance of understanding the Olympic Games from an urban development perspective (Chen & Spaans, 2009).

One could emphasis that the interesting aspect of a city such as Barcelona is that it was always popular with tourists as a "must see" destination in Spain. In this context, a question could be raised whether the city could have planned and managed equally well with alternative tourism marketing strategies if it had not hosted the Olympic Games

When the legacy concept is not properly addressed in the planning phase for a mega event, the hosting city will invest capital in under-utilized developments and infrastructures, such as was the case of Montreal's 1976 Summer Olympic Games, where the mega event saddled government with massive debts and creating potential urban blight with under-utilized assets or white elephants.

In Sydney, host of the 2000 Summer Olympics, the Games were a significant catalyst for urban infrastructure development around the region. Beside the direct investments made for the Games, the indirect investments after the Olympic Games were expedited. These improvements included better transport connectivity including a new local railway line with a railway station and a major capacity expansion scheme to its airport, Kingsford Smith International, as well as capacity improvements at its main rail hub, Central Station (Richter, 2012).

The 2000 Summer Olympics Games reinvigorated and rehabilitated a part of Sydney that was largely brownfield land with little appeal to the community, so that was certainly is a lasting legacy of the Games. However, it is worth noting that the Homebush Bay site is not quite what the State Government wanted it to become with it being unable to capitalize on tourism and only achieving partial success in transitioning itself to an office park precinct. Besides, many of the sporting facilities were surplus to requirements post Olympics, and the Olympic Stadium was downscaled immediately after the Games and is now planned to be replaced with a new up-to-date stadium.

Athens, host of the 2004 Summer Olympics, had transport issues that were significantly different from Sydney's. Athens is an ancient city with a dense urban form. It also did not have much of the tertiary structure that is necessary to handle the increased demands of an Olympic Games. Due to the city's urban form and a lack of large parcels of available public land, Athens had to spread out its Olympic venues across the Attica Plain. This was problematic due

to the notorious traffic congestion facing Athens and the limited existing public transport infrastructure within the city. Thus, by agreeing to host the Olympic Games, Athens embarked on a large scale of transport investment. The direct and indirect investments in transport infrastructure included a new international airport, two metro lines, a tram system, and a suburban railway. All of these infrastructure improvements were built with the goal of making transport more efficient during the Olympic Games (Richter, 2012).

London's model for urban development was similar to Sydney. It had an area ripe for regeneration at Stratford. London also had transport connections near the site of the Olympic Park but needed significant investment in public transportation infrastructure to make the site accessible. The Olympic Village was also adjacent to the Olympic Park, in a similar arrangement to that found in Sydney. However, the similarities between the two cities end there. London had a much more complex set of existing transport infrastructure already in place when the Olympic Park was developed. The success that was the key for London's 2012 Plan was to arrange and maximize the efficiencies of its transport infrastructure to serve the Games and assist in regenerating the area around the Olympic Park in Stratford afterwards (Richter, 2012).

4. The Demand for Urban Development and Transportation Infrastructure Required by Hosting Mega Event

It is widely recognized that hosting a mega event will place critical demands on urban development, its transport system and other infrastructure. Often, this will require improving existing infrastructure systems by adding new physical infrastructure and/or upgrading the capacity of the existing systems. Therefore, a mega event is considered as a great opportunity for local authorities to provide a catalyst for initiatives that will reshape and update the city with the latest modern technologies and policies. In fact, without the catalyst of a mega event, the investment in urban development and adding new infrastructures or upgrading existing urban development would not be financially or politically possible.

In a dynamic and fast-growing world, the demand for urban development, availability of transportation, provision of accessibility and flexible connectivity are vital for people to maintain business continuity, a high-quality lifestyle and addressing the growing needs for communities and cities. However, there are substantial challenges and obstacles hindering the achievement of this demand. One of the major obstacles is a risk of global warming due to increased urban development and its associated greenhouse gas emissions. Hence, innovations for new thoughts and concepts in urban and transportation planning is indeed required to overcome the obstacles or minimize the impacts and provide an environmentally sustainable basis for the continual development and growth of cities.

Urban development and regeneration by redeveloping previously undeveloped or degraded land to a higher urban land use intensity with the provision of integrated transport system will assist in improving the welfare of people. This can be achieved by providing efficient, timely and flexible mobility and connectivity, improving the design of the urban environment, and more effective control of the use of land and protection and enhancement of the natural environment. Nevertheless, there are certain challenges that have to be addressed, such as, managing the interface and interests of different stakeholders, the requirements for land, expropriating land and the relocation of people due to claiming the required land for the event and urban development activities.

