Sustainable Geodesign of the Urban Cultural Heritage of Alexandria, Egypt Vision 2030: Homogeneity of Authenticity and Modernization

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Cosmopolitanism, geostrategic location, and over 2300 years of human activity have formulated the cultural heritage diversity of Alexandria since its foundation in 332 BC. However, centralization and contemporary social behavior raise the commercial value of Downtown Alexandria, which impact on its urban cultural heritage. Geodesign methodology and application provide a design framework of sustainable planning and supporting technology to leverage geographic information, resulting in designs that follow natural systems. Therefore, Geodesign Alexandria project could change mindset to preserve the authenticity of its historical urban fabric and merge it to the (NSDS), Egypt vision 2030 using interdisciplinary systems.

Keywords: *Alexandria, Geodesign, Cultural heritage, NSDS, Egypt vision 2030*

1. Introduction

Alexandria has multiple potentials that contribute to achieve sustainability for its diverse cultural heritage, which began to be formed since its founding in 332 BC. The Greek Hippodamic (crisscross) urban pattern that distinguished ancient Alexandria had exposed to historical deep change, due to war, economic impact and natural hazard. As a result, 2-10m depth of multi-archaeological layers and submerged antiquities have been generated, furthermore medieval and modern outstanding urban fabric at risk. In the same context, centralization and contemporary social behavior raise the commercial value of Downtown Alexandria, causing urban burden.

Geodesign provides a design framework of sustainable planning and supporting technology to leverage geographic information, resulting in designs that more closely follow natural systems. This contribution utilizes Geodesign methodology and application to settle the conflict of authenticity and development to preserve the urban fabric of Downtown Alexandria, improving urban mobility and environment with priority given to community needs. Geodesign Alexandria concept is outlined by the National Strategy for Sustainable Development (NSDS) 2030 via synthetic approach, based on GIS, land use, and cultural heritage management. On the other hand, sustainability of Geodesign Alexandria extends to change the mindset and capacity building of young stakeholders and researchers, aiming to create a qualified generation of future decision makers. So, interactive workshops were held that organized by DMUCH-Ritsumeikan University and Geodesign Hub, in collaboration with Egyptian and Japanese institutions.

2. Geodesign Methodology and Framework:

Geodesign changes geography by design. It is the development and application of designing intended to change the geographical study areas in which they are applied and realized (Steinitz 2012). The term "geodesign" as an alias to these past efforts offers two strategic advantages. Firstly, as a moniker for a group of mutually dependent fields of research, it sets a new research agenda aiming to explore symbiotic outcomes between them. Secondly, this is "geodesign thinking", akin to design thinking as explored by many cognitive scientists since the 1960s, except it has specific geo-spatial requirements to the problem at hand (Danbi 2014).

The framework for geodesign consists of six questions that are asked (explicitly or implicitly) that have sub-questions that are modified as needed by the geodesign team (Fig. 1). The answers to those questions are models, and their content and levels of abstraction are particular to the individual case study. Some modeling approaches can be general, but data and model parameters are local to the people, place, and time of the study (Steinitz 2014).

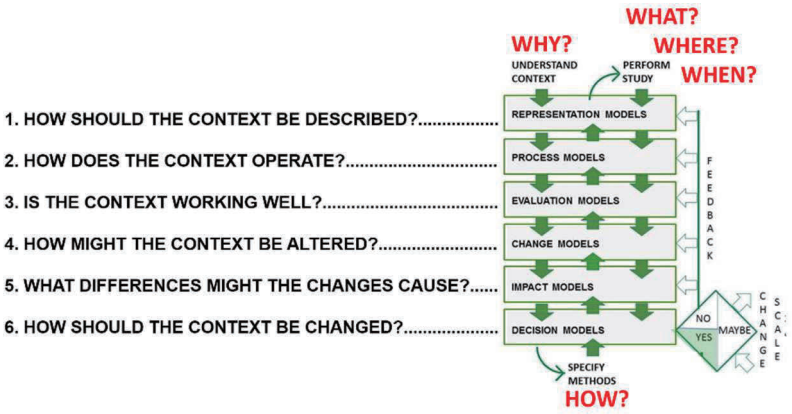

Figure 1 A framework for geodesign (Source Steinitz C. 2012)

