



Waterfront Development through a Lens of Sustainable Smart Agenda: Breathing Life into El-Anfoushy Touristic Promenade



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Abstract: Water plays an essential role in shaping the aesthetics and psychological impacts of urban waterfronts, thereby enhancing their popularity as centers for tourism, communal activities, and events. The universal appeal of water attracts a diverse audience, including both residents and visitors, leaving a lasting impression on all who experience its charm. Urban waterfronts, epitomized by the historical city of Alexandria, Egypt, are cultural and historical repositories, showcasing a rich tapestry of architectural styles and epochs. Alexandria's waterfront presents a scenic view of the Mediterranean Sea, enriched by its architectural diversity. However, waterfronts face numerous challenges that underscore the critical need for their preservation and development. The development of waterfront areas involves transforming these zones into vibrant, sustainable, and appealing spaces that encourage community interaction and enhance the quality of urban life. This encompasses a comprehensive approach to placemaking that integrates architectural design, urban planning, environmental responsibility, social equity, and economic viability to forge places of unique identity and aesthetic value. The research presented herein reviews existing literature on urban waterfront development strategies and processes, and examines successful international cases of waterfront revitalization. A focus is placed on the El-Anfoushy touristic promenade in Alexandria, employing the SWOT analysis to assess its current conditions and the Analytic Hierarchy Process (AHP) to prioritize actionable outcomes. These methodologies facilitate the quantification and strategic prioritization necessary to address the challenges confronting this historical area. The ultimate objective of this study is to provide a sustainable smart development agenda that can be effectively implemented to rejuvenate and preserve waterfronts, offering a framework for city planners and policymakers to foster sustainable urban environments.

Keywords: Waterfront development; Sustainability; Smart; Alexandria; Qaitbay; El-Anfoushy; Urban planning

1 Introduction

The waterfront is the intersection of water and land. Water surrounds a portion of the land at its edge. This waterfront land involves a lot of human activity, as well as the most varied aspects. The water view has a significant impact on human emotions and the environment. Often, planners organize the waterfront into a belt along the beach. As a result, planners look for ways to make these locations more appealing to the public so that people will use them. The key obstacles are connecting traffic, setting up distinct functions, and communicating with the inner city. In general, the shoreline serves as the city's activity center. This zone is home to new public parks, residential communities, recreational spaces, and mixed-use zones [1]. Extended waterfronts that reach a short distance into the city center are beneficial for city-water links, although their shape and the location of the city are the most significant influences. The potential for public spaces to be created on the waterfront and connected to other nearby public spaces is increased by extended waterfronts. To improve cities sustainably, social life and the natural world must coexist. Urban natural water features play a major role in creating this balance. Water is regarded as a crucial component in the process of designing to satisfy the physical and psychological needs of humans. Additionally, it adds several utilitarian and aesthetically pleasing elements to the current environment. Aesthetic effects include tactile, psychological, auditory, and visual aspects. The visual includes a space that is livelier and more enjoyable because the soothing sound of flowing water and still water creates a mirror effect, and optical features act as reflective

elements, elements of calm and movement, and a feeling of expansion. The audial effect includes a sense of life, vitality, and happiness; stalling water contributes to a tranquil atmosphere; and flowing water gives energy and produces a musical effect. The tactful effect is sensed while diving into the water, which serves as a sort of retreat from the outside world. The psychological effect includes people's emotional responses to water reflecting their spirits, the sensitive outcome that is visible to the brain, and the aquatic aspect as something that breaks the continuity of life. As a result of the great positive impact of the water bodies on the community, all trends and thoughts must be directed toward the development of urban waterfront zones. The urban development of the waterfront targets creating an interaction between the community and the urban context by creating sustainable, vibrant, comfortable, and attractive spaces [2].

This research deals with a case study of El-Anfoushy waterfront in Alexandria, Egypt, where the city's unique imprint is further enhanced by its waterfront location overlooking the Mediterranean Sea. The location is also known by the Pharos Island of Alexandria as the lighthouse; one of the seven wonders of the world was built on it. However, the island had been destroyed and drawn by an earthquake. According to the archaeologist Jean-Yves Empereur, in 1994, he made an amazing discovery about the lost island, as he mentioned that there are a lot of monuments and statues dating back to the Greek era that are drawn under the water. The district is considered a historical area that was developed as a tourist promenade 15 years ago by the Egyptian government; however, nowadays the waterfront faces several problems. One of the biggest problems facing the waterfront space is the maintenance of the urban imageability elements due to the humidity and the preservation of cultural and social aspects in this area. The primary objective of the study is to restore the distinctive identity of this unique site while leveraging its waterfront location within the context of a development plan that prioritizes sustainability in the design process. This endeavor includes the incorporation of smart technology into the design framework to enhance the project's value and facilitate integration with novel technological advancements, along with the preservation of its remarkable historical features. Through the implementation of this developmental approach, users stand to benefit from heightened opportunities to engage with the natural waterfront environment, thereby enhancing their overall quality of life and fostering a deeper connection to the site's historical and cultural significance. Consequently, individuals are likely to perceive a sense of ownership over the locale, intertwining their newfound technological perspectives with the site's intrinsic attributes. Moreover, by stimulating tourism, this initiative is poised to stimulate economic growth and position Egypt as a forward-thinking nation committed to leveraging its unique assets through sustainable and technologically advanced design strategies that align with contemporary paradigms.

2 Methodology

The research methodology, as illustrated in Figure 1, comprises two primary sections. The first part is a literature review that presents understanding urban waterfront development and its processes, studying waterfront development strategies, and investigating two international examples of cities that succeed in developing their waterfronts, as the selection of Jeddah and Casablanca was based on their strategic blend of natural beauty, cultural significance, and economic potential. According to the previous theoretical part, the research proposed a sustainable smart agenda that is easily implementable and encompasses key strategies for effective waterfront development.



Figure 1. Methodology adopted in the research

The second part is an application of the proposed agenda to the selected case study of El-Anfoushy Waterfront in Alexandria. Firstly, a comprehensive analysis was conducted using the SWOT method, which serves as a tool to assess the current situation of the waterfront by identifying internal strengths and weaknesses, as well as external opportunities and threats. Followed by the AHP method, which provides a systematic framework for decision-making that helps stakeholders prioritize criteria, evaluate alternatives, and make informed decisions based on both qualitative and quantitative data. Additionally, questionnaires and interviews were conducted with experts and city planners, including those involved in previous developments in the case study area. This approach aims to establish a systematic framework, garnering support for policy-making initiatives while also enhancing transparency, efficiency, and effectiveness in the decision-making process, ultimately leading to the creation of vibrant and resilient waterfront communities. Secondly, an urban waterfront development was suggested based on the proposed sustainable smart agenda to develop the El-Anfoushy waterfront touristic promenade. This design incorporates adaptable strategies to conserve historic waterfronts, meet functional tourism needs, ensure long-term profitability, and enhance aesthetic appeal while safeguarding water integrity and environmental health.

3 Urban Waterfront Development

The term “urban waterfront development” describes the design, planning, and remodeling of spaces beside bodies of water in metropolitan environments. Riverbanks, harbors, lakeshores, and coastal zones are a few examples of these places. Urban waterfront development aims to produce aesthetically pleasing, sustainable, and dynamic areas that enhance the general well-being of a city or community. A combination of commercial, recreational, residential, and cultural components is frequently included in such developments [1]. However, it is difficult to find an excellent urban waterfront. Project for Public Spaces (PPS), a well-known non-profit organization, is committed to placemaking, which involves creating and sustaining public places that foster community development. Its staff has surveyed more than 200 urban waterfronts worldwide, encompassing robust lakefront burgs such as Milwaukee, Chicago, Cleveland, and Zurich, rivertowns like London, Paris, Buenos Aires, and Detroit, as well as seaside cities including Hong Kong, Vancouver, Miami, and Athens. While nearly every waterfront has some potential aspects, successful waterfronts are extremely uncommon. Here are some examples of the best waterfront city strategies in urban design: Stockholm, Sweden: The shoreline of Stockholm, a city of islands, has changed over time to accommodate a variety of uses. There aren't many busy roads, making biking and walking enjoyable. People are drawn to public places like City Hall and Kingstree Garden by Stockholm's promenades and esplanades, and pedestrian-only pathways connect to various parts of the city [3]. Porto, Portugal: The waterfront has human-scaled developments that connect two levels of a promenade along the slope and create active nodes with three entrances and broad plazas. Venice, Italy: Venice is special for one obvious reason: there are no cars there. It is all in the water. This implies that the only ways to move around are on foot, via water taxi, or by vaporetto. There are several examples of unique waterfronts; however, each one has its own unique features and design identity [3]. To achieve a successful urban design development of a waterfront, there is a development process that includes several phases that must be followed, such as:

A. Preparatory / Exploration Phase

- Analyze every facet of the area while considering its development, beginning with collecting and evaluating data. Primary data can be received directly from city hall, or raw data can be obtained via the statistics office. It may be acquired by secondary data that earlier studies have mentioned [4].

B. Feasibility Study Phase

- Determine whether the waterfront development project is viable from an economic, environmental, and social standpoint [4].
- As a strategy or indicator, project financing may involve arrangements with staggered payments disbursed over years following the project's finalization. Additionally, private developers often receive tax exemptions, which, while beneficial to their endeavors, have the potential to disrupt the equilibrium of public budgets [4].

C. Zoning Phase/Master Planning Phase

- Develop a thorough master plan that describes the objectives, vision, and design concepts for the waterfront.
- Conduct an Environmental Impact Assessment (EIA) to assess the development's possible environmental effects and determine how to reduce any negative effects.
- Involve the community in public consultations and involvement to make sure the project fits their requirements and preferences [5].

D. Design and Implementation Phase

- Obtain the necessary permits and consents from environmental agencies, local government agencies, and other pertinent organizations.
- Verify all regulations and ordinances that apply to the project's location.
- Work together with urban planners and architects to develop a comprehensive plan that incorporates green spaces, recreational places, and sustainable elements.
- Focus on new trends in design and incorporate smart and sustainable systems into the design concept to address human needs [6].
- Through the promotion of compact, mixed-use, and transit-oriented development, sustainable urban design aims to reduce reliance on private automobiles while encouraging pedestrianism, cycling, and the use of public transportation networks. Such initiatives have the potential to decrease energy consumption and emissions from transportation activities while also improving air quality and public health outcomes [6].
- Design unique, suitable elements and features as street furniture using sustainable materials and incorporating smart technology, while preserving the identity of the surroundings, meeting user needs, and considering the environmental aspects of waterfront sites.
- Respect the cultural heritage of the site's inhabitants; sustainable development initiatives should aim to curate activities that align with their cultural practices, fostering greater engagement between the community and the waterfront environment.
- Adopt adaptable and flexible design strategies to accommodate shifting climatic conditions. To address changing needs, utilize dynamic zoning restrictions and flexible infrastructure [7].

E. Operational Phase

- Establish the promenades, parks, roadways, and utilities that are required to support the development of the waterfront.
- Incorporate sustainable water management techniques such as flood mitigation, stormwater control, and water quality preservation into practice. This should involve the integration of natural drainage systems and green infrastructure [7].
- Introduce innovative systems to augment the drainage infrastructure and repurpose rainwater for irrigation through the utilization of appropriate materials and mechanisms, such as a porous paving tile system [7].
- Implement the project's infrastructure after a thorough examination of the surrounding environmental conditions.
- Design street furniture using sustainable materials capable of withstanding the climatic variability of the waterfront area. For example, consider utilizing limestone for its durability, integrating green concrete, and incorporating stone blocks as wave attenuators.
- Execute the building step in accordance with the authorized plans and designs.

F. Monitoring and Maintenance Phase

- Create a plan for the continuous maintenance and management of the waterfront region. For example, evaluate infrastructures such as walkways, bridges, street furniture, and recreational areas on a regular basis to look for symptoms of deterioration.
- Maintain the waterfront area's aesthetic appeal by doing routine landscaping and cleaning.
- Monitor soil conditions, water quality, and air quality; put pollution control measures into place; and handle any environmental issues to maintain the ecosystem's health and the safety of locals and tourists.
- Interact with the surrounding community to collect feedback on the waterfront development and resolve any issues.
- Create channels of communication to inform the community about planned upgrades and current maintenance and to raise awareness among the public about the need to preserve local neighborhoods [8].
- Stay updated on local, state, and federal regulations related to waterfront development and ensure compliance [8].
- Regularly review and update policies related to waterfront maintenance and development.
- Create and update emergency response plans on a regular basis to deal with anticipated hazards like storms, floods, and other natural catastrophes [7].
- Organize regular emergency response team training sessions and drills [7].
- Make use of data analytics, sensors, and Geographic Information Systems (GIS) to monitor environmental conditions and infrastructure in real time [6].
- Use smart city technology to improve maintenance activities' responsiveness and efficiency [6].
- Create long-term strategies for waterfront developments' sustainability and flexibility, considering population growth and climate change into account.