Chalkley and Essex (Chalkley & Essex, 1999) stated that different cities have shown increased interest in the idea of promoting urban development and change through the hosting of major events. This approach offers host cities the possibility of 'fast track' urban regeneration, a stimulus to economic growth, improved transport and cultural facilities, and enhanced global recognition and prestige.

The Olympic Park site at Stratford, London is one of best examples of an urban regeneration initiative and a sustainable development that resulted from hosting the 2012 Olympic Games in London (Richter, 2012). The land of the Olympic park was used as landfill after the 2nd World War bombing of London, and was compromised by poor drainage issues, with utility and transport infrastructure crisscrossing the site resulting in its functional fragmentation. The objective of using the Stratford site was to provide quality infrastructure: the value of the site and its surrounding areas was to be improved socially, physically and economically.

Due to its necessity and importance, transportation infrastructure has become an essential component of successfully hosting a mega event. Transportation infrastructure will provide easy access and mobility to the large volume of visitors and the event's associated logistics; therefore, the organizer/s seek to make their mega event as efficient as possible with the provision of an integrated urban transport network. Additionally, it becomes obvious that

when examining previous mega events over the last few decades, many of the host cities have tried to choose sites, which were underutilized, or brownfield sites. Often these sites are the only large sites within the central city that is suitable for the venues as seen in different places such as Homebush Bay in Sydney, Helliniko Airport in Athens, and Stratford in London. In all cases, some transportation infrastructure may have been in place, yet it was derelict or obsolete, or underutilized or inefficiently serving the site.

5. Transit-Oriented Development a Sustainable Approach for Urban Planning

Transit-oriented development (TOD) is defined as an approach to provide efficient integration between public transportation systems and urban development by maximizing the amount of residential, business and leisure space within walking distance of public transport hub and enrich the use of public transport systems. In other words, the TOD concept can be defined as mixed-use development around the transit stop or station within certain radius of affordable walking distance e.g. 400 to 800 metres. The conceptual basis of the TOD focuses on dense, compact, mixed-use neighbourhoods with vibrant streets and integrated transport system and safe public spaces for social interaction. (Curtis, et al., 2009) (Curtis & Scheurer, 2016).

Different benefits can be achieved from adopting transit-oriented development in urban and transport planning, such as: optimizing the economical use of land value, enhancing the aesthetic value of the built environment, encouraging public transportation ridership and decreasing car dependency through creating walking-friendly environment, attracting complementary land uses, increasing urban densities, maximizing populated ridership catchments and introducing affordable housing.

6. Planning for Dubai Metro Extension Route 2020 Required for Expo Site

The existing railway network of Dubai is located far from the EXPO 2020 site, and there is no public transport system available to connect the Expo site with the existing Dubai railway network. In fact, the location is yet to be developed. Therefore, different alignments were looked at to obtain a sustainable transport solution to link EXPO 2020 site with railway network. The alignment options were studied are shown in figure 1 below.

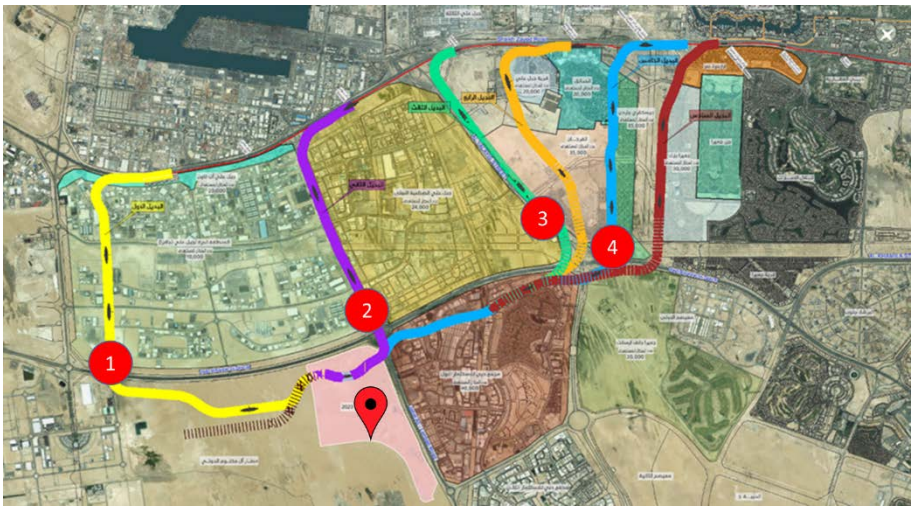

Fig. 1. Alignment options for route 2020 metro extension toward Expo 2020 site [Roads & Transport Authority Dubai].