The basic problem of geodesign can be stated as, "How do we get from the present state if this geographical study area to the best possible future?". In the framework the answer of the question: "How might the study area be altered?" is provided with change models; the ways of designing and achieving the objectives of the geodesign study (Steinitz 2012). Every change model goes through four common and hierarchically organized phases, all of which are essential for a successful decision and implementation: vision, strategy, tactics, and actions. Geodesign change models frequently combine "offensive" development-oriented allocation strategies and "defensive" conservation strategies. All change models combine decisions related to allocation, organization, and expression, and all require visualization and communication (Steinitz 2012).

The evaluation system is related to building a reliable change model. Accordingly, the geodesign evaluation system adopts five categories based on constraints, obligations of stakeholders, and current land use of the study areas, aiming to determine the appropriate intervention (Fig. 2).

	Existing	Not appropriate	Capable	suitable	Feasible
classification	is where the system is "existing" already and in a healthy state, meaning that it is feasible to remain.....a constraint in terms of information but not a total Constraint.	is lowest priority for change... "not appropriate" or not capable of supporting the system, meaning don't put it there, e.g. too wet or steep or....unless you provide change to the basic area conditions e.g. fill in the ocean for new land, regrade the mountain, etc.. (all very risky projects). This is also a constraint in terms of information.	is low but higher priority ...."capable", meaning that you can place it here IF you also provide the technology and market to make it feasible, e.g. water and sewers, access roads for mechanical harvesting, etc., and the market comes...	is higher priority...."suitable", meaning that the area is capable of supporting the project and it already has the appropriate technologies to support the activity taking place e.g. septic tank soil or sewers, access roads for mechanical harvesting, etc. BUT there may not yet be a market for the change.	is the highest priority for change...."feasible", meaning that it is suitable AND there is a demand or market to provide the new land use change, e.g. that someone wants to buy the product or new house (and at a profit) OR that the government wants to protect and improve an historical landscape.

Figure 2 Geodesign evaluation system (source Steinitz C. 2012)

3. Downtown Alexandria Study Area

Diverse cultural heritage of Alexandria is concluded in the designated study area, parallel to the contemporary development potential (Figs. 3 and 4). A narrow strip of land between the Mediterranean Sea to the north and Lake Mareotis to the south was an ideal location for a strategic city. Alexandria accesses to the Mediterranean through two harbors as well as connects to Egypt with an inland harbor on Lake Mareotis. Alexander the Great appointed Deinocrates of Rhode in 332 BC to plan his new city, according to Hippodamic urban pattern (Carole 2012). The Ptolemaic dynasty erected splendid buildings, particularly the magnificent lighthouse of Pharos. Heptastadium, a thick wall, linked Pharos with the landmass encompassing the Great Harbor to east and Eunostos Harbor to west. Water system of a canal, subterranean channels and cisterns conduct fresh water from the River Nile to the waterless city (Carole 2012).

Alexandria declined after the Arab conquest in 641 CE (Abouseif 1989). However, the city was growing steadily during the successive Islamic periods, since Tulunid, Fatimid, Ayyubid and Mamluk (c. 9th-16th CE) reconstructed the city, while turned into a warehouse of goods during the Ottoman period (c. 16th-18th CE) (Le Pére 1991). Population mobilized to inhabit the Heptastadium that became the modern city in 1789 (Salem 1982). The development movement expanded inside and outside the old city during the Mohamed Ali dynasty (1805-1952), supported by modern transportation means, especially tram and railways (Soliman 2009).

Figure 3 The cultural heritage diversity of Alexandria over 2300 years.
a; Eliyahu Hanavi Synagogue (1850), b; Terbana Mosque (1685),
c; Qaitbay Citadel (1477), d; Amphitheatre (C. 4th CE), e; Manshiya Square (1884)

