Abstract
Science and technology plays a significant role in the development of future generations. In this work, a proposal on developing a science and technology center at Jeddah, Saudi Arabia is presented. In this study, 5 case studies were investigated to attain key input in designing the proposed science and technology center. The proposed science center will comprise of several zones such as research center, administration center, amenities, logistics and outdoor space. The estimated gross floor area for the science and technology center is 21,328 m². In this work, 4 construction sites were compared in terms of location, accessibility, visibility, land use, views, landmarks, site shapes and proportions, and security and safety. Thus based on this criteria, Site 2 which is located at Alshate’ District was selected as the proposed site, as it attained the higher evaluation score of 178. The proposed science and technology center is expected to raise the level of education in Jeddah City and keep the community well informed with the latest technologies around the world.

Keywords—science center, technology, education, knowledge, facility, Saudi Arabia

INTRODUCTION
Science and knowledge are very important to the development of human lives [1]. Science centres play a major part in making the knowledge of science simple and enjoyable for the younger generations [2]. The primary goal of the scientific center is to renew the love of science in the fresh generations as they encounter science themselves through distinct operations [3]. Science centers assist in cultivating favourable mental reactions among individual towards science education [4].

Furthermore, science centers cater the significance of science to everyday life, and embodying the essence of science for the community [5]. Clements et al. [6] has confirmed that science centers enables the young generation to be exposed and develop the foundations of science and technology at an early age. Hsu [7] work has also stated that science centers enables the development of science teaching methods among educator in a fun and engaging manner, as this will enable better understanding of science among the younger generations.

However, in the context of Saudi Arabia, specifically in Jeddah city, it lacks educational facilities that combine education, science, and entertainment [8]. Thus, this work presents a proposal on developing a science and technology center for the Jeddah community. This center is expected to make Jeddah as one of the leading cities in knowledge and research studies.

CASE STUDIES
This work has analysed five case studies. The case study details are stated as follow.

a. King Abdulaziz Center for World Culture. Dhahran, Saudi Arabia.
b. Phaeno Science Center. Wolfsburg, Germany.
c. Biotechnology Research Institute in San Martin University. Buenos Aires, Argentina.
d. King Abdullah Petroleum Studies and Research Center (KAPSARC). Riyadh, Saudi Arabia.
e. Glasgow Science Center. Glasgow, Scotland.

King Abdulaziz Center for World Culture. Dhahran, Saudi Arabia

King Abdulaziz Center for World Culture is located in Dhahran in the eastern province of the kingdom (Figure 1). This structure was designed by Snohetta Architects. The site area is 100 000 m² and it has a gross floor area of 45,000 m². The center houses a library, learning centers for innovation, museums, exhibits, and hall for multipurpose.

A combination of different programs is combined to create a place where new generations can explore and learn through entertainment. The building is architecturally inspired by the geology and rock formations of Saudi Arabia that preserved the energy of petroleum.

The iconic building’s thematic concept was inspired by 5 separate caves that shaped the center. These five pebbles full of human energy, however, are linked together to create a united space that combines all activities within a single structure.

The concept of the project was derived from the concept of connecting three elements, space, time and context. The building is one of the most technologically advanced in the world, using innovative technology in the structure. The building envelope consists of two elements of an isolated, weather-tight envelope wrapped in a shaded veil feature.

The feature veil that is built from stainless steel tubes is largely hidden from view and shaded. These thin walled tubes are pre-bound to the geometry of the pebble surface and are simply flattened at window locations, allowing natural lighting to show through while retaining its external shading role. The building is guided by the international standards of excellence of Leadership in Energy and Environmental Design (LEED).

In addition, by installing water meters to control and monitor the volume of water used in the building, the building ensures an efficient use of water through various methods. In addition to installed smart water controllers to organize irrigation, based on local landscape and weather conditions.
Phaeno Science Center, Wolfsburg, Germany.

Phaeno Science Center is located in Wolfsburg, Germany (Figure 2). This structure was designed by Zaha Hadid Architects. The site area is 15,000 m², with gross floor area of 12,000 m². This structure can accommodate 2144 visitor per day. The Phaeno Interactive Science Center was built on a public site to serve the residents of Wolfsburg and its visitors. The science center houses various programs to educate and entertain its visitors from all ages, children and adults, and to attract them to the world of science, such as physics, chemistry and biology. The center houses a public area that allows people to gather to experience things and give them a chance to communicate. The public area also houses 250 interactive exhibits. On its well-selected location, the construction of the scientific center seems to be the gateway to the city's fields. Instead of an artificial floor, some pedestrian and vehicular paths are drawn to the site to integrate the building into the city. These paths were designed on the grounds of the site's first traced main axis. The building has been designed to resemble a spaceship. The horizontal building is formed by a heavy volume, sharp edges and angular lines, raised above ground level on multiple concrete cones. On the façades, crashed windows were designed to allow street people to watch the great activities happening inside. The building of the science center accommodates a plaza, auditorium, exhibition, event areas and supporting facilities. The main gallery space was designed wide and open, characterized by irregular and spatial articulation, where there is a clear division of planes and spaces, but sudden openings between the walls allow visual connection. The concrete cones accommodate different functions; within these cones, a bookshop, a theater, labs and services are all allocated. The entrance occupies the largest cone with a staircase leading to the main exhibition hall.