The existing railway network of Dubai consisted of two transit systems Dubai metro and Dubai tram. Dubai metro (red & green lines) is a driverless system runs for about 75 km with total number of 47 stations. The major part of Dubai metro runs in an elevated section, whilst, the underground sections of the two lines are in the central business district (CBD) of Dubai. There are two transfer underground stations between the red line and green line at Union

Square and Burjuman. The length of Dubai tram is approximately 11km with 11 stations. The Dubai Tram is connected with Dubai metro red line via footbridge at two stations, Dubai Marina station and Jumeirah Lake Towers JLT station as shown in figure 2 below.

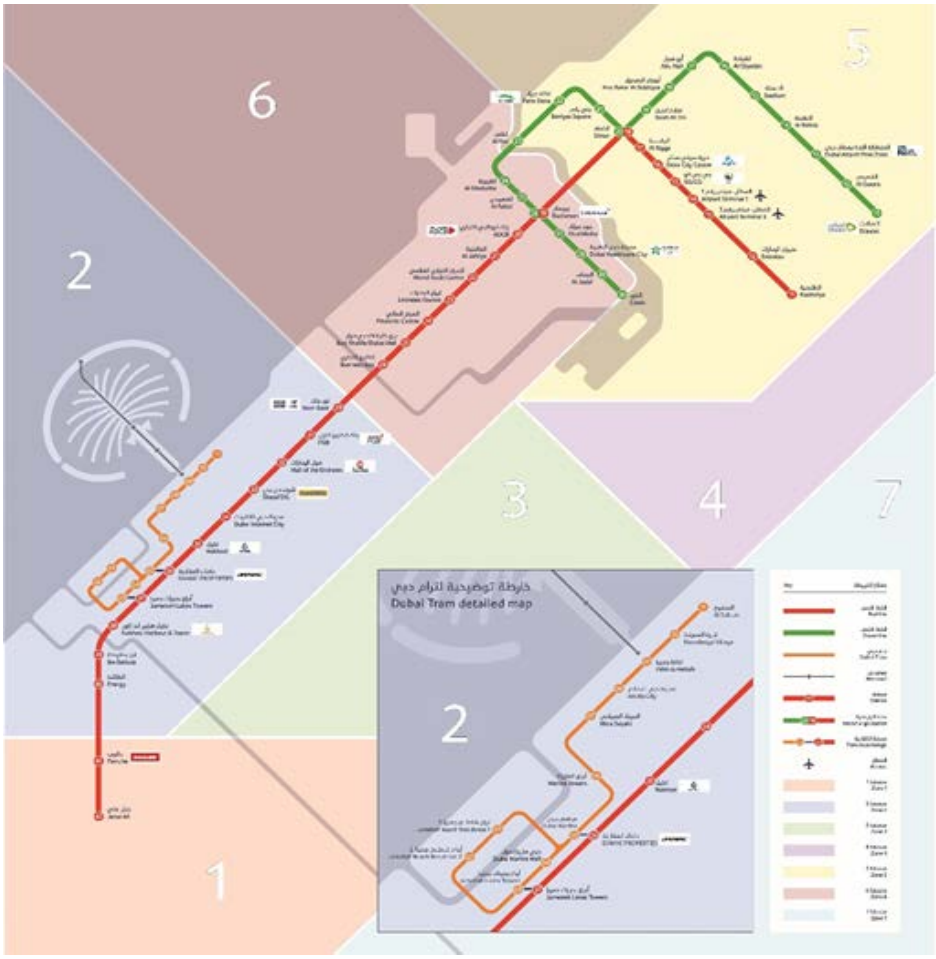

Fig. 2. Dubai railway network [www.rta.ae]

The planning of the route plays a key part with potential opportunities to serve major developments, whether new or existing, along its route. The current transportation model adopted by RTA Dubai is used to produce reliable passenger ridership forecasts for defining key system parameters and station sizing. The model was updated incorporating the most recent forecasts for EXPO 2020 rail passengers, including planning data from the local land authority and the major developers within the study area.

7. Alignment Options

The main objective of this research paper is to present the work performed to identify the optimum and feasible new metro line route to connect the existing Dubai Metro Red Line to serve the EXPO 2020 site and existing and potential developments along the route and connecting more people to the Dubai transit network. To address this objective, four alignment options (as shown in figure 1) were chosen to be examined against the adopted evaluation criteria by Roads and Transport Authority of Dubai and agreed with major stakeholders and developers that consisted of following elements to find out the potential alignment insertion option: Transportation & Future Developments,

Route Insertion, Constructability and Sustainability. The four alignment options are listed in the table below with summary against each one.