4 Waterfront Development Strategy

Waterfront development strategy refers to the planning and implementation of various approaches and initiatives to enhance and utilize the potential of waterfront areas. It involves creating a vibrant and attractive environment by incorporating mixed-use spaces, public access, connectivity, natural features, and cultural attractions. It also emphasizes sustainable design and practices to minimize environmental impact. The goal is to create a dynamic and inviting waterfront that serves the needs of the community, attracts visitors, and contributes to the overall development and revitalization of the area [2]. Urban planning processes take social and environmental factors into account, and the living environment has an impact on the overall quality of life [9]. A comprehensive plan for developing or renovating waterfront properties is crucial to balancing conflicting demands, a vibrant economy, and a healthy social environment. This approach promotes inclusive, environmentally friendly, and sustainable development that is culturally and historically relevant. Various strategies are needed to overcome current techniques, improve capacity to handle obstacles, and create a conceptual framework for future opportunities. A sustainable waterfront should provide improved living conditions for city residents, celebrating the city's beauty, diversity, economic vitality, creativity, heritage, and natural environment. Also, preserving the natural environment is a necessary precondition for the effective development of a city's shoreline. Waterside areas play an important role in the global environment. On the one hand, the natural ecology must be protected while also improving its current state. Especially locations that were utilized for industry could improve this position today. Environmental protection can also be helped by reducing future energy usage and recycling materials [10].

4.1 Sustainability

Sustainability is one of the most essential strategic objectives for urban development. It should be included in the city's overall development strategy. Sustainable development is the process of meeting current requirements without jeopardizing future generations' ability to fulfill their own needs [9]. As a result, including sustainability as a strategic aim in waterfront development initiatives is critical for improving inhabitants' living circumstances, not

just economically and environmentally but also in terms of preservation and social inclusion, Figure 2. Furthermore, sustainable development techniques seek to enhance human wellbeing by creating better locations for people to live, work, and visit in the present and future. Furthermore, sustainable methods of waterfront development incorporate a complete framework that includes shoreline maintenance, available resources, and usage requirements [9]. Sustainability goals involve integrating sustainable waterfront development standards into all stages of the development process, including architecture, city planning, and urban design, and managing decisions across disciplines [10].



Figure 2. Relation between sustainability and urban waterfront development

4.1.1 Social sustainability

While the waterfront region is seen as an urban asset that draws significant investment, the social part of waterfront development or any project is the most overlooked and difficult to handle. When people see friends, get to know their neighbors, and feel comfortable talking with guests, they become more committed to the area that promotes these types of social interactions. While acquiring a location might be difficult, once achieved, it becomes an evident trait. The area has a selection of cultural, educational, and recreational programs for people of all ages [11]. Social cohesion and harmony are concerned with the opportunity to have/build social networks, participation in community life, environments that promote social cohesion and community connections, inclusiveness versus alienation, the creation of exclusivity or inequality, and tolerance of diversity through various recreational and social activities. Health advantages contribute to public health improvement since it has been established that spending time in nature improves mental weariness and the associated sentiments of aggressiveness and hostility. Natural resources provide a variety of “activities” that take little to no work while still restoring a person’s physical and emotional wellness. Open places like these may help youngsters rest and unwind while also promoting social development. Physical health and wellness can also be maintained by engaging in organized sports, exercising informally, connecting with nature, and spending time outside in the fresh air and sunlight [12].

4.1.2 Economic sustainability

The waterfront contributes significantly to human wellbeing and the overall economy. It is crucial for coastal policymakers and analysts to evaluate coastal management measures. A waterfront area is valued as a measure of willingness to pay for improved ecosystem services. It encourages investment in the surrounding region and city, transforming it into an urban structure with high land value. However, these expenditures must be consistent with urban functions such as cultural, tourist, and recreational facilities. The waterfront is regarded as a key reason to develop the city’s economy, but it may be wasted if it exploits the best position poorly, resulting in “jump-start” waterfront revitalization [10]. Its economic benefits include trees and water, which reduce pollution control expenses, promotion of the city as a tourist attraction and commercial event, and an increase in property prices and tax income. Furthermore, waterfront locations may play an important role in the establishment of new businesses and local economies by bringing tourists and investors to the area. As a result, people who create, administer, and maintain the sites may have more chances for work. If the waterfront looks like a complicated and troublesome reality, its abundance of resources and promise are as obvious. The urban waterfront has always been extremely desirable, not just from a real estate standpoint but also from a sociological, cultural, and landscape perspective. It is a location associated with the historic city center, a stenographic area with high visibility, and a space for interaction between two distinct systems: land and water. From a location of intense traffic and economic development to a previously blighted and inaccessible urban area that later became one of the most valuable in the city, often at the center of new urbanization projects, the urban-port context has gradually focused attention on its historic and cultural identity, natural environment, and landscape. This currently presents a great opportunity for many international-level cities to define, promote, and implement their growth at the local, regional, and national levels. In some cases, the waterfront has been identified as a key value in urban and regional development. Most recent regeneration attempts have primarily resulted in the collective being able to “reclaim” areas facing the sea [13].

4.1.3 Environmental sustainability

People and investments are constantly drawn to attractive and unique areas, but attempting to maintain this image may reduce the production of a generic environment as a result of contemporary growth. So, the difficulty of a successful waterfront is to create a distinct place based on its personalities and activities while still providing modern services. As a result, waterfront properties present excellent potential for urban development and allow the city to compete with other cities on a global scale to attract riches in both physical and human terms. Competitive advantage

is an important part of many countries and municipal urban initiatives. While the waterfronts are extremely visible in most cities, their development is critical to many environmental and urban regeneration initiatives. Additionally, successful waterfront development necessitates an understanding of the global process. As a result, distinct settings, sufficient infrastructure, and distinctive locations at waterfront sites give cities a considerable competitive edge in the global economy and attract tourists [12]. Unfortunately, the concern for coast ecology was previously ignored, and all attention was directed to industry and technology; however, in recent decades, the interest in creating ecological protection areas has grown, as has the importance of protecting water quality and the environment as a fundamental issue for development. Waterfronts in cities confront several issues, including global climate change, rising sea levels, and trash from diverse usage. As a result, environmental protection may be achieved by selecting appropriate economic-social applications and using resources responsibly, using all decision-makers' assets. Some uses are critical to achieving this, including ensuring water quality and environmental protection of aquarium life, lowering energy and material consumption, and utilizing green infrastructure such as trees and vegetation along greenways. These applications should help reduce energy consumption, enhance air quality, eliminate heat islands, and lower sound transmission and local noise pollution levels. Use sustainable storm water management and provide pedestrian-friendly walkways and appealing open areas with shade spots. It may also do this by implementing a sustainable transportation system, building using renewable energy resources, and managing garbage in a sustainable manner [13].

4.2 Identity

Identity is a concept that distinguishes individuals from similar ones and expresses their uniqueness. It is influenced by experiences and preferences, which shape a person's identity in relation to their environment, people, and the world. The identity of a place is determined by the needs, expectations, feelings, values, and beliefs of its inhabitants, as well as the tastes and preferences of the people. The purpose of a place and the preferences of its inhabitants play a significant role in shaping its identity [14]. Culture and history play a crucial role in urban renewal, driving change, and promoting sustainability in the cultural sector. Integration of locations, people, economies, and cultures results in employment as well as social and sustainable development. Creative cities aim to enhance the relationship between social renewal, economic development, and regeneration. Because of their distinct local characteristics, these cities focus on urban planning, marketing, and revitalization. They evolve into creative clusters due to structural and economic changes, implemented through innovative initiatives based on the economics of excellence, culture, and territorial quality. This article aims to demonstrate the primary elements influencing creativity in cities [12] and new policies such as participation, history, local identity, cultural resources, sustainability, and an iconic case study of creative regeneration [14].

4.2.1 Place identity

Place identity is a complex pattern that combines the identity of a place and a person, determined by preferences, expectations, feelings, values, and beliefs. It is influenced by the experiences and preferences of people in relation to the natural environment and others [14].

4.2.2 Urban identity

Urban identity is significantly impacted by environmental and cultural factors, particularly in waterfront locations. The loss of local tradition and culture due to urbanization and population expansion has negatively impacted identity. The development of the waterfront provides a chance to exhibit the city's distinctive character and encourages identity preservation. The key to the waterfront's design and planning success is preserving the city's richness and feel as it evolves over time. Various forms and methods characterize urban identity and convey the elements of place identity that contribute to the success and efficacy of urban areas as physical environments and sites for activities [14].

4.3 Imageability

Imageability is the quality of a place that makes it recognizable and memorable. A place has high imageability when specific physical elements and their arrangement evoke distinct images or positive feelings. These physical elements, such as street furniture, street signs, landscape features, and building facade features, all together create a strong image for urban design. In addition, the waterfront cities have a great opportunity to have a stronger imageability of urban design as the waterscape evokes a distinct, strong image for the users and even the visitors. Moreover, the legibility of a city, according to the pioneer Kevin Lynch, has a great role in creating strong urban imageability, as it also combines both the ability of the physical object to project a strong, distinctive image as well as the ability of the observer to mentally select, process, store, organize, and endow the image with meaning [15].

4.3.1 Public space

Public space refers to meeting areas outside of buildings that promote community engagement and closeness. It prioritizes public engagement over ownership or stewardship. A good public area is both pleasant and appealing, with

a sense of security, cleanliness, and sitting options. People prefer sites that provide a range of seating alternatives, allowing them to be in or out of the sun at different times of the day or year. A diversity of activities is required for a wonderful site to attract a diverse group of individuals at different times of day. Activities like playgrounds, basketball courts, and concerts may appeal to a wide range of ages and demographics. This is the most significant trait a location can have, since it becomes a preferred destination for people to meet friends, greet neighbors, and feel at ease talking with strangers. When a location becomes a preferred venue for people to meet friends, greet neighbors, and feel comfortable engaging with strangers, it is well on its way to being a fantastic destination [16].

To improve the waterfront experience, a waterfront design should incorporate many elements, such as a promenade or boardwalk, observation decks, docks, and art installations. These features can link services and activities, give panoramic vistas, and function as focal points for water-related events. Public art installations, sculptures, and murals may have cultural significance as well as aesthetic appeal. Playgrounds, sports courts, and exercise areas may encourage active engagement and increase the flexibility of the space. Environmental factors should be considered, such as introducing native flora, wetlands, or bioswales to boost biodiversity and filter stormwater runoff. Tourists may travel to the waterfront area and find numerous amenities and activities with clear signage and navigation systems. As a whole, an attractive shoreline may improve the whole tourist experience [17].

Open public space design is a comprehensive process that includes building places that are inviting, useful, and visually appealing to the public. These spaces serve as gathering places for a variety of activities, encouraging social contact, recreation, and community involvement. In urban situations, scale is critical for producing drama, visual closeness, and reflecting a place's practical or symbolic value. The pedestrian environment depends on creating a comfortable degree of spatial confinement, with the optimal width equal to or less than the height of adjacent buildings. Hardscape materials must be visually appealing, structurally sound, weather-resistant, and require little upkeep. They must be used creatively to create areas that are appealing and detailed enough not to be readily destroyed. The ground is one of the planes that surrounds any space and can be handled in ways that complement or contrast with the space's and surrounding planes' characteristics. Attention to detail is critical for the quality of the public realm since it influences aesthetic appearance and practical accessibility. In big projects or regeneration zones, street design and material selection must be uniform and reasonable throughout the territory. In these circumstances, consistency in design and material selection is critical [18].

4.3.2 Waterfront greenspace

Along the urban waterfront, vegetation provides a variety of functions, including aesthetic, ornamental, and ecological ones. Improving people's quality of life, the environment, and the way the city is perceived are all dependent on it. The planning and organization of waterfront park greenery can be guided by an understanding of the fundamental concepts and layout of waterfront urban landscaping. Given that people are naturally drawn to water and are concerned about urban ecology, waterfront gardening landscapes are highly valued for their distinctive aquatic environments. It is aesthetically pleasing, ecologically significant, and blends in nicely with the surroundings. To better fulfill the role of ecological aesthetics, the plant landscape of the waterfront park can be combined with topographic features, zone construction of the water environment, and the ecological habits of various plants. It can also be arranged in a way that is reasonable and scientific to improve the city's climate environment while also meeting the needs of both people and nature [19].