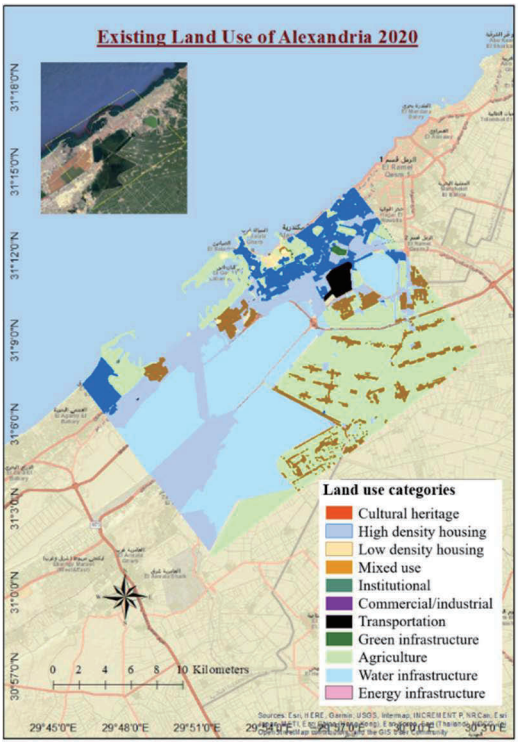

Figure 4 Existing land use of Alexandria 2020

4. Problematics and Constraints of Developing Alexandria

The population of Alexandria is now estimated at 5,280,664 m / 2020, an anticipated growth rate 2.02% (610,333+) / 2030 (Table1), (Fig. 5). People of Alexandria occupy 2.818 km^2 area extends (E/W) alongside the Mediterranean Sea. As a result, the southern cultivated area is being corrupted owe to random urban expansion for the same reasons. In response, unconventional solutions should be considered to accommodate the population pressure. In the light of that, interlaced factors deteriorate the outstanding value of the cultural heritage of Alexandria, essentially the illegal development and slow implementation of regulations. Moreover, the multiple possession of cultural property, despite government efforts.

On the other hand, classic preservation policies of the cultural heritage would impede ambitious development

plans, especially infrastructure and transportation, and likewise, the practical development trend may lead to deteriorate Alexandria cultural property, frequently. In the same context, the geostrategic location of Alexandria as the main harbor for Egypt would hinder some development activities, fortunately in a very limited context that facilitate the overall future perception for developing the city.

Table 1 Growth rate of population of Alexandria in 80 years (2020-2030) (Central Agency for Public Mobilization and Statistics (COMPAS), Cairo, 2030)

Year	Population	Growth Rate (%)	Growth
2030	6,417,384	2.02%	610,333
2025	5,807,051	1.92%	526,387
2020	5,280,664	1.97%	491,302

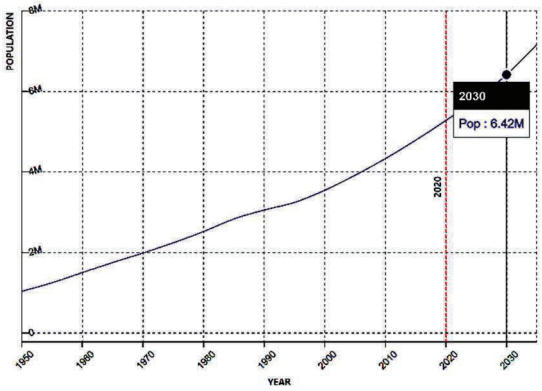

Figure 5 Growth rate of population of Alexandria over 80 years (1950-2030) (Central Agency for Public Mobilization and Statistics (COMPAS), Cairo, 2030)

5. Developing A Sustainable Change Model

Geodesign organizes targets for change across nine systems, meaning what kind of change anticipated in the coming years needs to be addressed in the design, which are designed according to the typical Geodesign Hub symbology to distinguish targets of the strategy adopted in advance. Accordingly, these nine systems integrated to generate the final change model of the Alexandria geodesign project for achieving the SDGs, while the proposed change model was designed based on concepts of each system to achieve timetabled targets by 2030 of Egypt's NSDS as follows:

(1) Cultural Heritage (CULTH):

Reconsideration of the national and UNESCO regulations is highly demanded for protection, management, and developing the cultural heritage properties in Downtown Alexandria.

a) 2022 Target: adopting policy to identify a protected core zone (PCZ) of Downtown Alexandria to regulate developing activities stipulated by local authorities, on total area: 17.935 km^2 (Fig. 6).

b) 2024 Target: utilizing the submerged antiquities can add value to the tourism industry in Alexandria. So, developing Archaeo-Tourism Diving Centre (ATDC) next to Qait'bay Fort is a promising project supplied with diving and snorkelling tools, add to glass boat and submarine covers 2637.69 m^2.

c) 2026 Target: two sub-concepts to protect and conserve the cultural heritage properties should be achieved.