Table 1. Summary of Studied Options

Section	Option 1		Option 2		Option 3		Option 4	
	Length	Stations	Length	Stations	Length	Stations	Length	Stations
Elevated	9.0 km	4	12.86 km	2+Airport	8.1 km	3	11.5 km	5
Tunnel	-	-	-	-	6.3 km	2	3.5 km	2
Total	9.0 km	4	12.86 km	2+Airport	14.4 km	5	15.0 km	7
Remarks	Including a length of about 300m required to connect with Existing Red line		At grade for a length of 500m at the beginning of the Alignment		Including a length of about 375m required to connect with Exist. Red line		Includes length of about 940 m required to connect with Exist. Red line	

8. Alignment Evaluation Criteria

Each of the proposed alternative alignments were assessed and scored from 1 to 5 based upon each sub - criteria below and weighted with their respective technical importance, a score of 5 being the highest and a score of 1 being the lowest. The following criteria are identified for the evaluation of the proposed Alignments.

1. Transportation & Future Developments,

2. Route Insertion,

3. Constructability,

4. Sustainability

8.1. Transportation & Future Developments

Table 2. Alignment Evaluation Matrix of Transportation & Future Developments

SN	Sub Criteria	Weight of sub criteria	Options			
			1	2	3	4
1	Passenger Ridership Projections	30%	1	3	4	5
2	Travel Time to EXPO/DWC	20%	3	1	4	5
3	Multimodal Integration	10%	1	2	3	5
4	Station Catchment Area - Existing Development	10%				
5	Station Catchment Area - Future Development (TOD)	30%	4	1	5	5
Score (Weighted)			2.5	1.7	4.2	5
Score (Out of 100)			50	34	82	100

The evaluation criteria related to transportation and future development are measured again certain factors listed below:

- Passenger Ridership Projections - This factor accounts for the volume riders, which each Alignment may attract.
- Travel time to EXPO - This factor assesses travel time from existing Red Line to EXPO 2020.
- Multimodal Integration - The ability to transfer from one mode of transit (i.e., Rail, Bus, Car & Taxi) to another.

- Station Catchment Area for Existing Developments - The population density of the areas in existing developments within close proximity of the Stations.
- Station Catchment Area for Future Developments based on Transit Oriented Developments (TOD) - The population density of the areas in future developments within close proximity of the Stations, and the opportunities for Transit Oriented Developments (TOD).

8.2. Route Insertion

The potential route was assessed against the difficulty or easiness of route insertion based on the following factors:

- Availability of a Right of Way (ROW) - This factor evaluates the availability of a corridor for the proposed Alignment that has minimum impact on the existing utilities and private lands and existing buildings. This corridor can be within an existing road ROW, a new or existing development. Acquisition of privately held land and the demolition of existing development are also considered.
- Route Quality - This factor assesses the quality of the ride experienced by the passengers. The number and the radii of horizontal curves including the applied minimum curve along the Option route and existence of future constraints that may lead to reduce the value of these curves are taken into account. It also classifies the effect of the Option route on its profile with respect to the variation from one level to another and if this variation lies in a straight or curved horizontal Alignment.
- Station location consideration - The Station implementation criterion classifies the possibility of the applied Option to provide straight stretches of sufficient length and proper slope to allow the implementation of the Stations at desirable locations.
- Conflicts with Roads/Interchanges - This factor evaluates the potential conflict between the proposed Alignment and existing major roads, junctions and existing interchanges as well as any expansion or upgrading of existing roads and interchanges or with a proposed new one. This impact also affects the traffic movement during the construction period of the metro connection (i.e., traffic diversion) as no major impact should be expected to existing main roads or interchanges.
- Impact of Utility/Other Infrastructure - This factor evaluates the conflict between the proposed Alignment and existing major utilities including existing Overhead Cables.

Table 3. Alignment Evaluation Matrix of Route Insertion

SN	Sub Criteria	Weight of sub criteria	Options			
			1	2	3	4
1	Availability of ROW	15%	4	3	2	3
2	Route Quality	20%	5	4	3	3
3	Station location consideration	5%	4	2	3	3
4	Conflicts with Roads/Interchanges	30%	3	3	4	3
5	Impact of Utility/Other Infrastructure	30%	4	1	3	3
Score (Weighted)			3.9	2.6	3.2	3.0
Score (Out of 100)			78	51	63	60

8.3. Constructability

The constructability of the optimal route alignment was assessed against certain factors listed below:

- Site Access - This factor is based on the ease of access for construction crew, materials and equipment to the work site. Number of detours and diversions for existing traffic and related maintenance of traffic efforts will be compared for each proposed Alignment.