Urban waterfront landscape plants: Trees, herbs, shrubs, creepers, and flowers are the five primary categories of plants found in urban settings. Although they all seem different, with various kinds of roots, stalks, leaves, flowers, fruits, seeds, and so forth, they all contain the same parts and serve the same purposes. As a result, the basic criteria used to classify plants are several; in addition, the plants' height, life cycle, branches, and softness of stem are all taken into consideration. The most intricate and challenging landscape plans are those for urban waterfronts. Urban waterfront landscape design requires careful selection of plants that can thrive in specific conditions, such as salty soil, wind exposure, direct sunlight, and salt spray [20].

4.3.3 Street furniture

Street furniture is a collection of structures and items used in public spaces, including outdoor ones, to enhance functionality and aesthetics. It includes practical elements like benches, lighting, barriers, waste bins, and decorative pieces like banners and public art. Street furniture also helps manage traffic by designating lanes and separating pedestrian zones from vehicular traffic. Decorative elements like fountains provide relief in hot climates, while bike racks offer secure parking for cyclists. Seasonal kiosks serve temporary business or informational purposes during peak travel seasons. Street furniture contributes to the overall livability and vibrancy of public environments, transforming them into thriving centers of activity and innovation [21].

Street furniture design should consider weather conditions, especially in coastal regions with high humidity and salty air. Strong shapes, organic materials, and natural finishes are essential for durability and minimal maintenance. Materials like stainless steel, outdoor-prepared iron, and synthetic resin are recommended for their durability and corrosion resistance. Concrete furniture offers a long lifespan and aesthetic appeal, often requiring no installation

unless vandalism is a concern. Stone is also robust and resistant to damage, making it a cost-effective choice for various design styles. These materials contribute to the durability of street furniture and their ability to withstand weather conditions, providing functional and aesthetically pleasing solutions for public spaces [21].

4.4 Diversity

Waterfront areas serve a vast range of demographics, including age, gender, and color. As a result, a wide range of activities should be considered, from toddler play to adolescent entertainment to geriatric health. It is critical to improve visibility to and through the park by reducing dense plants, walkway dead ends, and walled sections. Circulation routes that connect via a park from off-site locations are a smart approach to ensuring a steady flow of pedestrians, increasing the feeling of safety [22].

4.4.1 Land use

Urban waterfronts serve a variety of functions, including being hubs of water-dependent commercial activity and appealing public leisure sites. They are also desirable areas for residential and commercial purposes, such as restaurants and shopping. Waterfronts must also adapt to a variety of stresses and changes, including quickly changing economic conditions and rising flood danger. Waterfronts are very adaptable in nature, which means they may serve a variety of functions. Local governments may want to create it for a specific cause, or they may desire to use waterfronts for numerous purposes at the same time. The latter is where they must exercise extra caution since distinct elements may be too contrasting to operate correctly when placed close to one another. This issue is also a strategic topic.

(1) Commercial: The waterfront may be a desirable location for enterprises of all sizes. This is why commercial waterfront developments are common.

(2) Residential: People construct waterfronts for residential purposes as well. It's amazing to have a property with a breathtaking view of the waterfront.

(3) Recreational: It complements the preceding one. Specifically, seaside inhabitants need a place to recreate, and a local promenade appears like an excellent answer in most circumstances [22].

4.4.2 Waterfronts activities

The activities that occur on waterfronts are determined by the land use. People go to waterfronts to play sports, enjoy water recreational amenities, work, dine, sit, shop, travel, trade, and even stay. Sports such as basketball, volleyball, swimming, walking, jogging, riding, and fishing can take place in public or private venues. Many water recreational amenities, including swimming, diving, boating, jet skiing, rafting, and surfing, are accessible on waterfronts, either in public open spaces or private commercial areas. People gather to work along the shoreline in commercial, industrial, or open public places. People can work in a variety of facilities, including boats, kiosks, shopping malls, factories, and others. Other activities include dining or drinking at restaurants, cafeterias, or kiosks; sitting in parks, open spaces, or cornices; and shopping at retail stores or chalets [23]. The waterfront activities influence the community's physical activity, behavior, and health by offering maintenance, safety, beauty, and facility to the public spaces, Figure 3.

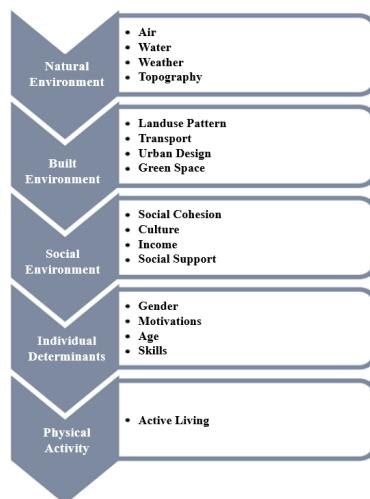


Figure 3. Factors that affect physical activity in communities

4.5 Accessibility

Urban open spaces should be universally accessible, incorporating features like ramps, elevators, and clear signage for people with disabilities. They should be well-connected to the surrounding urban fabric, with clear pathways and connections to nearby streets and transportation networks. Circulation design encourages efficient use, while safety and security are prioritized through appropriate lighting, clear sightlines, and surveillance cameras. This creates a sense of comfort and safety, encouraging frequent use of the space [24].

4.5.1 Vehicle accessibility

Well-planned roads that give cars safe, clear routes should be present around waterfront locations. To help drivers, this involves using the appropriate traffic signals, signage, and lane markings. Vehicles should be able to park in sufficient numbers close to shoreline areas. This could include parking garages, on-street parking spots, and designated parking lots. Supplies and goods must frequently be loaded and unloaded in waterfront regions. To enable these operations, designated zones should be established, guaranteeing effective vehicle circulation, and reducing traffic disturbances. Public transportation systems should be well connected to waterfront areas so that people may visit these places without having to rely entirely on private vehicles. To lead drivers to seaside areas and point them in the direction of parking lots and other amenities, there should be clearly visible signage posted. Wayfinding elements, such as maps and directional signs, can help drivers navigate the waterfront area easily [24].

4.5.2 Pedestrians accessibility

These are designated paths for pedestrians to walk on, separated from vehicular traffic. Pedestrian signals These are traffic signals that indicate when it is safe for pedestrians to cross the street. They should be visible and audible to all pedestrians, including those with visual or hearing impairments. Adequate lighting is essential for pedestrian safety, especially at night or in areas with high crime rates. Streets that are designed with pedestrians in mind have features such as wide sidewalks, on-street parking, and reduced speed limits. This can encourage more people to walk and create a more livable, walkable community [24].

4.5.3 Accessibility for people with disabilities

People with disabilities should be able to access waterfront areas by design. This involves constructing ramps, parking lots, and walkways that are accessible. The sidewalk should feature curb cuts or ramps at crossings to make crossing the roadway easier for those with disabilities, especially wheelchair users. It should also be sufficiently broad to accommodate wheelchair users [25].

4.6 Stakeholders' Responsibility

Effective coordination and collaboration among waterfront district stakeholders is critical to guiding growth, ensuring sustainability, and enhancing community well-being. This balance between community requirements and environmental protection ensures that the waterfront remains a beneficial resource for all parties concerned and for all its users.

4.6.1 Government agencies

To balance environmental preservation, economic growth, and public enjoyment, government organizations are essential to the management, development, and protection of waterfront regions. In addition to economic growth and tourism, they oversee coastline management and flood prevention, public access and recreation, urban planning and development, environmental protection, and stakeholder engagement and collaboration. Enforcing pollution laws, keeping an eye on the condition of the water, and making sure businesses and individuals follow environmental standards are all part of environmental protection. The process of urban planning and development includes creating master plans, zoning laws, and managing the building of infrastructure. Creating and maintaining parks, beaches, boardwalks, and other public areas while striking a balance between public safety and conservation initiatives is known as public access and recreation. Coastal management and flood protection entail creating plans to reduce the dangers brought on by storm surges, sea level rise, and coastal erosion [26].

4.6.2 Private investors

Private investors play a crucial role in financing and constructing development projects in waterfront areas, enhancing the area's attractiveness and economic potential. They must integrate environmental considerations into their projects, implement stainable design practices, and adhere to environmental regulations. They should also provide public access and community engagement, as well as amenities and recreational spaces that benefit residents and visitors. Engaging with the community through consultations, meetings, and partnerships ensures alignment with community needs. Private investors contribute to the local economy and social well-being by creating job opportunities, attracting businesses, and supporting emerging businesses. They can also invest in comfortable public liberalization, contributing to the overall prosperity of the community [27].

4.6.3 Community members and the public

The public and members of the community are essential to the sustainable management and use of waterfront assets. Stewardship and conservation, active involvement in decision-making processes, advocacy for sustainable practices, observance of public areas, reporting of environmental issues, and support of community engagement are among the principal duties. Respecting the environment and abstaining from damaging practices are essential components of stewardship. The participation of the public in discussions and consultations regarding policies, rules, and development plans influences the formulation of decisions that affect the waterfront. Programs for recycling, energy saving, and wise water usage are examples of sustainable practices. An environment that is welcoming can be achieved by reporting environmental issues and showing respect for public spaces. Participation in local efforts by the community encourages shared responsibility for the wellbeing of the waterfront and a sense of community ownership [28].

4.7 Smartness

The technological period has had a major impact on urban living, with technology helping to shape these areas. This study uses descriptive-analytic and library research methodologies to analyze the relationship between technology and urban space. Urban space is the result of historical, social, and cultural influences, and it is shaped by geographical, physical, and civic factors, as well as technology design. Understanding the mechanism of technology in space is critical for comprehending the social, cultural, and physical dimensions of urban life. Technological urban spaces can only be created if civic space is aligned with science and technology [29].

4.7.1 Technology aspect

The integration of information technology, human-computer interaction, and urban planning are key concepts in this study. Web platforms have emerged to share information about spatial projects with local people, allowing them to understand their needs and knowledge. The use and implementation of technology, especially in relation to waterfront areas, need to be appropriated to the water's character and location [29].

4.7.2 Technology in urban space

Technology has a significant impact on urban life, impacting the design and execution of public places including parks, squares, walkways, and retail malls. The future of urban life is dependent on the use of technology to decrease material waste, promote sustainability, and optimize energy-saving goods and materials. To overcome this issue, urban architecture must integrate the notion of technology into the city and include inhabitants in its execution [30].

4.7.3 Secure Internet of Things (IoT) architectures for smart applications

Designing safe IoT infrastructures for smart applications is crucial for satisfying people's expectations and needs. The Internet of Things Architecture (IoT-A) aimed to lay the groundwork for the creation of an Architectural Reference Model (ARM) for the IoT, with the goal of creating a coherent architecture that allows for the integration of disparate technologies and supports IoT system interoperability [30].

4.7.4 Solutions to proper technological design in urban space

Designers may create rooms that are both useful and appealing by incorporating technology into architectural design, as well as using bright and basic colors to promote sustainability. Displaying technology as the essence of the elements employed in the next era of space design [30].

- Clarifying, layering, and presenting motion in places utilizing cutting-edge materials and building techniques.
- Using bright and basic colors to achieve sustainability in terms of attractiveness.
- Utilizing buildings and structures to enhance architectural aesthetics.
- Choosing functional practical materials to address structural and climatic challenges, while enhancing visual appeal.
- Using lightweight and flexible components to adjust the perspective of areas as needed.
- Separating the service provider parts from the portions that are being serviced.
- Designing IoT integrated smart street furniture [31].
- Generating electricity by footpath power generator floor tiles.
- Creating walkable urbanism and promoting green transportation planning.
- Combining conventional creative and technical skills with a current grasp of environmental, social, and economic implications.
- Using the standards to reduce energy and CO_2 emissions in buildings and urban areas.
- Implementing an environmental assessment methodology in all urban developments.

4.7.5 Smart urban mobility

Urban mobility is a crucial concern for local governments, necessitating meticulous planning and optimization of automobile traffic. Technological design is critical to attaining this aim since it enables walkable urbanism, transit-oriented development, and green transportation planning. Smart urban mobility entails regulating and optimizing vehicular traffic inside metropolitan bounds to provide simple and seamless transportation to anybody, anywhere, at any time. This necessitates the careful design of urban places dedicated to automobile traffic, as well as the ability to immediately go online when necessary. The IoT plays an important role in enabling smart cities by supplying real-time data from the urban vehicle environment [29, 30].