-Adopting protection policy to list (LST) outstanding cultural properties below, on total area: 122,996.79 m^2.

LST/1: Galleria de Menasce: 7827.39 m^2.

LST/2: Galleria de Monferrato: 5082.6 m^2.

LST/3: St. Mark Anglican Cathedral: 8030 m^2.

LST/4: Silsila Fortress: 22023.3 m^2.

LST/5: Um Qubiba Fortress: 80033.5 m^2.

-Preservation process for existing listed sites (PRSV) is highly demanded throughout implementation of conservation and adaptive reuse projects for two prominent sites, on total area: 185,120 m^2.

-Rehabilitation of Kom al-Nadoura as Alexandria Panorama Cultural Centre (APCC): 53989.450 m^2.

-Rehabilitation of ibn al-Nabih cistern as Alexandria Water Heritage Centre (AWHC): 8134.45 m^2.

(2) Residential: (High Density Housing / Low Density Housing) / (HDH / LDH):

Adaptation of the high-density construction (HDH) to low-density (LDH) (max. 7 floors) mitigate the urban burden on the protected core zone, considering stipulated urban regulations and code of practice. Consequently, a new urban area should be developed to accommodate gradually the surplus of a population outside the protected zone, with priority given to the local community. Kom al-Dikka, Gomrok, Manshya, and Labban, which are authentic urban areas, are good start to implement this concept, on total area: 3.423 km^2.

a) 2022 Target / HDH / LDH-1 (Kom al-Dikka): 0.100 km^2.

b) 2024 Target / HDH / LDH-2 (Manshya, Labban/A): 0.64 km^2.

c) 2028 Target / HDH / LDH-3 (Manshya, Labban/B): 1.523 km^2.

d) 2030 Target / HDH / LDH-4 (Gomrok): 1.159 km^2. (Fig. 7).

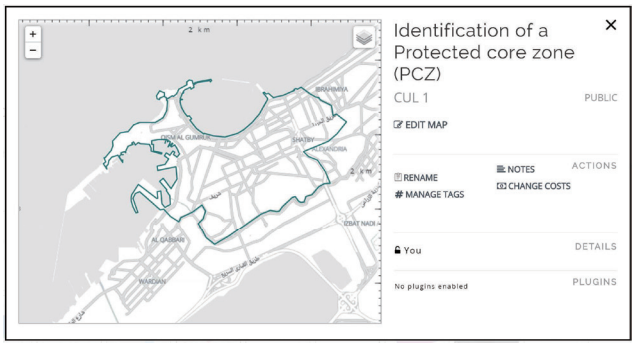

Figure 6 Proposed protected zone for Alexandria cultural heritage

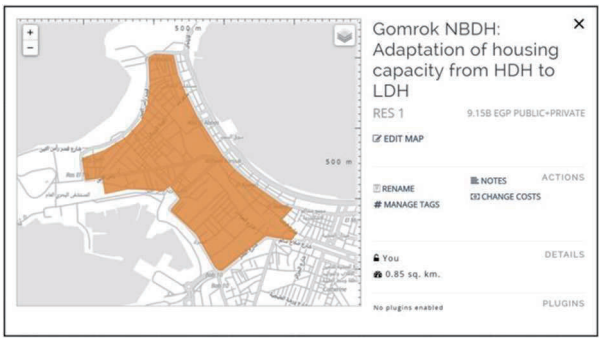

Figure 7 Adaptation of the high-density construction (HDH) to low-density (LDH)

(3) Institutional (INST):

Cultural heritage properties of Down Alexandria are deteriorating due to institutional misuse or neglect. So, mitigation of intensive institutions should be adopted in favour of cultural, educational, and micro-economical uses, parallel with transferring the governmental complexes outside the protected zone. Three prominent sites are prioritized to implement conservation and adaptive reuse projects, on total area: 11,245.47 m^2 (Fig. 8).