- Ease of Construction - This factor depends on the length of the route, number of stations and the complexity of the possible construction elements necessary for aerial, at-grade or underground sections of the proposed Alignments.
- Equipment & Materials Laydown Areas - This factor is based on the proximity of available laydown areas of suitable size for each of the proposed Alignments.
- Demolition of Existing Features - This factor is based on the number, size and nature of existing features that have to be demolished and cleared.
- Health, Safety and Environmental (HSE) - This factor is based on the effect that the construction of the proposed Alignments will have on health, safety and environment of all communities in the vicinity of the construction sites. It takes into consideration the proximity of such communities to the construction sites, their population densities and the possible existence of environmentally sensitive natural elements that must not be compromised. Risks to health and safety during construction due to the presence of high voltage lines, oil and gas lines, hazardous waste disposal areas, asbestos in demolished buildings, etc., must also be considered

Table 4. Alignment Evaluation Matrix of Constructability

SN	Sub Criteria	Weight of sub criteria	Options			
			1	2	3	4
1	Site Access	10%	5	1	4	3
2	Ease of Construction	45%	4	3	2	2
3	Equip. & Materials Laydown Areas	10%	4	3	5	4
4	Demolition of Existing Features	10%	4	2	3	3
5	Health, Safety and Environmental	25%	3	3	2	1
Score (Weighted)			3.9	2.7	2.6	2.2
Score (Out of 100)			77	54	52	43

8.4. Sustainability

Table 5. Alignment Evaluation Matrix of Sustainability

SN	Sub Criteria	Weight of sub criteria	Options			
			1	2	3	4
1	Ambient Environment Impact	25%	4	3	3	2
2	Conserve Resources	25%	4	3	1	2
3	Contamination Discovery Potential	35%	1	1	3	4
4	Conserve Green Fields and Landscaping	15%	1	2	4	4
Score (Weighted)			2.5	2.2	2.7	3.0
Score (Out of 100)			50	43	53	60

Sustainability is one of the major elements considered in the performed task and was measured against the following elements:

- Ambient Environment Impact (Air, Noise, Water, Vibration, etc.) - This factor measures the ambient environment impacts to the surrounding areas resulting from the insertion of all metro components including stations, footbridges, entrance pods, emergency egress structures and piles/viaducts.
- Conserve Resources - This factor measures the ability to preserve, optimize or conserve resources including water, energy, materials, etc., associated with each Alignment.
- Contamination Discovery Potential - This factor measures the impact of encountering contamination potential associated with each Alignment.

- Conserve Green Fields and Landscaping - This factor measures the impacts of each Alignment/Station location to green fields or other areas which may require preservation or compliance with restrictions.

8.5. Overall Technical Scoring

Based on the technical assessment and the evaluation of the four options, the overall technical scoring result is presented in the table below.

Table 6. The Technical Overall Score of all four Alignment Options

SN	Sub Criteria	Weight of sub criteria	Options			
			1	2	3	4
1	Transportation & Future Developments	55%	2.5	1.7	4.2	5.0
2	Route Insertion	15%	3.9	2.6	3.2	3.0
3	Constructability	20%	3.9	2.7	2.6	2.2
4	Sustainability	10%	2.5	2.2	2.7	3.0
Score (Weighted)			3.0	2.1	3.6	3.9
Score (Out of 100)			59.6	41.5	71.4	78.6

Among these different alignment options, one alignment was selected as the best and most environmentally sustainable solution that is viable to serve local communities after the completion of the event. The chosen alignment among others is shown in Figure 2 below. The main consideration applied to choose the alignment was for the line to be viable after the completion of the event to serve existing and new development communities in the area. The total length of the line is 15 km. The over ground section consists of 11.5 km and 4 elevated stations, while the underground section tunnel is around 3.5 km long and includes underground 2 stations.