Traffic monitoring: The capacity to monitor traffic congestion and detect traffic incidents in real time is critical for creating safer roads and better traffic flow. Such capacity can be obtained using statically installed cameras or other sensors, as well as real-time readings from the vehicles [31].

Smart parking: cameras or other sensors may be used to monitor the availability of vacant parking lots in the city, directing cars to the best parking options. Such a service may result in several benefits, including reduced transportation congestion, lower emissions, and less stressed residents.

Smart traffic lights: communications between traffic lights and automobiles can be developed to inform the latter of the best speed to hit a green light or other essential information. Additionally, certain traffic lights in the city may be changed in real time to improve the mobility of emergency vehicles [31].

5 Analysis of International Waterfront Development Examples

To better understand how sustainable waterfront development initiatives can influence waterfront cities, this section will examine two international examples of prosperous sustainable waterfront development. The selection of Jeddah Corniche as the location for waterfront development stems from a strategic blend of natural beauty, cultural significance, and economic potential. Situated along the Red Sea, the Jeddah Corniche boasts breathtaking views of the water, creating an aesthetically pleasing backdrop for a waterfront development project. The city's rich historical and cultural heritage further enhances its appeal, offering a unique blend of tradition and modernity. Additionally, the Jeddah Corniche is a popular destination for locals and tourists alike, providing a vibrant and dynamic atmosphere for leisure and recreation. The selection of Casablanca as the location for the Marina Project Development is a deliberate choice driven by a combination of strategic, economic, and geographical factors. Casablanca, Morocco's economic and business hub, is a vibrant metropolis with a rapidly growing urban landscape. The city's coastal location along the Atlantic Ocean not only provides a picturesque setting but also offers significant potential for maritime and leisure activities. The Casablanca Marina Project is designed to capitalize on these attributes, transforming the waterfront into a modern, sophisticated destination that integrates luxury living, commercial spaces, and recreational facilities. Moreover, the strategic positioning aligns with the city's aspirations for urban development and economic growth, making it an ideal location for attracting investment, tourism, and fostering a dynamic waterfront community.

5.1 Waterfront Development of Jeddah Corniche

Jeddah Corniche is another name for Jeddah Waterfront. It is a 110-kilometer-long seaside leisure area in Jeddah. It covered over 100 kilometers alongside the Red Sea, running north to south. The southern, middle, and north corniches make up the corniche. There are restaurants, beach cabins, lodging options, and a playground there. The Al Rahma Mosque in the north, the Jeddah fountain in the middle, and the open museum statues in the middle of the corniche are the most well-known features [32].

5.1.1 Geographical location

Saudi Arabia's business and tourism center is Jeddah, a city on the eastern financial institutions of the Red Sea. The 110 km² Jeddah Waterfront, sometimes called Jeddah Corniche, is the city's seaside vacation region, Figure 4. It is situated beside the Red Sea and spans around 100 kilometers from north to south alongside the coast. The corniche is separated into the southern, middle, and northern sections [32].

5.1.2 Main goals of the Jeddah waterfront development project

(1) Social benefits: Jeddah's waterfront is a key attraction for both residents and visitors, offering various recreational and social opportunities. The megaproject aims to integrate the waterfront into a cohesive design, providing diverse functions and essential public services for people of all socioeconomic backgrounds [33].

(2) Cultural benefits: Future plans can take advantage of current cultural wealth. Guarantee the safety and enjoyment of visitors and consumers, in addition to securing areas for numerous events. Conducting permitted mobility analyses to enhance traffic flow along the corniche [33].

(3) Economic benefits: Creating a sufficient infrastructure for power, sewage, water supply, and drainage. It also aims to renovate the commercial sources to give personality to the area and provide services that satisfy international standards [32].



Figure 4. Satellite view of Jeddah

5.1.3 Stages of Jeddah Corniche development

With the help of four large initiatives, this massive project, which was started in 2011 to enhance and extend Jeddah's waterfront, seeks to accomplish a number of objectives [34].

1st stage: Development of Northern Corniche: The Northern Corniche is composed of three pathways that run parallel to one another and produce man-made lakes alongside the highways as they approach the sea, Figure 5. The two components of the project's development plans will be created over the course of five stages: The first part has an amusement park, sand coastline, marina, outdoor dining options, attractions for families, kids' play areas, open green spaces, and outdoor festival centers. May 2011 was the beginning, and August 2012 marked the end. In the second part, 350 m² of waterfront will be developed, along with 500 m² of vegetated space, 4634 m promenades, 200 m² of bathing beaches, 10 public restrooms, 25 Gothic-style buildings, 5 viewing towers, a marine transportation system, ornamental artworks, and 75 marine ports, and parking areas covering 1600 square meters, Figure 5 [34].



Figure 5. Development of northern corniche

2nd stage: Development of Middle corniche: This section of the Jeddah seafront extends approximately 3.6 kilometers. The construction of the work, which cost around \$36.135 million, began in 2011 and was completed in 2013. Situated next to Palestine Road alongside the Central Corniche is the well-known Hassan Enany Mosque. It was constructed in 1984 by designer Raouf Helmi on Hassan Enany's contract, a Makkan businessperson. It is a unique prayer hall with space for 1200 worshipers, capped with an octagonal gold dome, Figure 6. This section included the development of 800 parking spaces, infrastructural rainfall drainage, floral cases, asphalt, lights, signage, advertisements, irrigation systems, and benches, Figure 6 [33].



Figure 6. Development of middle corniche

3rd stage: Development of Southern Corniche (Al-Saif Beach): This corniche is situated on Jeddah's southern shore and is parallel to the Jeddah South Highway, which connects the city's center to the south. The distance between this area of the shoreline and Jeddah's city is around twenty minutes. Additionally, compared to other coastal areas

in Jeddah, this area features naturally occurring sand beaches. This construction project's initial stage contains a 230 m^2 landscape located 3 kilometers along the coast, Figure 7. The primary goals of the work are to grow and improve the coastline, maintain, and utilize the area's distinctive geological as well as topographic characteristics, supply the necessary amenities, and establish tourist destinations, Figure 7 [34].

4th stage: The Open Museum: This section of the waterways, which occupies 7000 m^2 , is one of the biggest public exhibits in the entire globe and is situated next to the Al-Anany mosque on the middle Corniche, Figure 6. This free exhibition features a large collection of 26 bronze statues created by well-known artists, including Mostafa Sonbol, Jean Arp, Victor Vasarely, Hennery Moore, and César Baldaccini. By putting paintings and other sculptures at intersections and on sidewalks that run beside the Corniche, the Corniche's accepted form gives a sense of art throughout. Most of the statues and paintings are in the northern and central sections of the corniche [33]. The biggest collection of statues and paintings by well-known international artists is said to be housed in the Jeddah, Figure 7.



Figure 7. New playground area near coastline and sand beach in southern corniche, along with statues and artworks in the open museum

5.1.4 Maintenance of Jeddah corniche development

The adoption of laws and policies that support sustainable development is a crucial part of Jeddah City's efforts to enhance its waterfronts in a sustainable manner. This section will look at Jeddah City's current laws and rules on sustainable waterfront development and how they affect projects involving waterfront development. The region's distinctive ecosystem, biodiversity, and natural resources are all to be preserved while promoting sustainable development through these initiatives. When conducting development operations alongside the waterfront, contractors must abide by these regulations [35]. Additionally, there are several opportunities to support Jeddah City's sustainable waterfront development and bolster current laws and policies. One chance is to employ technology, like drones and satellite imaging, for tracking compliance with regulations, which can help enforce current regulations more effectively. Enhancing cooperation and coordination presents another chance. Additionally, there are chances to support Jeddah City's sustainable waterfront development and bolster current laws and policies. One chance is to employ technology, like drones and satellite imaging, to monitor compliance with regulations, which can help enforce current regulations more effectively. Enhancing cooperation and coordination between the departments and agencies of the government in charge of overseeing Jeddah's waterfront development presents another chance [35]. Another essential component of environmentally friendly waterfront development is environmental restrictions. To safeguard the shoreline alongside the Red Sea, Saudi Arabia has been putting environmental guidelines and laws into place. These initiatives assist in environmentally friendly growth by protecting the area's distinctive environment, biodiversity, and natural resources [35].

5.2 Casablanca Marina Project Development

Morocco's economic hub is Casablanca. The city has a deep, personal, and intricate relationship with the Atlantic Ocean since it represents the city's urban development, its entryway to the outside world, and the source of previous colonizing dangers. For ages, the city has been giving in to the water due to the latter, with the coastline region being used for harbor operations, large-scale manufacturing, or just general degradation. Decision-makers in the city did not begin to take an interest in the coastal area until the 1990s [36].

5.2.1 Geographical location

Casablanca was situated outside the polygon of centers that dictated Morocco's future up until the nineteenth century. It became the melting pot of a modern civilization due to the mingling of inhabitants and the productive collaboration of businesspeople, speculators, professionals, and wise officials. It has, nevertheless, continued to be a battleground for conflicts between political parties, socioeconomic classes, and national groupings. Casablanca demonstrates the paradoxes of its status as the principal port of contemporary Morocco, with the affluence and sophistication of its bourgeois population coexisting with the destituteness of those who have been uprooted from the countryside, Figure 8 [37]. 26 hectares in all were created for the project, including 10 hectares that were retrieved from the sea. Its principal components are a central business district, neighborhoods, establishments, and open places. The building's program has $476,600\text{ m}^2$ of floor space overall, not including parking lots, and is divided into

several uses: workplaces (33%), commerce (15%), lodging (12%), recreation, amenities, and amusement (10%), and housing (30%). In addition to becoming a commercial center, the project linked two of the city's most notable buildings, the Hassan II Mosque, and the Casablanca Port, and restored the city's connection to the ocean [38].

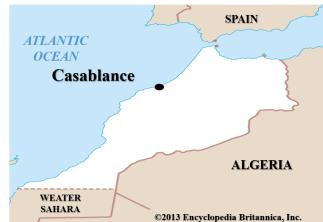


Figure 8. Casablanca geographical location

5.2.2 Main goals of the Casablanca marina project

The Casablanca-Settat region is home to numerous cultural and natural resources, allowing us to provide a wide range of unique experiences to visitors. The area wants to create a two-pronged offering surrounding city-breaks that caters to both nature and business travelers as well as those interested in culture and leisure. The city and its environs rank among the most popular tourist sites in the country, and the future of tourism looks quite bright. In the dynamic, international metropolis of Casablanca, both contemporary and ancient cultures coexist [39].

(1) Economic benefits: This project seeks to build an important imaginative and cultural hub that will showcase local and international skills and operations. It also intends to establish a business hub in town that will support foreign businesses, offer workplaces to new companies, boost the local economy, and generate 16,000 jobs in the manufacturing, sales, and artistic endeavors fields. It is considered a novel attraction and the point of departure for travelers arriving in the town by train or plane [39].

(2) Cultural benefits: Supplying cultural infrastructure such as theaters and plazas, organizing festivals and other cultural events, developing new centers for the arts and culture, and highlighting the value of the arts and culture both domestically and globally [38].

(3) Social benefits: Huge and open public areas can be provided that are accessible to all citizens. Social space available for soaking up the ocean view provides places to eat, shop, and relax (restaurants, marinas), as well as organizing social gatherings and activities [39].

5.2.3 Stages of Casablanca marina project development

This mixed-use development project aims to create a dynamic, easily accessible urban space for business and leisure on Casablanca's seafront. A thorough design assessment was conducted on the development's master plan, which includes for a large marina containing a yacht club, two luxurious hotels, 10,000 m^2 of commercial space, a 20,000 m^2 event center, and 35,000 m^2 of carpark, Figure 9 [39].



Figure 9. Current marine development

1st stage: Maritime Promenade: Numerous logistical problems caused it to be delayed in construction for a number of years. Consequently, it didn't begin until 2001, was restarted in 2005, and was delivered in March 2018. The timing of the new structural project, "Maritime Promenade of the Hassan II Mosque of Casablanca" is ideal for bolstering the city's fundamental infrastructure and elevating it to the status of universal cities and towns. This project, whose development work was started on Wednesday by HM King Mohammed VI, may God assist him, entails building an urban park that is accessible to the public from the Hassan II Mosque to El Hank, as well as a cornice along El Hank dike [40].

2nd stage: Commercial zones: It featured a pedestrian zone and central alley, a scenic area, a recreational area, a cultural area, and a section with cafes and restaurants. As it was divided into three sections: celebratory, coastal, and

natural, the project featured rest spots, places, walks, outdoor sport, Figure 10, direct beach access, and an amazing promenade, Figure 10 [40].