a) 2022 Target: Rehabilitation of the educational department building of West Alexandria as a Micro-Skills Training Centre (MSTC) dedicated to homeless children to develop workshops and exhibitions for selling their products (3845.99 m^2).

b) 2024 Target: Devoting the Real State Registration Department building to create Alexandria Cultural Heritage Institution (ACHI) as a unified institution to manage Alexandria cultural property (2666 m^2).

c) 2026 Target: Adapting the Alexandria Court (Haqania) to develop Alexandria Social Aid Centre (ASAC) to eliminate adult literacy, supporting children who drop out of education, and building capacity of breadwinner women (4733.48 m^2).

(4) Commerce / Industry (COMIND):

Downtown Alexandria is the traditional centre of commercial and industrial activities, which causes condensation of population and urban mobility. That requires regulating the commercial and industrial activities to be compatibilized with the cultural heritage values, parallel with developing unconventional projects, which provide job opportunities to attract people outside the protected zone, with priority giving to the local community, on total area: 2.00 km^2.

a) 2024 Target: Wholesale market of fisheries production (WMF) at Airport Farm Lake (0.031 km^2).

b) 2024 Target: Wholesale market & storage of medical herbs production (WMSH) in Nadha Sector (0.436 km^2).

c) 2026 Target: Herbal pharmaceutical factory (HPF) in Nadha Sector (1.535 km^2) (Fig. 9).

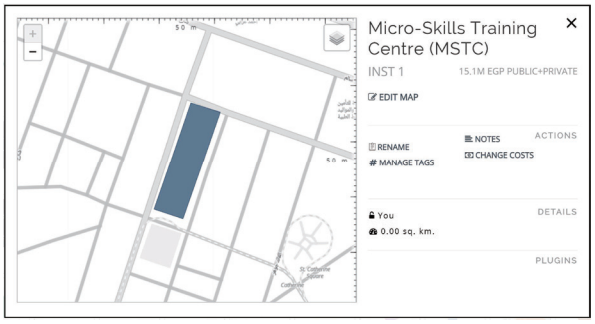

Figure 8 Micro-Skills Training Centre (MSTC)

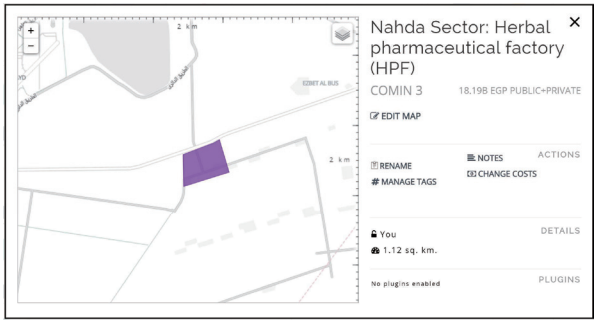

Figure 9 Herbal pharmaceutical factory (HPF)

(5) Transport (TRANS):

As a result of intensive traffic in Downtown Alexandria; changing the urban mobility behaviour is highly demanded to reduce traffic density and improve the environment. Consequently, that can be achieved by

upgrading the public and environmental transportation.

a) Developing bike tracks (BT) and parking lot on main streets in total length: 58.791 km, are demanded infrastructure to implement "Your bike… Your health" initiative of the Ministry of Youth and Sports that encourages people to have bicycles in easy instalments.

-2022 Target: BT-1: 26.803 km.

-2024 Target: BT-2: 31.988 km.

b) Upgrading the infrastructure of the historic Tramway network (Tram al-Madina) (TM) within the protected zone mitigates the intensive private transportation and improve the environment in total length: 23.188 km (Fig. 10).

-2024 Target: TM-1: 8.177 km.

-2028 Target: TM-2: 12.474 km.

-2030 Target: TM-3: 2.536 km.

(6) Green Infrastructure (GI):

Downtown Alexandria has limited green spaces. So, adopting policy of environmental balance and economic impact can increase the green infrastructure, on total area: 0.4666 km^2.

a) Developing public green spaces as Children Playground Park (CPP) by 2024 (10,823 m^2) (Fig. 11).

b) Adopting rooftop cultivation concept (RC), focusing on Downtown Alexandria on total area 455,789 m^2:

-2026 Target: RC-1: 135,669 m^2.