Biotechnology Research Institute in San Martin University. Buenos Aires, Argentina.

Biotechnology Research Institute in San Martin University is located at Buenos Aires, Argentina. This structure was designed by architects De La Fuente, Luppi, Pieroni, Ugalde and Winter. The gross floor area of the structure is 4000 m². This structure is dedicated to science, education and research-related activities. Besides accommodating the space for scientific and cultural exchange. The areas of circulation, facilities and meeting articulate the labs and workspaces. The main goal of this center is to be an area dedicated to scientific innovation and cultural exchange. The ground floor, consisting of three levels and a ground floor, is designed to be the public area and host the Institute's public space. Administrative areas, classrooms, laboratories, and an auditorium are all laid out along the ground floor courtyard, the public area. The stairs, voids, bridges and light penetration create a unique area to give the circulation areas a walking tour atmosphere. The laboratories are located on the first and second floors. They are wide and spacious to allow research areas to be developed. These spaces are connected to specific enclosures that address safety and technology requirements. The areas of freezers and cell culture surround the wide research spaces. The last floor is designed for recreation and dining areas, and the designers also provided some bedrooms for occasional visitors. The building's mass has horizontal stripes and a mysterious black box dialog to perform a harmonious tension. The opening show volume, however, allows daylight and drops shadow inside the building that changes during the seasons over the year. They also allow the greenery of the campus to enter the building, make it a truly peaceful and comfortable place and enrich it with positive energy.

King Abdullah Petroleum Studies and Research Center (KAPSARC), Riyadh, Saudi Arabia.

King Abdullah Petroleum Studies and Research Center (KAPSARC) is located at Riyadh, Saudi Arabia (Figure 4) and it was designed by Zaha Hadid Architects. The site area is 530,000 m² with gross floor area of 66,000 m². KAPSARC is an independent, non-profit institution that focuses on energy economics, policy, technology and environment research. Its research areas include global energy and economic markets, energy efficiency and productivity, energy and environmental technologies, and carbon management. The modular structure was inspired by an organic scheme, a tree leaf, which represent connectivity. The modular unit is composed of three-dimensional six-sided cell, allowing future expansion without compromising the visual integrity of the project. The building emerges as a cluster of crystalline forms that respond to harsh environmental conditions. Each component of the project fits the function it...
serves. The façades are composed of shell-like envelopes, concealing the actual building and porous interior, and covering the courtyards that bring natural daylight into the center of the scheme. Working as a buffer zone, they allow a gradual transition of temperature between external and internal environments.

Glasgow Science Center. Glasgow, Scotland

Glasgow Science Center is located at Glasgow, Scotland and it was designed by Building Design Partnership (BDP) Architect Company. The gross floor area is 15030 m². The Glasgow Science Center is a recreational educational complex. The complex consists of three major buildings: the Science Mall, a snail-like IMAX cinema, and a wind-turning observation tower, 127 meters high. Built on a riverside site to be one of the city’s iconic buildings and attract visitors. The complex was divided into two distinct buildings to combine similar activities. The main and largest building houses area activities and interactive exhibits. The last building is the wind-turning tower built to distinguish the complex. The Science Mall is a linear building with a large glazed façade that allows visual connection with the city and nature, and also allows natural daylight in the space to enrich the building with energy. It accommodates different spaces: theaters, labs, studios, shops, e-learning center, exhibition area, and interactive exhibits. The materials used for cladding are titanium, making this complex the first buildings to use this extraordinary lightweight metal.