Figure 10. Outdoor sport area and Marine recreational design

3rd stage: Components during the final phase: The project's objectives are to build hotel rooms, residential towers, and business, office, and recreational facilities in the center, shown in Figure 11. Given the project's location, the harbor will have a significant tourism hub that provides a range of facilities to improve the surrounding area, which includes the historic Medina and the port of Casablanca in addition [40]. Marjane Shopping Center connects the new residential and business district of "Casablanca Marina" into which it is harmonious, with the other parts of the city and the old medina. It is situated between Boulevard des Almohades to the south and the Atlantic Ocean to the north. Additionally, it perfectly blends in with the vibe and atmosphere of the Kingdom's new Corniche, which is not exclusively just a strolling and holiday spot but rather a venue for gatherings and diversity, Figure 11 [39].

4th stage: Components under construction: The centerpiece of Casablanca, Morocco's plans to entice visitors and residents with an exciting new attraction, is a huge aquarium. A 15,000 m^2 aquarium with a variety of marine creatures, including sharks, sea lions, dolphins, and penguins, would be constructed at the Casablanca Marina, shown in Figure 11. The Oceanographic Park of the City of Arts and Sciences in Valencia, Spain, which is collaborating with the new aquarium following the signature of a memorandum of understanding in April 2013, served as the model for the plans, which are the brainchild of the Casablanca-based Al Manar Development Company (AMDC). It is a Dolphinarium, a shark tank, and habitats for a variety of marine life will also be part of the development. The lead developer for the project is Groupe Coutant, a specialist in aquarium design. With this aquarium installed in Casablanca Marina, the city hopes to become more appealing and competitive both regionally and globally as a travel and business attraction [39]. The structural behavior of the Marriott hotel is determined by its twisting shape, which includes a crooked triangular floor that rotates at each subsequent floor, totaling a 135° twist. This twist is addressed by an inner circular core and a series of inclined outer and inner columns that follow the twist of the floor, Figure 11 [40].



Figure 11. New residential towers and Marjane shopping center, along with Casablanca new aquarium proposal and Marriott hotel in Casablanca marine

5.2.4 Maintenance of Casablanca marina project development

A significant shift in Morocco's tourist strategy has been the country's intention to support yachting tourism through the establishment of marinas. In an effort to transform the kingdom's maritime infrastructure, a number of initiatives have been developed. First-class lighting and hardwood candelabras were chosen by the government due to the excessive humidity in the area. With the help of the Downtown Waterfront Landscaping & Maintenance contract, Casablanca was able to increase the number of employees, including a number of women, who are not often seen in this industry. They have made investments in snow removal services, IOT cleaning systems for landscapes, and new equipment that will enable them to concentrate on landscaping prospects [39].

6 Proposed Agenda

The agenda outlined in Table 1 was proposed by integrating data from previous waterfront development strategies, insights from two international cities, principles of sustainable design, smart technologies, ecological restoration, and resilient infrastructure. This proposed agenda for urban waterfront development is a multifaceted initiative grounded in the convergence of urban planning, environmental sustainability, and community engagement. It seeks to address the dynamic challenges and opportunities presented by waterfront locales within urban landscapes and create a harmonious balance between urban fabric and the natural water environment.

Table 1. Proposed agenda

Strategy	Principles
Sustainability	<ul style="list-style-type: none"> •Protecting the integrity of water and the environment; •Creating a safe pedestrian path along water; •Increasing the use of sustainable transportation options; •Using sustainable infrastructure along the waterfront; •Protecting water quality and environmental sustainability
Identity	<ul style="list-style-type: none"> •Reusing historic buildings; •Restoring the design identity of the study area; •Improving community livability; •Prioritizing the unique identity and feeling of location during the development process; •Expanding the societal segment that is being addressed, which promotes variety; •Enhancing the safety aspects of open areas
Imageability	<ul style="list-style-type: none"> •Creating comfortable pleasant public spaces; •Creating different activities and amenities in public areas to attract a wide range of individuals; •Allowing people to stroll, jog, or cycle; •Providing viewing points to the water; •Creating points of attraction by adding public art and sculptures; •Increasing the versatility of recreational facilities of the space; •Recognizing the Environmental Considerations and creating habitat for wildlife; •Respecting a comfortable degree of spatial enclosure; •Designing the wayfinding elements and signages; •Designing suitable street furniture; •Using materials that are visually appealing, structurally strong, and have good weathering properties; •Treating the ground surfaces; •Detailing the aesthetic appearance and functional accessibility; Ensuring continuity in design and material
Diversity	<ul style="list-style-type: none"> •Creating public spaces with opportunities for recreation activities; •Linking facilities and open spaces on the waterfront; •Making building reuse and adaptive reuse; •Combining residential, commercial, and recreational areas; •Fostering a vibrant community and reducing the need for extensive commuting
Accessibility	<ul style="list-style-type: none"> •Providing Vehicles Accessibility: well-designed roadways; •Providing sidewalk Accessibility: designated paths for pedestrians to walk; •Providing accessibility for people with disabilities: accessible parking spaces, ramps, and pathways; •Enhancing public transit capacity and routes; •Increasing the range of public transit options
Stakeholders' Responsibility	<ul style="list-style-type: none"> •Provide an outdoor public space when feasible; •Design an outdoor public space to be actively used; •Promoting social integration through community participation and sustainable practices; •Respecting and maintaining the public spaces; •Reporting environmental issues; •Improving community livability; •Providing job opportunities; •Striving social equity
Smartness	<ul style="list-style-type: none"> •Using of renewable energy sources; •Using Urban integrated photovoltaic; •Using innovative technology to produce street furniture; •Using smart technology to improve maintenance activities' responsiveness and efficiency; •Producing energy in urban spaces

7 Case Study

7.1 Historic Background

Alexandria became Egypt's capital after Alexander the Great conquered the kingdom in the fourth century BC. During Ptolemy II's reign, the city served as Egypt's principal gateway to the outside world, known for its ports, harbors, lighthouse (one of the Seven Wonders of the Ancient World), and trade [12]. The air of the ancient Mediterranean city is still best inhaled in the Bahary area, located at the western end of the corniche, a 17-kilometer-long coastal promenade [2]. The site of Bahary was formerly the Heptastadium, the bridge that connected the mainland to the island of Pharos, connecting the Eastern and Western Harbors, when Alexandria was the hub of the Hellenistic world, Figure 12. The neighborhood is likely named after Augusto Anfossi, an artillery instructor under Mohamad Ali. There are many historic buildings, like the citadel of Qaitbay and the El Morsy Abou-El Abbas Mosque. This 13th-century mosque was dedicated to Andalusian Sufi Sheikh El Morsy Abou-El Abbas and housed his grave. The Citadel of Qaitbay, a defensive castle, was erected by Mamluk Sultan Al-Ashraf Qaitbay, Egypt's ruler, from 1468 to 1496 [41, 42]. El-Anfoushy is positioned along the Mediterranean coastline, offering residents and visitors breathtaking views of the sea. Known for its charming streets, El-Anfoushy is a blend of traditional and modern elements, featuring a mix of historic architecture and contemporary amenities [43]. The Morsy Abou-El Abbas and Bahari neighborhoods of Alexandria were formerly a cemetery area named Bab Al-Bahr, which means "gateway of the sea" since it faces the sea. Although, cemeteries were traditionally built outside the city walls, as more foreigners arrived, the city expanded beyond its boundaries [42]. By the beginning of the nineteenth century,

the city's walls had been mostly dismantled. Bahari and El-Anfoushy were the first regions to be developed since they were adjacent to the city's major port, and it made sense for them to become fishing hotspots [44].

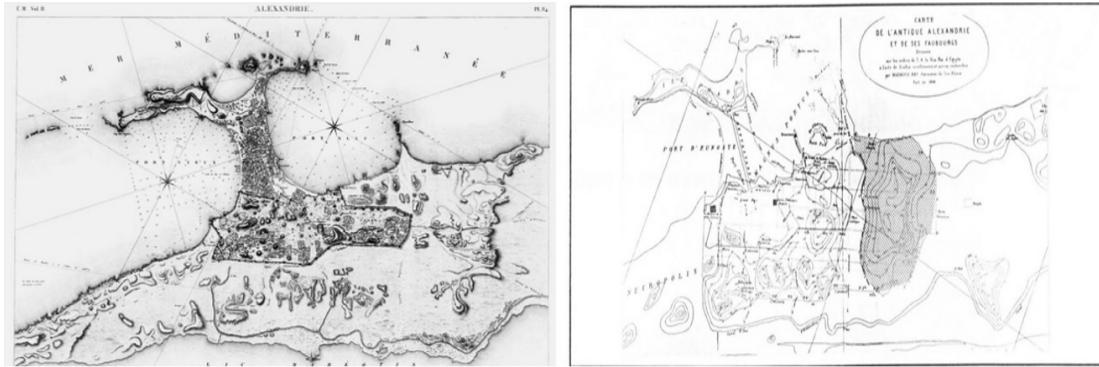


Figure 12. Maps of ancient Alexandria

Note: The left map showing Alexandria in 1798 by Description de l'Égypte, Vol. V, and the right map illustrating the Heptastadium that connects Pharaos Island to the mainland, by M. Al-Falaki, 1866

7.2 Location

El-Anfoushy is a neighborhood in El-Gomrok district, the west of Alexandria, Egypt, and overlooks both the Eastern and Western harbors [43]. El-Gomrok, covering an area of 4.7 km², is considered the oldest district in Alexandria [45]. Additionally, it is recognized as the smallest and most densely populated area in the city, accommodating 165,558 people [45]. The Mediterranean Sea's geographic location appears to have a significant influence on this area's ability to enjoy its moderate climate, which is ideal for human life during the whole year [44]. El-Anfoushy is known for its historical significance and cultural vibrancy, and it blends traditional architecture with contemporary structures, offering a diverse urban experience [43]. It is recognized as a neighborhood on the ancient Pharos Island and stands as one of the city's oldest suburbs. It is the starting point for exploring the hidden jewels of old Alexandria, away from the modern hotels, buildings, and restaurants [42]. El-Anfoushy is home to many old landmarks, including El Morsy Abou-El Abbas Mosque, El-Anfoushy Fish Market (Halaqat el-Samak), and Anfoushy Tombs. Its strategic location provides easy access to Alexandria's iconic landmarks [42].

The touristic promenade varies in width from 40 to 70 meters, extending 540 meters along the eastern harbor on the Mediterranean Sea, including many recreational buildings like clubs, restaurants, and aquarium museums, and ending by the citadel of Qaitbay [2, 42]. This promenade has proven to be a valuable asset to the community, attracting people together for social gatherings and tourists to take in the breathtaking scenery and appreciate its monumentality [2].

As a first phase in the waterfront development process, the location of the touristic promenade has been identified using Google Earth map, Figure 13, to initiate the survey process and document the current conditions, considering all users and site needs for the design process. These current conditions have been presented by the following maps, Figures 14-16, created through field surveys and multiple site visits to analyze various aspects of the site, encompassing solid and void areas, land use of surrounding buildings, building heights, building conditions determining facades in need of restoration, landmarks in context and their relation to it, and evaluating circulation and pathways around the site to study the promenade's permeability.