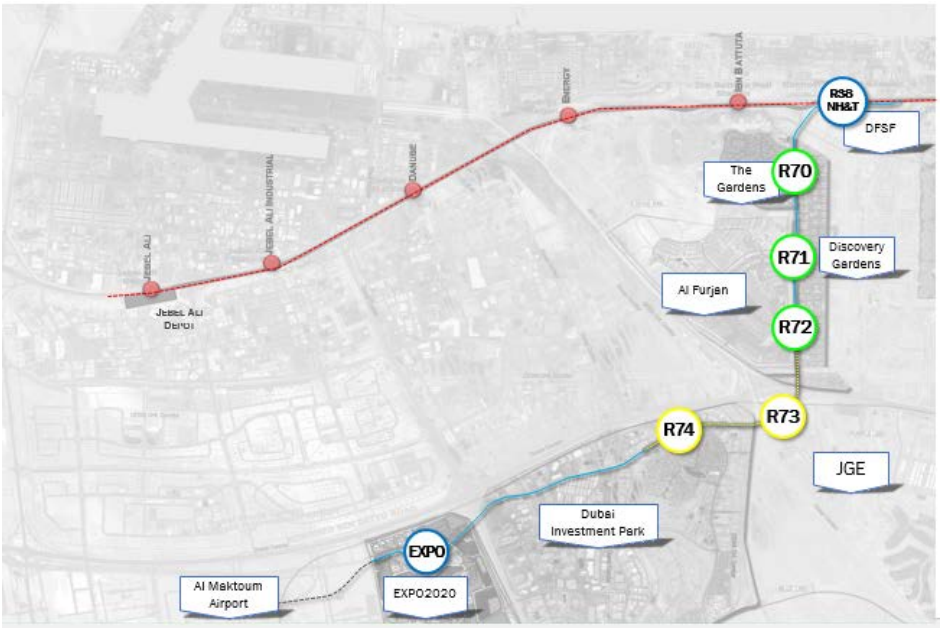

Fig. 2. The Alignment of route 2020 metro extension toward Expo 2020 site

Route 2020 is planned to serve commercial and residential areas with medium to large densities population about 270,000. The capacity of route 2020 is estimated at about 46,000 passengers per hour in both directions (i.e. 23,000 passengers in each direction per hour). The number of users of the 2020 route is expected to reach 125,000 passengers

per day by 2020 and will rise to about 275,000 passengers per day by 2030. It is anticipated that about 35,000 of Expo visitors per day will use metro station of Route 2020 and this number will rise to 47,000 visitors a day during the weekend. These figures represent about 20% of the total number of daily visitors expected to visit Expo during the event.

The summary and differences in the studied option is tabulated below in table 7.

Table 7. Summary of advantages and disadvantages of four Alignment Options

Option	Advantages	Disadvantages
1	– Reserved ROW corridor of 10m available for most of the section. – Extension to new Al Maktoum International Airport – Relatively short Option, shorter construction schedule – Straight stretches of Alignments available for the Station locations. – No major modification to roads and interchanges – No interference to Etihad railway. – Fewer crossings with high voltage overhead power line	– Does not serve major communities; only serves the industrial area – Accessibility to Station & parking requires additional land and modification to the existing infrastructure – Runs parallel to a major road for most of the length. Construction over live traffic and need for traffic management – Runs close to Gas pipeline for a length of 2.5km – Runs close to Irrigation water main for a length of 1km – 132KV high voltage power cables and 11kv power cable and other minor utilities need to be diverted
2	– Connection with the existing red line is easy and just an extension. – No disruption to Operations on Existing metro during construction – Minimum impact to utility corridors	– Doesn't serve the existing and future developments – Longest Travel Time Thus Least Desirable – Corridor is highly industrial – Lowest expected legacy ridership – Entry restriction in JAFZA and DWC
3	– Possible Extension to new Al Maktoum International Airport – Straight stretches of Alignments available for the Station locations – Minimum impact to High voltage and gas corridor – Minimum interference to Etihad Railway	– Most of the Alignment on Private property – Access to the Stations and parking are to be located on private property – Insertion of metro on DIP impacts the existing road ROW – Poor ride quality due more number of horizontal curves and change in elevation for the transition to tunnel segment – Longest route (in comparison to others)
4	– Serves existing major high density communities – Possible Extension to new Al Maktoum International Airport – Straight stretches of Alignments available for the Station locations – Highest Built-in Legacy Ridership – Minimum interference to Etihad Railway	– Insertion of metro will impact the congested Discovery Gardens road & utility ROW for a length of about 4 km – Insertion of metro on DIP impacts the existing road ROW – Poor ride quality due larger number of horizontal curves and change in elevation for the transition to tunnel segment – Accessibility to Station & parking requires additional land and modification to the existing infrastructure in Discovery Gardens Area & DIP area

The alignment of route 2020 was coordinated with Al Maktoum International Airport to identify future extension of the route inside the airport. Route 2020 Metro extension line will also serve as an integrated transport mode for the area and provide a link to the heart of Dubai. The development areas integrated with the new metro line Route 2020 are a mixture of business, residential, industrial, and mixed-use developments that encompass a number of emerging developments, including Dubai Financial Support Fund DSFS, Nakheel area (The Gardens, Discovery Gardens, Al-Furjan), Jumeirah Golf Estates (JGE), Dubai Investment Park (DIP), Dubai World Central DWC, Dubai EXPO 2020 and Al Maktoum International airport.

