Abstract

Recently, Saudi Arabia has been committed to research and innovation. Yet, the kingdom still does not have enough number of research centres that allow raising the rate of development in the fields of researches and innovations. This outlines the importance of developing interdisciplinary research centre, where studies are formed and analysed to assist in acquiring sufficient project programs. Several case studies were included in this project for project idea construction. The proposed space program consists of public spaces, research offices and laboratories, business spaces and support spaces. The site evaluation was conducted based on several criteria such as accessibility, adjacency to related research facilities, potential for views, visibility, noise level, utilities, site capacity for GFA, capacity for parking, relationship to an academic core and future expansion capability. The selected site is located Obhur Street in an imperative area in Jeddah. The site accessibility and climate analysis were performed to further examine the site. The design concept is inspired by the bridges where its connection between the various researches disciplines.

INTRODUCTION

Knowledge is the beginning of freedom. Human as populace is to seek knowledge to assist in the development of the countries [1]. There are many learning institutes these days are made to enhance the level of knowledge such as, schools, universities, learning centres, libraries and research centres [2]. Providing such institutes will widen the level of awareness, the development and mobilization of resources and expertise for national growth.

Although interdisciplinary or multidisciplinary is often considered a term of the twentieth century, the concept has historical pioneers, especially in Greek philosophy, Islamic golden age “Hakims” and during renaissance “renaissance man” [3]. Distinguished men such as Avicenna, Leonardo Da Vinci and Aristotle are people who specialize in many different subject areas [4, 5]. This diversity in the sources of knowledge allowed them to discover, invent and expand the base of knowledge to the whole world. The idea of diversity has been adopted recently in a form of institutes that presents’ scientists an opportunity to discover, invent and expand the base of knowledge to the whole world.

The idea of diversity has been adopted recently in a form of institutes that presents’ scientists an opportunity to discover, invent and expand the base of knowledge to the whole world.

In Jeddah, Saudi Arabia, the research centres are the main research unit of King Abdullah University of Science and Technology. These centres are strategic and focus on the subject areas that promote research projects to achieve their goals. The research centres focuses on catalysts, computational bioscience, red sea, clean combustion, water desalination and reuse and various other fields.

CASE STUDIES

There are three research centers from UK, Australia and USA are chosen for the case studies due to its unique and attractive design concept. The selected research centers are carefully design according to the research facilities requirement and they are:

a. The Sainsbury laboratory, Cambridge, United Kingdom
b. Lowy Cancer Research Centre, Sydney, Australia
c. Loyola science centre, Scranton, Pennsylvania, USA
The building is powered by a 770KW gas-fired cogeneration power plant connected in parallel with the main grid. Power is distributed to the entire park through the on-site high-voltage ring network. It is estimated that the device can save 1,600 tons of carbon dioxide annually. Cutting-edge medical research requires advanced laboratory furniture. For Lowy Cancer Research Facility, the ground above 5,000 meters is equipped with a gantry system, including reagent racks, maintenance thorns and other necessary conditions [8]. As far as the research direction is concerned, the laboratory has been developed, especially in cancer research. For example, over time, it is difficult to predict changes in the instrument. The system is pre-configured to meet the changing needs of laboratory users. Users can easily adjust components, which make the system suitable for decades of use [8].

**Loyola science centre, Scranton, Pennsylvania, USA**

One of the key elements is that science is human endeavour. The most powerful scientific tool is human mind, building a facility that fosters inspiration, critical thinking, and teamwork is essential to the spirit of scientific inquiry [9].

The university is dedicated to maintainable design and promotes a sustainable lifestyle (Figure 3). The sustainable development plan includes the use of local materials, such as stone mined from local quarries. Next, follow the motto: "The greenest space you can build is the space you don’t build." This is the maxim that maximizes the efficiency of each laboratory. Designed with less building materials and less energy throughout the entire life cycle of the building, such as energy-saving lamps and heating systems, heat exchange wheels to recover heat from exhaust gas, and efficient water appliances [9].