Figure 13. Location on satellite Google maps

7.3 Current Situation

The waterfront touristic promenade is regarded as one of Alexandria's primary urban potentials and is integrated into the urban fabric of the city. It has existed since antiquity and represents the various historical eras in the

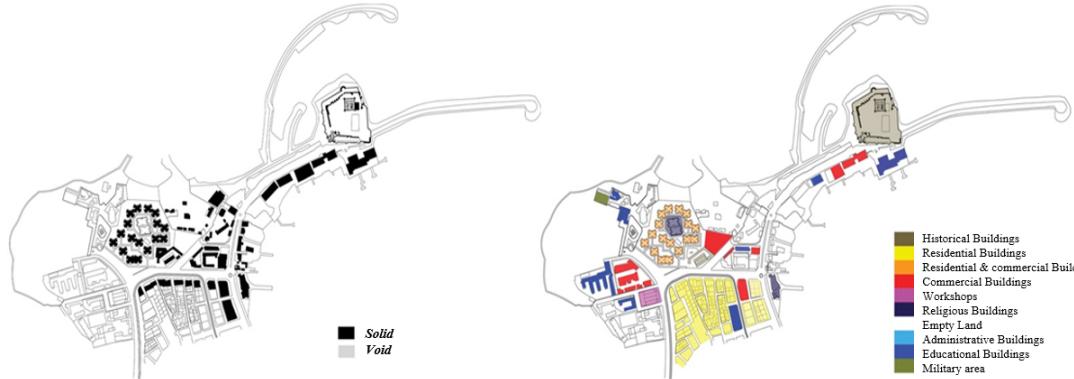


Figure 14. Solid and void map and land use map



Figure 15. Buildings' height map and Buildings' condition map

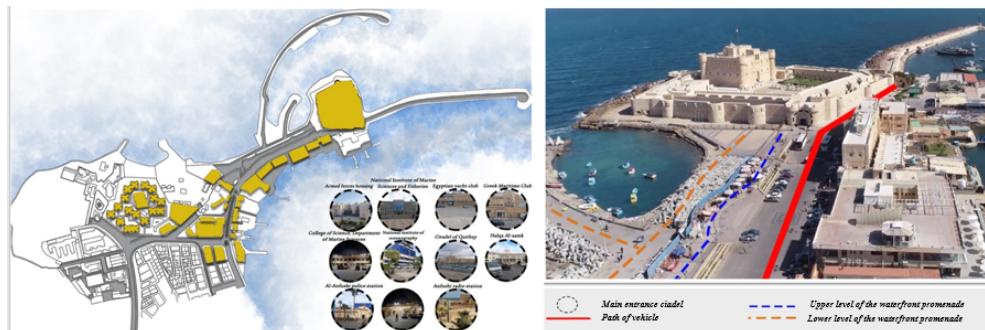


Figure 16. Landmark map and circulation and paths map

city's growth. The current location of the promenade is notable for its significant tourism appeal, drawing both local and international visitors and consequently resulting in a notably high visitor density. However, the existing standards fall short of meeting the diverse needs of guests in terms of services and the overall design of the place. In particular, public amenities, including furniture and lighting fixtures, exhibit several design flaws. Moreover, there is a noticeable lack of enthusiasm for programs aimed at educating people and improving the overall health and environment at these cultural centers. The situation is further compounded by environmental degradation, marked by the loss of trees and a variety of plants, as well as an alarming increase in litter. This not only detracts from the aesthetic appeal of the location but also poses potential environmental hazards. Regrettably, the specific details about the location, including its services and features, are not provided on the website, limiting the potential for informed decision-making and exploration by potential visitors. In essence, while the location holds great tourism potential, there is a pressing need to address deficiencies in service standards, place design, public amenities, and environmental conservation efforts. A comprehensive improvement strategy that encompasses these aspects could significantly enhance the overall appeal and sustainability of the site. The current situation, borders of the site, and its relation with the city as a whole have been identified, as well as some shots have been drawn, Figure 17, to determine all the development needs and begin the development design plan.



Figure 17. Current master plan and current situation shot

7.4 SWOT Analysis

Figure 18 summarizes the SWOT analysis of the current situation, which is also presented by some recent photos, Figure 19. This analysis determines the strengths, weaknesses, opportunities, and threats using the proposed waterfront strategies. These strengths and opportunities might help in achieving objectives; besides, weaknesses and threats might resist accomplishing targets. Then, apply the AHP method to prioritize these outcomes to make them measurable and to assign pairwise comparisons between these factors to determine their relative importance in achieving the overall goals of waterfront development and identifying the most effective approaches for revitalizing the waterfront area. The AHP method is utilized within the SWOT matrix by assessing SWOT groups through pairwise comparisons, utilizing a scale ranging from 1 to 9, as outlined in Table 2. This is followed by the comparison of SWOT factors within each group, as detailed in Tables 3-6. The collective priority of the SWOT factors is then determined, as presented in Table 7. The waterfront development process of El-Anfoushy can be improved by preserving strengths, providing different solutions for weaknesses, seizing opportunities, and avoiding threats. These approaches also suggest a supportive strategy for the enhancement of tourism as a dynamic unit by incorporating strategies, tools, and protection and sustainability goals to establish a "Breathing Life into Waterfront," which can develop and progress smartly and sustainably throughout the years while considering its history.



Figure 18. SWOT analysis

Table 2. Pairwise comparisons matrix of SWOT factors

SWOT Groups	S	W	O	T	Importance Degrees of SWOT Groups
Strengths (S)	1.00	5.00	0.20	3.00	0.22
Weaknesses (W)	0.20	1.00	0.14	0.33	0.05
Opportunities (O)	5.00	7.00	1.00	5.00	0.62
Threats (T)	0.33	3.00	0.20	1.00	0.11
Consistency Ratio CR = 8.8%					

Combining the SWOT and AHP methods yielded the previous results, indicating the ranking of each priority within the SWOT groups of the case study: the opportunity was assigned the highest priority, while the weakness was given the lowest priority. Additionally, the significance of various factors varies across the four SWOT groups.

1. STAINABILITY	1.1 ENVIRONMENT	STRENGTHS -The site is characterized by a diversity of natural resources, such as the sea and green areas, to create a healthy environment.	WEAKNESSES -The site lacks sufficient green areas and lacks integrated design to connect all elements. -It is also not available sustainable wastes collection management.	OPPO RTUNITIES - A successful waterfront environment will help to have unique and special areas that have characters and activities with modern facilities.	THREATS -global climatic variation, raise of the sea level and wastes of various uses.
1.2. SOCIETY		- The region around the site is characterized by a large population, which allows for the presence of many different age groups and diverse cultures.	- The state has no interest in or support for events that increase public awareness and motivate individuals to interact socially with one another at the site.	- Investments in cultural, tourism, leisure, and commercial projects will enhance social life and health by strengthening human-nature relationships.	-The lack of safety in the area affects the presence of large numbers.
1.3. ECONOMY		-Tourists are drawn to the areas because of its rich cultural and historical heritage that will increases the economy.	-There is no suitable organization for the site, and there is insufficient and inappropriate promotion for the area, which lowers the number of site visitors.	-Giving the area consideration and using it to boost the country economy will motivate the nation to consider similar initiatives in other locations.	-Rising taxes and rental rates levied against project owners on the property. Encroachments by private entrepreneurs.
2. IDNETITY		-Tourists flock to these regions due to their rich historical heritage such as the citadel of Qaitbay, EI Morsy Abou El Abbas Mosque.	- The loss of local tradition and culture due to urbanization and population expansion has negatively impacted identity.	-The success of waterfront design and planning relies on preserving the city's richness and atmosphere, while expressing identity	-A danger to the lives of sea creatures.
3. STAINABILITY	3.1 ENVIRONMENT	-There are many large squares that can be reused for various gatherings and activities. The site's numerous visits offer numerous opportunities for gathering.	-The improper and disorganized use of existing open areas discourages various activities and lacks comfort and hygiene techniques to promote their use by visitors.	-The open spaces on the site aim to enhance social and cultural life by facilitating diverse meetings and promoting various hobbies, including sports.	-Authorities in the region have neglected upkeep, and there aren't enough safety precautions in place to keep the crowds safe.
	3.2. LANDSCAPE	-The capacity of the area to support a wide variety of plants, together with other natural factors like the sea and green spaces, is what makes it unique. Many plants can be grown in this area as a result of the nature present on the site.	-The site lacks interest in random plant distribution, affecting the plants' natural function, and there is no design or landscape upgradation to connect the landscape with the surrounding elements.	-when the landscape is properly planned, it produces a harmonious environment and an appealing look that enhances the area's usability	-Disregarding the upkeep and care of crops and failing to assist nations in providing the resources required to grow plants.
	3.3. STREET FURNITURE	-There are many open spaces and pedestrian walkways.	-There is little street furniture, and there is no design for it or any directions to distinct areas of the site.	- Making Street furniture available on the site will improve social life, establish meeting spaces, and make the site more aesthetically pleasing.	- Inadequate upkeep and furniture theft from local residents and guests.
4. DIVERSITY	4.1 ACTIVITY	-There is a nature environment that helps organize different activities such as sports, tourism, and fishing, boating, kiosks and eating.	-The site lacks a clear design of space or directions to different areas, indicating an inadequate organization.	- Enhancing social and health conditions and establishing a structured atmosphere can attract various investments.	-There isn't enough safety precautions in place to keep the crowds safe.
	4.2. LAND USE	-There are many land uses, such as cultural, commercial and recreational.	- Neither the destinations selected nor the existing buildings' link to the urban environment are well-designed.	- generating employment, boosting the nation's economy, and boosting tourist.	-Rising taxes and rental rates levied against project owners on the property. Encroachments by private entrepreneurs.
5. ACCESSIBILITY		- Variety transportation to the site (cars, tram and buss). Also, its located near to main road.	-There are no designated parking spots and no consideration is given to pedestrian or disability access routes.	- Facilitating the access of tourists and visitors to the region in a simple and direct way, which encourages people to come to the site and increase tourism.	- Lack of maintenance of roads and pedestrian walkway.
6. STAKEHOLDERS		- The capacity of the area to support a wide variety of type of store.	- The site's organization is inadequate, and the area's promotion is insufficient, leading to a decrease in visitors.	- The site aims to improve social and cultural life by facilitating diverse meetings.	- The property is facing increased taxes and rental rates, as well as private entrepreneurs' encroachments. -Lack of maintenance .
7. SMARTNESS		-The location offers numerous technological features for visitors to explore the region's ancient history and anticipate future activities.	-There are no technological resources available on the site.	-Technological services enhance visitor awareness and encourage diverse experiences, offering various activities to cater to different ages and population burdens.	-There is inadequate protection at the location, making it vulnerable to theft.

Figure 19. Current photos

8 Waterfront Development of El-Anfoushy

A new urban design has been developed based on the proposed agenda to conserve historic waterfronts while also meeting functional tourism needs. The development process took into consideration the physical and design conditions of the case study using maps, images, interviews, questionnaires, and a SWOT analysis. Engaging the community in the planning and decision-making processes was implemented to guarantee that their perspectives are considered and their issues addressed, thereby nurturing a sense of ownership and commitment to the success of the

Table 3. Pairwise comparison matrix of the strengths factors

SWOT Groups	S1	S2	S3	S4	S5	S6	S7	Importance Degrees
S1 Sustainability	1.00	0.20	0.33	0.33	1.00	3.00	9.00	0.09
S2 Identity	5.00	1.00	5.00	3.00	5.00	7.00	9.00	0.40
S3 Imageability	3.00	0.20	1.00	0.33	3.00	5.00	7.00	0.15
S4 Diversity	3.00	0.33	3.00	1.00	3.00	5.00	7.00	0.21
S5 Accessibility	1.00	0.20	0.33	0.33	1.00	5.00	7.00	0.09
S6 Stakeholders' responsibility	0.33	0.14	0.20	0.20	0.20	1.00	3.00	0.04
S7 Smartness	0.11	0.11	0.14	0.14	0.14	0.33	1.00	0.02
Consistency Ratio CR = 8.3%								

Table 4. Pairwise comparison matrix of the weaknesses factors

SWOT Groups	W1	W2	W3	W4	W5	W6	W7	Importance Degrees
W1 Sustainability	1.00	5.00	0.33	3.00	3.00	0.20	0.14	0.08
W2 Identity	0.20	1.00	0.14	0.33	0.33	0.14	0.11	0.02
W3 Imageability	3.00	7.00	1.00	3.00	3.00	0.20	0.14	0.11
W4 Diversity	0.33	3.00	0.33	1.00	0.33	0.20	0.14	0.04
W5 Accessibility	0.33	3.00	0.33	3.00	1.00	0.20	0.14	0.05
W6 Stakeholders' responsibility	5.00	7.00	5.00	5.00	5.00	1.00	0.33	0.26
W7 Smartness	7.00	9.00	7.00	7.00	7.00	3.00	1.00	0.44
Consistency Ratio CR = 9.6%								

Table 5. Pairwise comparison matrix of the opportunities factors

SWOT Groups	O1	O2	O3	O4	O5	O6	O7	Importance Degrees
O1 Sustainability	1.00	0.20	0.33	0.20	0.33	5.00	7.00	0.08
O2 Identity	5.00	1.00	5.00	3.00	3.00	7.00	9.00	0.37
O3 Imageability	3.00	0.20	1.00	0.33	0.33	5.00	7.00	0.11
O4 Diversity	5.00	0.33	3.00	1.00	3.00	5.00	7.00	0.24
O5 Accessibility	3.00	0.33	3.00	0.33	1.00	5.00	7.00	0.16
O6 Stakeholders' responsibility	0.20	0.14	0.20	0.20	0.20	1.00	3.00	0.03
O7 Smartness	0.14	0.11	0.14	0.14	0.14	0.33	1.00	0.02
Consistency Ratio CR = 9.8%								

Table 6. Pairwise comparison matrix of the threats factors

SWOT Groups	T1	T2	T3	T4	T5	T6	T7	Importance Degrees
T1 Sustainability	1.00	5.00	3.00	5.00	3.00	0.20	0.33	0.13
T2 Identity	0.20	1.00	0.20	0.33	0.33	0.11	0.11	0.02
T3 Imageability	0.33	5.00	1.00	3.00	3.00	0.20	0.14	0.08
T4 Diversity	0.20	3.00	0.33	1.00	3.00	0.14	0.14	0.05
T5 Accessibility	0.33	3.00	0.33	0.33	1.00	0.14	0.14	0.04
T6 Stakeholders' responsibility	5.00	9.00	5.00	7.00	7.00	1.00	3.00	0.40
T7 Smartness	3.00	9.00	7.00	7.00	7.00	0.33	1.00	0.28
Consistency Ratio CR = 8.7%								

development. The rehabilitation process prioritizes preserving history, restoring damaged landscapes, well-choosing and organizing the landscape elements, and revitalizing the tourist waterfront. The waterfront design incorporates adaptable components to ensure long-term profitability and esthetic appeal while protecting the integrity of water and the environment, according to the agenda, by emphasizing sustainable and smartness aspects. The proposed waterfront development plan is guided by a specific vision, encompassing the preservation and restoration of the locale's identity. Simultaneously, the objective is to foster prosperity, enhance the quality of life, and rectify any existing disorders or irregularities. Furthermore, the plan underscores the importance of sustainability and the integration of smart technologies. It is imperative for the realization of these objectives that the community actively participate in the process, Figure 20.