Table 1. Zones detailed area.

| Zone     | Gross Floor Area (m²) | Net Area (m²) | Foot Print (m²) | Number of Floors |
|----------|-----------------------|---------------|-----------------|------------------|
| Assembly | 10,664                | 7,998         | 2,666           | 4                |
| Academic | 5,332                 | 3,999         | 1,777           | 3                |
| Amenities| 1706                  | 1,280         | 853             | 2                |
| Admin    | 1493                  | 1,120         | 1,493           | 1                |
| Logistic | 2133                  | 1,600         | 533             | 4                |
| Total    | 21328                 | 15,997        | 7,322           |                  |

SITE SELECTION

Proposal site: Site 1
The first site (Figure 6) is located at Alshate’ District (the previous site of the old Jeddah Science and Technology Center), between Alcorniche Road and Prince Faisal Bin Fahd Street. This site has an area of 27,178 m².

Proposal site: Site 2
The second site (Figure 7) is located at Alshate’ District, next to Hilton Hotel, surrounded by 2 main roads, Alcorniche road and Prince Faisal Bin Fahd Street (Almamsha, a pedestrian walkway). This site has an area of 30,400 m².

Proposal site: Site 3
The third site (Figure 8) is located at Alshate’ District, next to Movenpick Resort, surrounded by 2 main roads and 1 secondary street, Alcorniche road. This site has an area of 30.790 m².

Proposal site: Site 4
The fourth site (Figure 9) is located Alhamra District, Corniche Road, surrounded by 1 main street. This site has an area of 29,785 m².

PROGRAM ASSUMPTION AND SPACE DETAILS

Based on the analyzed case studies, the estimated gross floor area for the development science and technology center is 21,328 m². It is expected to host 4000 visitor per day. Table 1 shows the details of the zone area. Based on Table 1, the center will comprise several zones which are assembly, academic, amenities, admin and logistics. The comprehensive details of the gross floor area, net area and foot print of each zone is shown in Table 1. Furthermore, the site will have around 10,983 m² landscape and outdoor spaces, and 9,352 m² parking area.
Site Evaluation

All four proposed sites were analysed in terms of location, accessibility, visibility, land use, views, landmarks, site shapes and proportions, and security and safety. The evaluation result is shown in Table 2. Based on Table 2, site 2 was selected as the proposed site; as it attained highest evaluation score of 178, compared to site 1 with 132, site 3 with 156 and site 4 with 117.

| Site Criteria        | Site 1 | Site 2 | Site 3 | Site 4 |
|----------------------|--------|--------|--------|--------|
| Location (WF=3)      | 7      | 9      | 7      | 5      |
| Accessibility (WF=3) | 7      | 9      | 9      | 6      |
| Visibility (WF=3)   | 7      | 9      | 9      | 5      |
| Land Use (WF=3)     | 5      | 9      | 7      | 5      |
| Views (WF=3)        | 9      | 9      | 7      | 7      |
| Landmarks (WF=2)    | 5      | 8      | 8      | 5      |
| Site Shape (WF=2)   | 6      | 9      | 8      | 9      |
| Security (WF=2)     | 7      | 9      | 7      | 6      |
| Total               | 132    | 178    | 156    | 117    |

SITE ANALYSIS

Site 2 was selected as the proposed site. It is located in the middle of the city. The site is located on two main roads that make the center visible. In addition, a highway that connects the southern part of the city to the northern part of the site, which is the King Abdulaziz Road, facilitates access to the site. The area surrounding the site is formed to the east by two types of buildings, mixed used, which is the coastline area, and residential, which lies behind the mixed use area. Few hotels surround the site and the corniche is undergoing development. While there is an open exhibition on the eastern side of the site that adds another value to the chosen site. To promote safety, a fire station is located next to the site, which also gives another value to the site. The sea is to the west of the site, adding an aesthetic value to the site and allowing it to have good and peaceful panoramic views for the commercial, offices and research center. All the facilities of the science center, such as the exhibitions and theaters, will be located inward in the middle of the site. However, facilities such as: library, offices, administration, workshops, and main restaurant will have views of the sea and outdoor museum on Prince Faisal Street. The site will be visible from Corniche Road and Prince Faisal Street. Figure 10 shows the zoning of the proposed site. The zoning of the proposed science and technology center will comprise of research center, admin, theaters, commercial zone, library, outdoor, service, parking and entrance. Figure 11 shows the overview of the proposed science and technology center.

CONCLUSION

This study has presented a design plan proposal for a science and technology center at Jeddah Saudi Arabia. The proposed science center will be developed at Alshate’ District, next to Hilton Hotel. The total gross floor area of the proposed site will be 21328 m², and will comprise of several zones which are assembly, academic, amenities, admin and logistics. Science is very essential in people’s lives, the town of Jeddah lacks any instructional infrastructure that encourage understanding in people’s lives. Thus, the development of this Jeddah science and technology center will make Jeddah as one of the major towns in education and science studies, where knowledge is gained through scientific entertainment, and new research studies.
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