![Figure 1. The Sainsbury laboratory, Cambridge, United Kingdom](Image)

![Figure 2. Lowy Cancer Research Centre, Sydney, Australia](Image)

Within all case studies it has been noticed that research spaces accommodates the majority of the building total area. Buildings also share in common the availability of research offices, auditoriums and social spaces.

It is necessary when designing a research building to have strong linkage between facilities yet, define the separation for obtaining healthier environments for laboratories. Research centres obtain the horizontality when designed where a building height would be five floors high maximum.

New trends and values are maximizing the efficiency of each laboratory. In addition, visual links between permeability and reality and architectural functions should be allowed. Use flexible research spaces to adapt to changing future needs. The overall effect is strongly horizontal, ample informal learning spaces and also creates interactive spaces.

**SPACE PROGRAM**

The project allocates the space program for five primary zones namely public zone, research offices, research zone, business zone and support zone. The build-up area of the project is about 27440m² and the un-build area is about 10360m². The biggest zone is allocated for research space about 70%, where 10% for medical engineering and 30% each for agriculture and technology engineering. Table 1 demonstrates the space program of the project.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Use Percentage (%)</th>
<th>Built Use Area (BUA) (m²)</th>
<th>Number of floors</th>
<th>Foot Print (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public spaces</td>
<td>15</td>
<td>2600</td>
<td>2</td>
<td>1300</td>
</tr>
<tr>
<td>Research offices</td>
<td>7</td>
<td>1702</td>
<td>1</td>
<td>1702</td>
</tr>
<tr>
<td>Research spaces</td>
<td>70</td>
<td>20400</td>
<td>2</td>
<td>10400</td>
</tr>
<tr>
<td>Business spaces</td>
<td>5</td>
<td>1538</td>
<td>1</td>
<td>1538</td>
</tr>
<tr>
<td>Support spaces</td>
<td>3</td>
<td>1200</td>
<td>2</td>
<td>600</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>27440</strong></td>
<td></td>
<td><strong>15540</strong></td>
</tr>
</tbody>
</table>

![Figure 3. Loyola science centre, Scranton, Pennsylvania, USA](Image)

The public zone is an area that receives visitors as well as the building users. It includes a lobby, conference halls, and library and computer labs. The zone serves as a linking point between all zones of the centre. It also functions as an interactive zone that visitors and users or researchers from different fields can interrelate and discuss latest scientific issues.

The research offices zone is an area that consists of offices of various sizes for the researchers adjoined with conferences rooms and facilities that serves the department. For better performance this zone must be directly connected to the research spaces zone.

Research zone occupies the largest area in the building. It’s divided into four units; each unit is done for a different type of discipline such as marine science discipline. This zone includes different types of laboratories adjoined with the support zone that includes different types of storages.

Business zone is an area that includes offices, conference rooms, meeting rooms as well as facilities. This zone is to serve as a marketing sector to all the outcome of researches and inventions done in the research centre.
SITE SELECTION AND ANALYSIS

There are three different potential site locations have been proposed for the interdisciplinary research center. Each site influences on by the functional and space program. The site selection for this project is highly affected by the disciplines or fields of research. The program involves three different fields, which are agricultural engineering research, medical engineering research and technological engineering research. Figure 4 shows site 1 is located in Obhor Street in an imperative area in Jeddah. It is located next to Al Batterjee Medical College. Figure 5 shows site 2 is located in Thuwal near King Abdulla University of science and technology. Figure 6 shows site 3 is located near King Abdulaziz University.

Table 2. Site Evaluation

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weightage (%)</th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility</td>
<td>15</td>
<td>9</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Adjacency to related research facilities</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Potential for views</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Visibility</td>
<td>10</td>
<td>7</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Noise at site</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Utilities</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Site capacity for GFA</td>
<td>20</td>
<td>20</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Capacity for parking</td>
<td>10</td>
<td>10</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Relationship to an academic core</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Future expansion capability</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>80</td>
<td>74</td>
<td>68</td>
</tr>
</tbody>
</table>

Based on the site evaluation result shown in Table 2, site 1 marks the highest score and is selected as the site location for the project. The selected site area is about 38000m². The Obhor street location carried highest potentials that would serve the program more efficiently. Its strategic location near the sea and its proximity to an academic core (Batterji Medical College) enables to define some of the disciplines that would be introduces. It lends itself to a program oriented to medical sciences, marine sciences and the arts and humanities sciences.