-2028 Target: RC-2: 320,120 m^2.

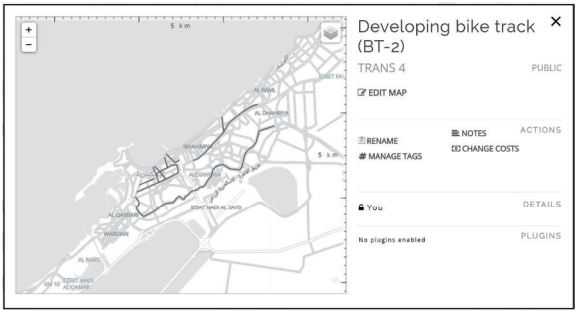

Figure 10 Bike tracks (BT) on the main streets

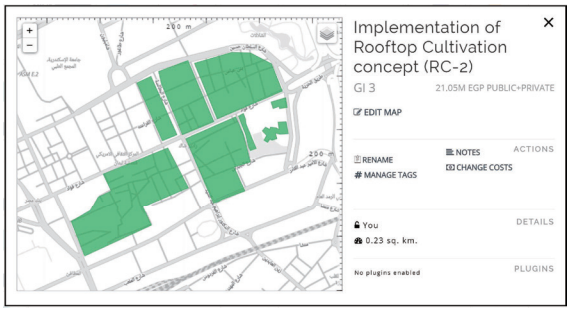

Figure 11 Rooftop Cultivation (RC)

(7) Water Infrastructure (WI):

Alexandria's waterbodies potential can produce and save freshwater in the time of water poverty, add to developing fisheries to supply the study area.

a) 2022 Target: Developing desalination plant (DP) for agricultural irrigation, covers 887.778 m^2 on Lake Mariout, saves freshwater for urban use.

b) 2028 Target: Developing smart fisheries on 7.615 km^2 at Airport Farm Lake achieves multiple targets, basically providing job opportunities and serving fish products for Alexandria community (Fig. 12).

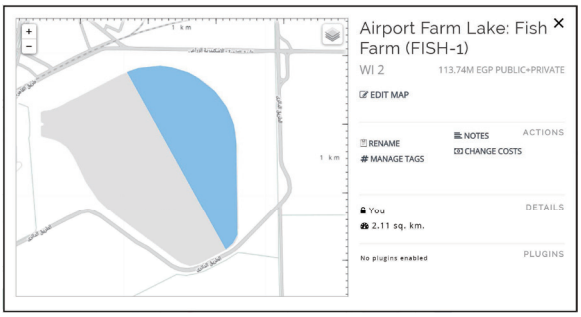

Figure 12 Developing Smart fisheries at Airport Farm Lake

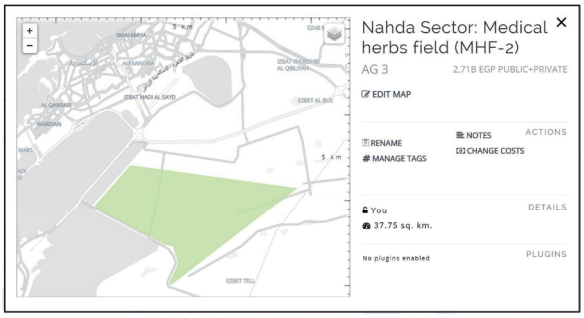

Figure 13 Medical herb fields (MHF) at Nahda sector

(8) Agriculture (AGR):

Agricultural activities are not considered a priority in Alexandria's economy. So, adopting vertical expansion policy is vital for cultivating crops of economic value that are not a high-water consumption. Accordingly, developing 84.234 km^2 of agricultural land as medical herb fields (MHF) promotes the agricultural economy of Alexandria.

a) 2024 Target: MHF-1: 32.733 km^2.

b) 2028 Target: MHF-2: 51.501 km^2. (Fig. 13).

(9) Energy Infrastructure (EI):

Adopting clean-renewable energy projects is a challenge to serve the study area. Solar Panels (SP) are recommended for supplying the institutional and commercial buildings with required power; e.g., Bank, Hotel & company, on total area: 0.8101 km^2.

a) 2024 Target / EI/SP-1: 0.339 km^2.

b) 2028 Target / EI/SP-2: 0.4711 km^2 (Fig. 14).