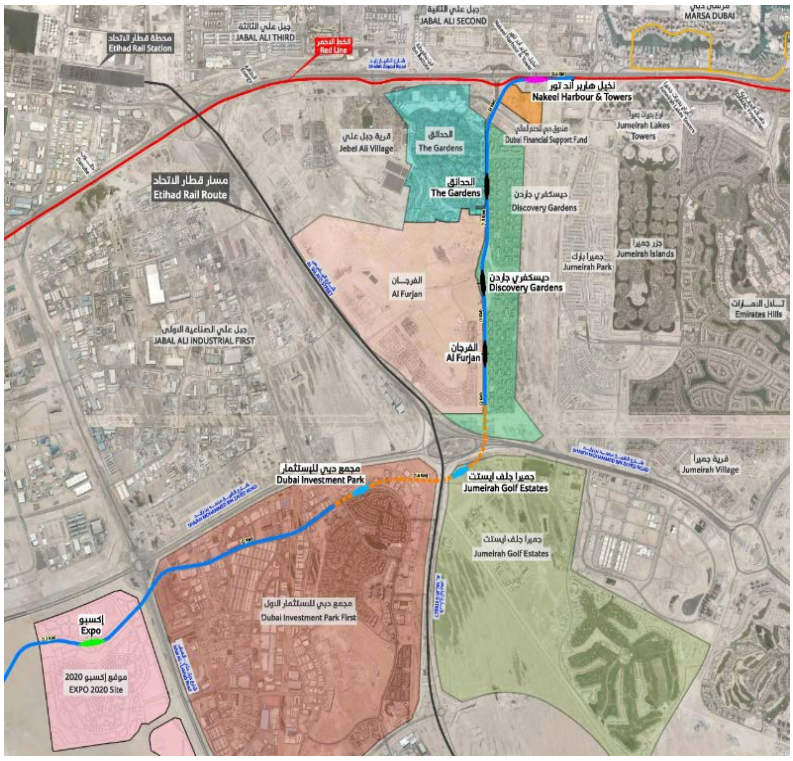

Fig. 3. Affected Development by Route 2020 Metro Line

9. Major Developers Affected by New Metro Line Route 2020

Major developers located within the catchment area of metro line extension from Dubai Metro Red Line towards Expo 2020 site are briefly presented in the following paragraphs.

9.1. Dubai Expo 2020

Expo 2020 is the major stakeholder of the study and a series of interviews will be conducted throughout the lifecycle of the project to collect information at each stage of the project. The area of the Expo 2020 site is 4.38 square kilometers which will include a gated Expo area, covering 1.5 square kilometers, and this will be surrounded by a residential, hospitality and logistics zone.

9.2. Dubai World Trade Center (DWTC)

Dubai World Trade Center (DWTC) is the UAE's leading event venue and the largest event and exhibition centre in the whole region. DWTC is a business complex located in Dubai along Sheikh Zayed Road E11 at the Trade Centre Roundabout. The complex comprises the original tower (built in 1978), eight exhibition halls, the Dubai International Convention Centre and residential apartments. As Dubai has won the bid to host the World EXPO 2020, DWTC management will be handling the development and operations at the EXPO 2020 site.

9.3. Dubai World Central (DWC)

DWC will be an economic zone to support a number of activities around Al Maktoum International Airport including logistics, aviation, commercial, exhibition, humanitarian, residential and other related businesses. The six-

month event of World EXPO 2020 will be held at the exhibition district at Dubai World Central. The DWC development is currently under construction in Dubai, United Arab Emirates. The construction area is 140 square kilometers. The development has been designed on the basis of three key factors: Dubai's geographic location, the increasing importance of airports in the Middle East region, and the region's booming aviation sector as one of the largest real estate Developers in Dubai and creator of several land reclamation Projects.