Regarding the accessibility analysis, the site can be accessed through a secondary road, directly connected to Obhor Street. A walking distance from Al Batterjee Medical College, pedestrians can reach the site easily. For climate analysis, the average maximum temperature is between 29°Cand 37.5°C and the average minimum temperature is between 18°Cand 27°C. Moreover, the average precipitation of the site is about 5mm in January, between 25mm and 21mm on November and December respectively.

ZONING AND PROJECT DESIGN

Figure 7 and Figure 8 demonstrate the site zoning and master plan of the project respectively. There are two parking space located at two corners and the main building is situated at the middle of the site and connected each other. The design concept of the project is to create a community that brings research from different fields of study together to come up with better results in research and innovation. Create a tangible sense of community.
within the facilities by having wide-open visible places to keep a form of connection between the spaces and have an identified magnet that naturally draw people together. In the first floor connection and circulation between the three research disciplines is made through creating bridges. The core is oriented towards the prevailing winds which enhances ventilation and wind movement within the project. Figure 9 and Figure 10 demonstrate the night view of research laboratories and public spaces of the project respectively. The main perspective view of the project is show in Figure 11.

CONCLUSION

Interdisciplinary research is a mode of research conducted by teams or individuals. It integrates information, data, technology, tools, perspectives, concepts and theories from two or more professional disciplines or institutions to enhance basic understanding or solutions. The solutions are beyond the scope of a single discipline or research practice area. The proposed project serves as a solution to improve the research efficiency in multidiscipline field. The space program covered public spaces, research offices and laboratories, business spaces and support spaces. The selected site location is located in Obhor Street in an imperative area in Jeddah, based on the criteria of accessibility, adjacency to related research facilities, potential for views, visibility, noise level, utilities, site capacity for GFA, capacity for parking, relationship to an academic core and future expansion capability. The design concept is to provide the connection between the various field, thus the floor connection and circulation between the three research disciplines is made through creating bridges.

REFERENCES


10. Google Maps [Internet]. Google Maps. 2019 [cited 17 June 2019]. Available from: https://www.google.com/maps/place/21%C2%B046'21.9"N+39%C2%B008'04.4"E/@21.772749,39.1323613,772m/data=!3m2!1e3!4b1!4m13!1m6!3m5!1s0x15c16314fd3c18ff:0xc359b26748d75a99b128batterjee+Medical+College!8m2!3d21.7693429!4d39.1318678!3m5!1s0x0:0x0!7e2!8m2!3d21.7727442!4d39.1345501

11. Google Maps [Internet]. Google Maps. 2019 [cited 17 June 2019]. Available from: https://www.google.com/maps/place/22%C2%B018'54.4"N+39%C2%B007'04.5"E/@22.3151189,39.1157153,769m/data=!3m2!1e3!4b1!4m13!1m6!3m5!1s0x15c11c505768a2f1:0x36139c007214e6bc2sKing+Abdullah+University+of+Science+and+Technology!8m2!3d22.309465!4d39.104697!3m5!1s0x0:0x0!7e2!8m2!3d22.315139!4d39.1179037

12. Google Maps [Internet]. Google Maps. 2019 [cited 17 June 2019]. Available from: https://www.google.com/maps/place/21%C2%B029'53.0"N+39%C2%B014'44.9"E/@21.498063,39.2436243,774m/data=!3m2!1e4!4m5!3m4!1s0x15c1249e18f:0x8e2892788a1c19c8!2sBatterjee+Medical+College!8m2!3d21.49806!4d39.2458413