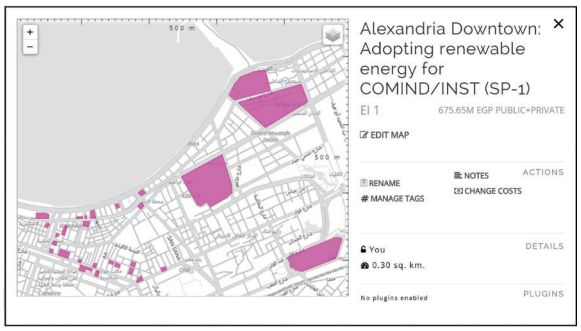

Figure 14 Solar Panels (SP) for supplying the institutional and commercial buildings

6. Stakeholders Negotiation for Decision Making

Stakeholders of Downtown Alexandria were represented in four teams implemented in three interactive workshops, which were held in Sept. 2020, Oct. 2020, and March 2021, engaging fifty participants in total belong to various disciplines and institutions. Institute of Disaster Mitigation for Urban Cultural Heritage (DMUCH)-Ritsumeikan University organized the events with technical support from Geodesign Hub in Dublin, Ireland in collaboration with Egyptian and Japanese institutions, basically Ministry of Tourism and Antiquities (MoTA), Egypt-Japan University of Science and Technology (E-JUST), National Research Institute of Astronomy and Geophysics (NRIAG), Ritsumeikan University, and TUFS (Fig. 15).

Consequently, the four teams represent the major interests of the study area, which are Heritage (HER), Municipality (MUNI), Economic development (EDOV), and young people (YNG). HER, MUNI, EDOV, and YNG were demanded to think how to take responsibility to achieve the SDGs within the framework of NSDS, Egypt vision 2030. The negotiation was running according to the process of 4-2-1 design. Each team was demanded to create an integrated design compatible with its own duty, then each two teams get the first negotiation round to vote on their contribution. Eventually, the chosen two designs processed in the second negotiation round to identify a reliable change model (Fig. 16).

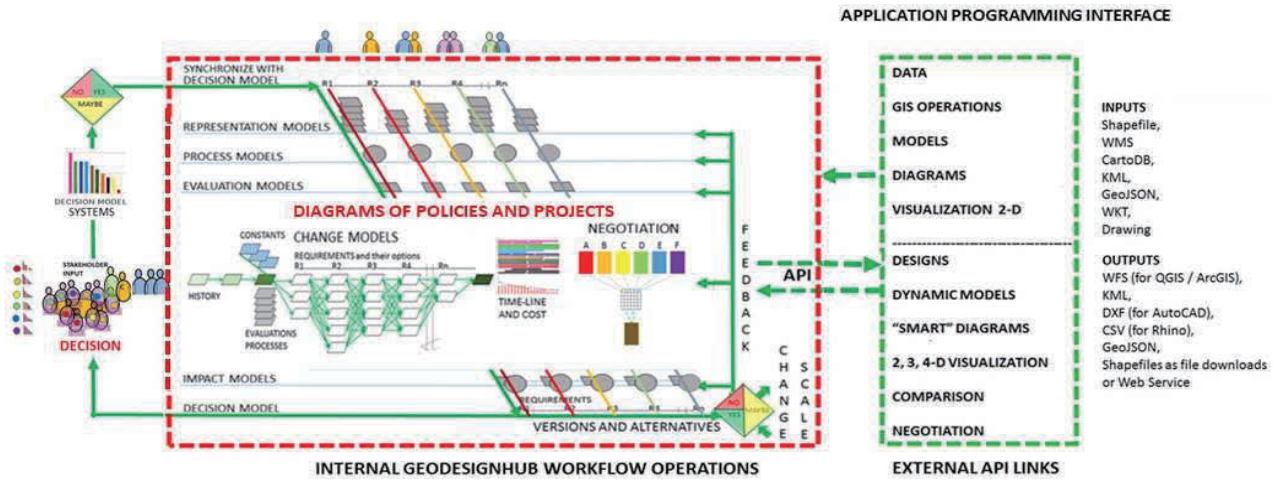

Figure 15 A digital workflow for dynamic geodesign. (Source Steinitz C. 2012)