9.4. Dubai World Central - Al Maktoum International Airport

At the heart of Dubai World Central is the Dubai World Central International Airport, the world's largest passenger and cargo hub, ten times larger than Dubai International Airport and Dubai Cargo Village combined. World Central is an integrated logistics platform, with all transport modes, logistics and value-added services, including manufacturing and assembly, in a single bonded and Free Zone environment.

9.5. Nakheel

Nakheel development areas are including the Palm Islands, the Dubai Waterfront, The World and The Universe Islands. Nakheel has a host of world- renowned Projects that span a range of different sectors i.e. residential, commercial, retail and leisure. Its residential projects include The Gardens, International City, Jumeirah Islands and Jumeirah Lake Towers. Nakheel operates under the umbrella of Dubai World, which manages various businesses on behalf of the Dubai government. Nakheel has a number of large developments within the project study area, including: Jumeirah Village, Jumeirah Park, Jumeirah Island, Discovery Gardens, The Gardens, Al Furjan, Jebel Ali Village, and Ibn Battuta shopping mall.

9.5.1. Discovery Garden

Discovery Gardens is a modern residential community located in Jebel Ali area. Discovery Gardens consists of six themed districts offering more than 26,000 spacious apartments of various sizes.

9.5.2. The Gardens

The Gardens is a community that offers a fine blend of style, nature and practical lifestyle. The Gardens is consisting of 129 low-rise buildings of 3,828 apartments of one, two and three bedrooms with convenient proximity to Ibn Battuta Mall. The Gardens is accessible from Sheikh Zayed Road E11 and Ibn Battuta Street D561.

9.5.3. Al Furjan

Al Furjan is one of Dubai’s most popular residential districts. Al Furjan is a vibrant residential development that easily accessible from Sheikh Zayed Road E 11, Sheikh Mohammed Bin Zayed Road E 311 and Al Yalayis Road, Al Furjan is located in close proximity to Ibn Battuta Mall and Discovery Gardens, and just 15 minutes away from the EXPO 2020 exhibition venue. Al Furjan development comprises four specific villages: North, South, East and West. The development includes 4,000 houses, apartments, hotels and commercial & mixed use plots.

9.6. Jumeirah Golf Estates (JGE)

Jumeirah Golf Estates is a modern residential community located between Sheikh Mohammed Bin Zayed Road E311 and Emirates Road E611 and is accessible from Sheikh Mohammed Bin Zayed Road and Al Fay Road, offering spacious apartments of various sizes.

9.7. Dubai Investments Park (DIP)

Dubai Investments Park is a unique, multifaceted lifestyle complex of mixed used development including industrial, business, residential, and recreational developments. DIP is designed to be the premier business park in the region. The Park is equipped with world-class facilities and services for manufacturing, housing, academic, research and development, distribution and logistics purposes. Dubai Investment Park is strategically located with close proximity

to the EXPO 2020 site and easy access from both the Mohammed Bin Zayed Road E311 and Sheikh Zayed Road E11. Also, Jebel Ali Port and Al Maktoum International Airport are in close proximity. Dubai Investment Park is a self - contained industrial, commercial and residential complex spread across an area of 2,300 hectares.

All new and existing developments located within the selected route alignment of the new railway metro line are coordinated to be closely integrated with station location of the new Metro line to provide easy access to the public transit system and ensure the continuity of the service.

10. Conclusion

The mega event of hosting Dubai Expo 2020 is emerging as a powerful strategic and practical planning tool in facilitating a new form of environmentally sustainable development in Dubai, one that is less focused on personal car travel as the principal means of personal travel, and instead creates a Dubai of the future that is public transit oriented city.

The main driver in the selection process for the new metro line that connects Expo site with the Dubai Metro railway network is to provide an environmentally sustainable solution that serves existing major high-density communities in the vicinity of the Expo site. The approach adopted in the selection process of the optimum alignment allows for the incorporation of the TOD concept while planning for the route, in order to achieve the main objective, which is the continuity of service after the period of Dubai Expo 2020. Based on the evaluation score of four alignment options, alignment option 4 is the best option compared to other options 1, 2 and 3 for the following reasons:

- Fulfilment of the project objective and requirements
- Limited impact on existing and future roads/interchanges
- Penetrates the dense area of the major existing developments and the proposed Stations could also serve future developments near Discovery Gardens and Al Furjan areas with potential for Transit Oriented Development (TOD) around the Stations
- Reserve the future expandability of the line to serve and penetrate the heart of Al Maktoum Airport area
- Provides easy site access and enough vacant space for equipment laydown and storage during construction
- Minimizing disturbances to the existing major utilities
- Optimum travel time to the EXPO 2020 site
- Good Integration of the system with other travel mode

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