Table 7. Priorities for comparing SOWT groups/sub-factors

SWOT Groups	Group Priority	SWOT Factors	Factor's Priority within the Group
Strength	0.22	S1 Sustainability	0.09
		S2 Identity	0.40
		S3 Imageability	0.15
		S4 Diversity	0.21
		S5 Accessibility	0.09
		S6 Stakeholders' responsibility	0.04
		S7 Smartness	0.09
		W1 Sustainability	0.08
		W2 Identity	0.02
		W3 Imageability	0.11
Weaknesses	0.05	W4 Diversity	0.04
		W5 Accessibility	0.05
		W6 Stakeholders' responsibility	0.26
		W7 Smartness	0.44
		O1 Sustainability	0.08
		O2 Identity	0.37
		O3 Imageability	0.11
		O4 Diversity	0.24
		O5 Accessibility	0.16
		O6 Stakeholders' responsibility	0.03
Opportunities	0.62	O7 Smartness	0.02
		T1 Sustainability	0.13
		T2 Identity	0.02
		T3 Imageability	0.08
		T4 Diversity	0.05
		T5 Accessibility	0.04
		T6 Stakeholders' responsibility	0.40
		T7 Smartness	0.28

8.1 Identity

Due to the distinct identity and cultural richness of the area, the development considered the Qaitbay Citadel area a key historical cultural tourist destination in Alexandria and explored ways to sustain tourism while preserving its cultural legacy. The design gives the community the potential to cultivate a distinctive sense of place by safeguarding their history and historic landmarks, which in turn attract visitors and investors, Figure 21. Also, it preserves the city's character, ensuring that new improvements and enhancements harmonize with the existing urban fabric while retaining its unique identity. The proposal design keeps the unique customs and cultural practices of the local inhabitants. Moreover, a history-telling node with a smart monitor for information dissemination is envisioned to increase the public's awareness of the historical value of the citadel. Additionally, meticulous renovations of building facades along the waterfront are envisioned, aimed at restoring their original identity by removing irregularities and implementing culturally resonant storefront designs, Figure 22.

8.2 Imageability

Following the surveying phase, a prominent issue identified in the locale pertains to street vendors. As a trial of a past development plan, the government introduced three kiosks on the pedestrian pathways as a prototype for vendors. Over time, this endeavor was abandoned, leading to vendors haphazardly placing their goods on the streets, obstructing pedestrian pathways. This development plan addresses this predicament by proposing a solution centered on the creation of sustainable and smart kiosks tailored to the vendors' requirements, strategically positioned for easy accessibility to visitors. The envisaged kiosk design is constructed from galvanized steel to withstand Alexandria's climatic conditions. The apex of the kiosk features a photovoltaic panel, ensuring the autonomy of the kiosk's electricity supply. Characterized by a lightweight structure, the kiosk is easily assembled. It offers vendors ample shelving and a spacious glass vitrine to effectively showcase their merchandise. The design incorporates a canopy to shield visitors from intense sunlight, fostering a pleasant and comfortable environment. Additionally, the development plan advocates for the integration of classic-designed street furniture to preserve the locality's identity while incorporating smart technologies, as shown in Figure 23.



Figure 20. Developed situation shot



Figure 21. Developed situation shot

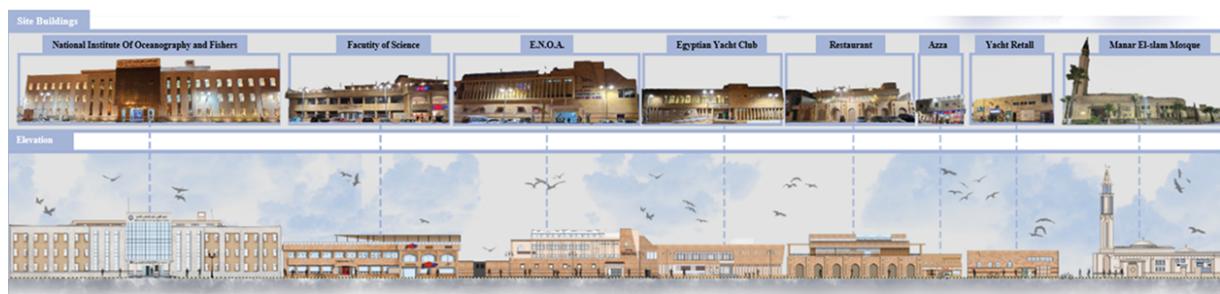


Figure 22. The renovation of the district building facades



Figure 23. The different street furniture elements designed to be integrated between smart tec. and classic style

Benches offer more than just a place to sit and rest. It serves as a Wi-Fi hotspot and public lighting point at night

and has in-built sensors, such as weather and air quality, as well as CCTV options and music. Moreover, it requires no energy whatsoever since it is solar-powered. Smart lighting systems based on the IoT leverage a network of intelligent devices that can communicate and work together to adapt to their circumstances by using interconnected sensors, actuators, and controllers. The increased interconnection of cities creates additional opportunities for automation, safety improvements, and efficient use of energy.

Waste bins are connected to the IoT, which facilitates constant interaction between the bins, garbage disposal staff, and central control systems. Gathering and interpreting data are also made possible by this sense of connection.

Digital signage consists of the presentation of photographs, videos, web pages, weather information, restaurant menus, and other information utilizing electronic display advances such as LCD, LED, projection, and e-paper. They serve to increase brand awareness in addition to orienting visitors.

Smart kiosks are analogous to a public information system. Beyond providing a user-friendly internet interface tailored for public spaces, kiosks serve as informational touchpoints across various settings. Essentially, a smart city kiosk, at its core, functions as an information kiosk strategically positioned to grant citizens access to details about city services and amenities, Figure 24.



Figure 24. The different designs used of the smart kiosks

8.3 Diversity

The district encompasses diverse activities and land uses, conferring upon it significant advantages. The proposed development plan aims to capitalize on these activities while preserving the main identity and sense of the place and enhancing community livability, namely residential, entertainment, educational, religious, and an open public space adjacent to the citadel, fostering socialization. The amalgamation of these mixed activities fortifies the district's intrinsic value, with enhanced socialization contributing to increased tourism. The development endeavors to establish a functional and well-suited focal point for social and commercial purposes, Figure 25. Furthermore, to heighten public awareness regarding the citadel's historical significance, a history-telling node is envisaged, featuring a smart monitor for informational dissemination, Figure 25.

Additionally, a dedicated children's zone, incorporating historical learning, is designed to enhance awareness among younger demographics. Reflecting community values, a gathering node for different events situated near the waterfront is conceived to foster interaction between the populace and the environment, Figure 26. A distinctive feature is the workshops focusing on boat information and ticketing, facilitating sea tours for tourists, and providing comprehensive boat-related education, Figure 26. The revitalization of prominent clubs, thoughtful consideration for accessibility, and meticulous planning for restaurants and cafes are integral aspects of the development strategy.

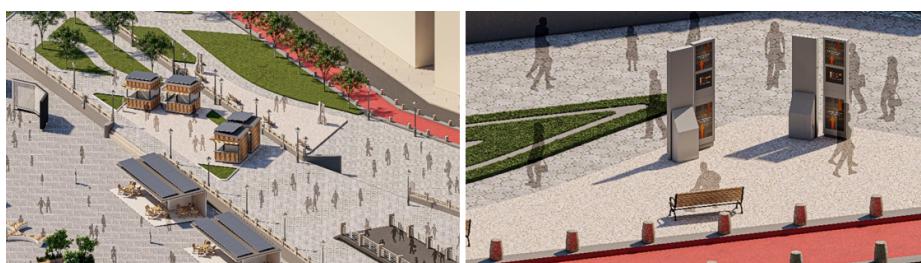


Figure 25. The development design of the different recreational activities and commercial kiosk and smart cultural monitors and cultural learning zones

Furthermore, the design evolution incorporated a dedicated athletic facility aimed at motivating young individuals to engage in physical training along the seaside, providing them with the opportunity to appreciate the scenic surroundings, Figure 27. Additionally, a distinctive photography area was conceived for visitors to capture memorable moments during their visit, as its design is inspired by the citadel material and identity, as shown in Figure 27.



Figure 26. The gathering node stage for different events to strengthen the community culture and the information and ticketing boat tour kiosk



Figure 27. The exercising node and the photography area

8.4 Accessibility

The accessibility of the waterfront is regarded as one of the top tourist attractions. Creating an accessible design is crucial for both individuals and people with disabilities. There are three main paths in this area: one for pedestrians, one for bikes, and one for golf cars and emergency cars. Additionally, there are some plazas, several activities, and a tiered walkway along the promenade that stretches beside the Mediterranean Sea and leads to the Citadel of Qaitbay, the area's main tourist destination. Along with various pieces of street furniture and safety barriers along the sidewalk, the promenade promotes public access. Boats, automobiles, buses, and horse-drawn carriages are some of the modes of transportation that are utilized to reach the shoreline.

While the development plan incorporates pedestrian-oriented design principles, the pavement is constructed with permeable tiles designed to interact with precipitation during the winter. This thoroughfare is segmented into distinct lanes, accommodating cyclists, pedestrians, and golf carts, Figure 28. To incentivize increased pedestrian activity, solar footpaths are strategically integrated into specific nodes and connected to sensors that harness kinetic energy from walking, generating electricity. Comprising solar tiles measuring 35 by 35 cm each, this sustainable pathway yields approximately 53,000 kWh of electricity annually, aligning with the objective of achieving carbon neutrality. This dual-purpose solar path not only powers a public edifice but also presents a versatile technology applicable to diverse settings, capable of supplying energy to buildings and various outdoor utilities. The golf cart lane employs basalt stone as its material, serving the dual purpose of reducing vehicular speed for enhanced safety and adhering to environmental friendliness. Vegetation is intentionally incorporated into the design, considering specific ratios and species for both environmental remediation and aesthetic considerations. Preserving existing palm trees in the district, additional shrubs contribute to visual continuity and are strategically planted for waterfront utilization. For swift errands, journeys to the Link light rail, ecologically conscious commutes, and numerous other reasons, the user can rent electric foot scooters and bicycles with batteries through scooter communicating and bike share programs. Simply put, the user can ride the nearest bike or scooter that is accessible to his location, then park it appropriately so that someone else can use it.

8.5 Stockholders' Responsibility

The waterfront development involves multiple stakeholders, such as government agencies, community groups, and private investors, to promote collaboration and partnerships among these groups. It presents a unique opportunity to create employment in various sectors and industries. Beyond the physical construction projects themselves, which require skilled labor in areas such as architecture, engineering, and construction, waterfront development generates job opportunities in the hospitality, tourism, and leisure industries. New waterfront attractions like restaurants, cafes, souvenir shops, and entertainment venues not only provide direct employment but also stimulate demand for ancillary services such as transportation, retail, and maintenance. Additionally, waterfront development incorporates recreational facilities such as parks, promenades, and marinas, which further contribute to job creation in landscaping,



Figure 28. The different lanes (pedestrian, bike, golf car and vegetation zones)

event management, and outdoor activities. Moreover, maritime activities such as boat tours, water sports, and marine transportation contribute to employment in the tourism and recreation sectors.