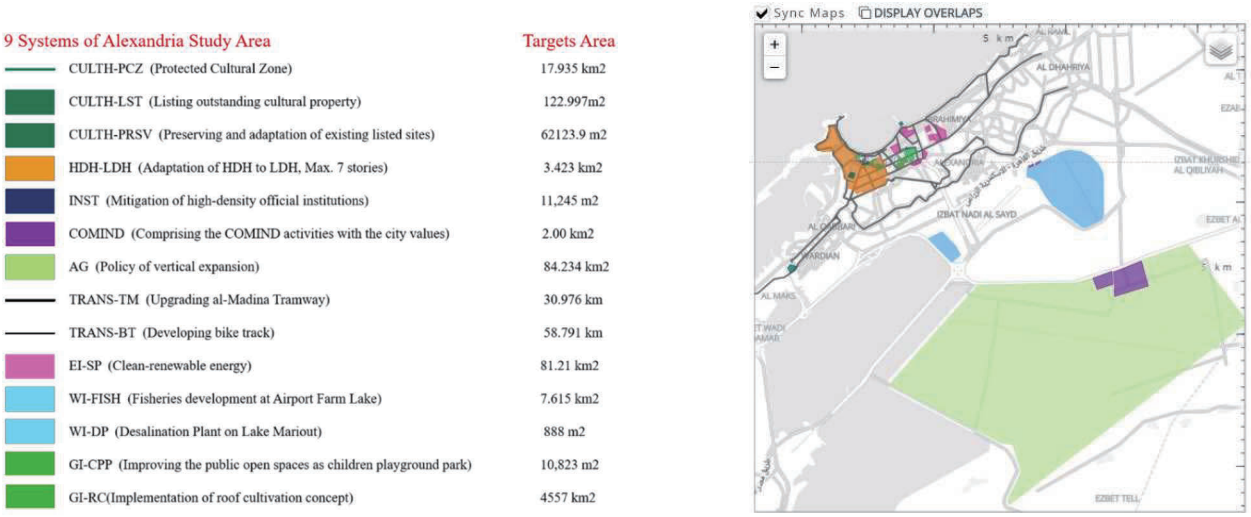

Figure 16 Change model of Alexandria geodesign within NSDS, Egypt vision 2030

Conclusion

2300 years of cultural heritage diversity of Alexandria have generated human inheritance potentials that could be utilized to add value to the city within the NSDS, Egypt vision 2030. Geodesign Alexandria project harmonizes the authenticity and modernization compact that is taking place in Alexandria in terms of preservation, management, and development of its cultural heritage, taking into consideration other potentials for sustainability. Accordingly, cultural heritage, urban mobility, and environmental consideration are three pillars that conclude the concept of Geodesign Alexandria project within time table of (2020-2030), taking into consideration social, financial, and bureaucratic impacts. So, Upgrading the existing historical land use potential and adopting innovative compatible projects in Downtown Alexandria are highly demanded to provide job opportunities and meet the local community needs. That leads to preserve the cultural heritage property, mitigate the urban mobility, and attract the population surplus outside the proposed historical core zone. On the other hand, three interactive workshops were held in in Sept. 2020, Oct. 2020, and March 2021, based on Geodesign Alexandria project aiming to change the mindset and capacity building of young stakeholders and researchers in Egypt and Japan. Consequently, collaboration is conducting with Egyptian and Japanese institutions basically, E-JUST, Ministry of Tourism and Antiquities, NRIAG, Library of Alexandria, Ritsumeikan University, and TUFS, engaging fifty participants belongs to various disciplines, with the aim of creating a qualified generation of future decision makers. However, more efforts should be made to promote the integrative development concept to stakeholders of Alexandria as a highly demand for sustainability.

Acknowledgment: The authors greatly acknowledge the Japan Society for the Promotion of Science (JSPS) for supporting this contribution, which comes out within the first author as International Research Fellow of Japan Society for the Promotion of Science of Postdoctoral Fellowships for Research in Japan.

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