The waterfront development strives for social equity by guaranteeing that all members of the community can enjoy and access waterfront areas. It considers the needs and preferences of the diverse groups of people who live in or visit the area, including children, the elderly, low-income families, and people with disabilities. This involves creating accessible public spaces and amenities that are designed to accommodate people of all abilities. Government agencies play crucial roles in safeguarding waterfront development projects. Government agencies, such as environmental protection agencies and urban planning departments, are responsible for enacting and enforcing regulations to ensure that waterfront developments adhere to environmental standards, zoning laws, and maintenance and safety regulations. They also oversee infrastructure projects, such as flood defenses and shoreline protection measures, to mitigate the risk of natural disasters and preserve the integrity of the waterfront area. Additionally, government agencies facilitate public-private partnerships and provide funding and incentives to support sustainable waterfront development initiatives.

On the other hand, encouraging the community to actively protect waterfront development involves fostering a sense of ownership and stewardship among residents, businesses, and local organizations. Education and awareness campaigns highlight the importance of preserving the waterfront's ecological, cultural, and recreational assets, emphasizing their significance for current and future generations. Additionally, organizing volunteer clean-up efforts, shoreline restoration projects, and community events can mobilize residents to take pride in their waterfront and actively contribute to its upkeep. Furthermore, implementing policies and incentives that promote sustainable practices, such as green infrastructure, responsible waste management, and water conservation, can empower the community to play an active role in protecting the waterfront's natural beauty and resilience against environmental threats. Through fostering a sense of community ownership and promoting sustainable practices, the community can become a powerful ally in safeguarding waterfront development for the benefit of all. By working together, government agencies and the community can effectively protect waterfront development, ensuring its long-term viability and resilience for future generations.

To increase and emphasize tourism and community awareness, the use and development of sensors and monitors that present the history of Alexandria and the citadel are important. The use of smart sensors imposes a new responsibility on the government and stakeholder groups, as the government's duty is to assign a group of youth with a well-known knowledge of smart technology and sustainable criteria to monitor and enhance the technology used in the development plan. In addition to stakeholders, their responsibility includes raising awareness of technology and sensors, learning how to use them, and protecting them from damage and theft. Furthermore, incorporating sensors for monitoring security, checking air and water quality, and integrating photovoltaics for generating electricity highlights the importance of utilizing renewable energy and adhering to sustainable design principles, Figure 29.



Figure 29. The different sustainable materials and smart elements used as photovoltaic panels above the kiosks and monitors

The project involved selecting an IoT platform to facilitate data streams for tracking and evaluating various IoT

system components. Maintaining data accuracy was deemed essential for effective project information management. A secure IoT platform was employed in the electronic infrastructure to connect the components of the IoT framework, effectively managing and displaying the collected data on a centralized control panel. Some detectors were supplied to enhance the robustness and reliability of the IoT system. Adopting a digital twin approach, networked sensors were integrated into the furniture, each possessing a unique IP address for internet connectivity and integration with other equipment, and connected to an online dashboard program, allowing for the tracking and evaluation of the furniture's usage pattern. With the addition of lights, free Wi-Fi, power outlets, USB charging, water, a weather station, and bench space, the furniture designs offered the neighborhood additional functionality. Consequently, tracking apps were utilized to record the usage of these tools, Figure 30.



Figure 30. The different materials and smart street furniture

IoT infrastructure and sidewalk furnishings should be implemented by public utilities or park management organizations, while information storage and detector connections should be managed by IT staff. To manage a virtual copy of tangible assets, government departments must acquire new multidisciplinary knowledge and responsibilities. Administrators need to learn new competencies to track and maintain IoT-enabled items. Monitoring and maintaining SIM card numbers, smartphone passwords, API codes, and carrier expiration dates are necessary for continuous, efficient service delivery.

9 Conclusions

Waterfront development has emerged as a prominent urban planning strategy, garnering considerable attention for its potential to bring about a wide range of benefits to communities. By focusing on the enhancement and revitalization of waterfront areas, such as rivers, lakes, or coastlines, this form of development aims to create thriving and sustainable urban environments. Waterfront development can have a significant economic impact on a community. It attracts businesses, including shops, restaurants, hotels, and entertainment venues. This influx of businesses creates job opportunities and generates revenue through taxes and tourism expenditures. Developing the waterfront improves the visual appeal of the area. It can involve landscaping, architectural design, public art installations, and the preservation of natural elements. These enhancements create a visually stunning environment that residents and visitors can enjoy. The idea of quality of life is multifaceted and sometimes impressionistic, with varying meanings for various individuals. Combining the psychological and physical inputs results in the best possible quality of life. Along with factual measurements of people's and communities' conditions, the idea of quality of life also encompasses subjective or qualitative occurrences at the individual and communal levels. City officials and other stakeholders, such as those concerned with social, sustainable, human, and healthful development, have a vested interest in quality of life. Thus, quality of life is important because a lot of people and organizations are paying attention to it.

Waterfront development provides various recreational opportunities. It can include the construction of marinas, boat docks, and fishing piers, allowing people to engage in water-based activities. Additionally, waterfront parks, walking paths, and cycling trails offer spaces for exercise, relaxation, and socializing. It improves quality of life by providing access to a vibrant waterfront, which enhances the overall quality of life for residents. It provides them with a unique and enjoyable environment to explore, relax, and connect with nature. Waterfront areas often become community gathering spaces for events, festivals, and cultural activities, fostering a sense of belonging and community pride. Waterfront development can incorporate sustainable design practices. This may include the use of green spaces, wetland restoration, storm water management systems, and energy-efficient infrastructure. These initiatives promote environmental conservation, enhance biodiversity, and contribute to a healthier and more sustainable ecosystem. Social Connectivity: The development of public spaces along the waterfront encourages social

interaction and community engagement. Waterfront promenades, plazas, and seating areas provide opportunities for people to connect, socialize, and enjoy shared experiences. This fosters a sense of community and strengthens social bonds among residents.

Waterfront areas often become cultural and entertainment hubs within a city. They may host art installations, live performances, music festivals, and food markets. These events and attractions contribute to the cultural fabric of the community, attracting visitors and fostering a vibrant atmosphere. Properly designed waterfront development has the potential to raise nearby housing prices. The appeal of living near a waterfront, with its scenic views and access to recreational activities, can make properties more desirable and sought-after. This can benefit homeowners and contribute to the overall prosperity of the neighborhood. Diversity is important, but it's not a necessity for every endeavor. Every location has distinct social, political, resource, and environmental circumstances. The greatest choices for land use mixtures and their effects on the setting can be found by having years of experience along with an understanding of local and regional circumstances. Comprehending and strategizing for heterogeneous interests in waterfront development is important to ensure successful project execution. Therefore, the research proposed a waterfront development agenda that comprises seven strategies: sustainability, imageability, identity, diversity, accessibility, stakeholders' responsibility, and smartness. Then, the research applied this strategy to the El-Anfoushy waterfront to develop its touristic promenade.

El-Anfoushy has been selected as a waterfront development case study in Alexandria, Egypt, since it is distinct and has a lot of potential for future development. The selection of El-Anfoushy district for urban waterfront development reflects a combination of historical significance, strategic location, community engagement, and economic potential. By leveraging these factors, planners can create a vibrant, sustainable, and inclusive waterfront that improves the quality of life for residents and visitors while preserving the district's unique identity and heritage. El-Anfoushy district's location along the Mediterranean coast makes it strategically important for urban development. This district boasts a rich historical heritage, dating back centuries. Its proximity to iconic landmarks such as the Citadel of Qaitbay makes it a significant cultural hub in Alexandria. Leveraging this historical significance provides an opportunity to blend modern development with preservation efforts, creating a unique and authentic experience for residents and visitors. The selection of El-Anfoushy district may have been influenced by an assessment of community needs and aspirations. By engaging with residents and stakeholders, planners can ensure that the development aligns with the priorities of the community, addressing issues such as public space deficits, economic opportunities, and environmental concerns. By providing new commercial and recreational opportunities, the development can attract businesses, create jobs, and generate revenue for the local economy.

The Egyptian government developed the waterfront tourist promenade of El-Anfoushy fifteen years ago; nevertheless, this area faces a multitude of challenges that make it a prime candidate for urban waterfront development. Due to the many challenges, the waterfront promenade confronts problems in maintaining the urban imageability features and preserving the social and cultural characteristics, in addition to the area's neglected potential and urgent concerns, and this reflects broader issues of economic disparity, environmental degradation, and social inequality. The district has historically been abandoned and underutilized, leaving the waterfront areas mainly undeveloped. The community's social neglect, environmental deterioration, and economic inequality have all been made worse by this neglect. Planners want to handle these problems head-on by concentrating on El-Anfoushy for reconstruction, bringing neglected areas back to life, generating employment possibilities, and promoting social harmony. The district's rich historical and cultural legacy also offers a chance to include heritage preservation initiatives into the design process, making it an attractive background for development.

The proposed agenda for urban waterfront development in the historic El-Anfoushy touristic promenade marks a significant milestone in the city's urban revitalization efforts. The implementation of mixed-use developments, including commercial spaces, recreational facilities, and green spaces, has not only enhanced the district's aesthetic appeal but also improved the quality of life for residents and visitors. Sustainable design principles have been integrated to mitigate environmental impact and preserve the area's natural beauty. The successful execution of the proposed agenda for urban waterfront development in El-Anfoushy district has catalyzed economic growth and stimulated tourism in Alexandria. The revitalized waterfront has become a magnet for both locals and tourists, offering a diverse range of leisure activities, dining options, and cultural experiences. The transformation of the El-Anfoushy waterfront has not only enhanced its physical landscape but has also generated a positive effect of social and economic benefits throughout Alexandria. By creating a vibrant public space, the development has encouraged community engagement and social interaction, fostering a sense of belonging and cohesion among residents. El-Anfoushy waterfront development has become a lively and dynamic attraction that perfectly represents the city's past, present, and future. Alexandria's vibrant promenades, lively markets, and cultural events attract tourists from all over the world, supporting the local economy and solidifying Alexandria's position as a top travel destination. Apart from its financial importance, the waterfront represents community perseverance, cooperation, and ambition; it is an example of what can be accomplished when vision, ingenuity, and group effort come together to work toward a common objective. Overall, the success of the proposed agenda for urban waterfront development acts as a perfect

illustration of the beneficial effects that careful planning and community involvement can have on a city's social, economic, and sustainability.

After development, the promenade is expected to attract a large number of visitors, leading to overcrowding and significant pressure on the place. This overcrowding on waterfront areas can have several potential negative impacts on the local ecosystem and community. One concern is the increased pressure on natural habitats and ecosystems due to excessive human activity. Furthermore, overcrowding can contribute to pollution through littering, improper waste disposal, and runoff from recreational activities, leading to water pollution and degradation of water quality. Socially, overcrowded waterfront areas can result in congestion, noise pollution, and conflicts among visitors, diminishing the quality of the recreational experience for residents and tourists alike. Additionally, overcrowding can strain local infrastructure and services, including parking, public restrooms, and emergency response systems, leading to increased maintenance costs and decreased satisfaction among residents. It's essential for policymakers and stakeholders to manage and regulate visitor numbers to prevent overcrowding and mitigate its negative impacts on both the environment and the local community. This may involve implementing capacity limits, improving infrastructure, promoting sustainable tourism practices, applying smart sensors, and raising awareness about the importance of responsible behavior on the waterfront.

The proposed waterfront development in Egypt is in line with the country's national policies on urban development and tourism. Firstly, it reflects the government's commitment to fostering sustainable urban growth by transforming waterfront areas into dynamic urban spaces. This supports Egypt's objectives of creating livable cities and enhancing the quality of life for residents. Additionally, the project aligns with Egypt's tourism strategy, which emphasizes diversification and the development of new tourism products and destinations. By creating attractive waterfront amenities and recreational facilities, the development aims to attract tourists and stimulate economic activity in the surrounding areas. Furthermore, the project may incorporate principles of heritage preservation and environmental sustainability, in accordance with Egypt's efforts to protect its cultural heritage and promote responsible development practices. Overall, the proposed waterfront development represents a strategic alignment with Egypt's national priorities, contributing to urban renewal, sustainability, technology, economic growth, and the enhancement of tourism offerings.

It's essential for developers, planners, and policymakers to carefully assess and mitigate these negative impacts through sustainable design, habitat restoration, community engagement, and equitable development strategies to ensure that waterfront development benefits both the environment and the local community in the long term.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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