Journal of Critical Reviews

ISSN- 2394-5125 Vol 7, Issue 8, 2020

MULTIDISCIPLINARY RESEARCH CENTRE

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Received: 25.04.2020 ***Revised: 30.05.2020*** ***Accepted: 20.06.2020***

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 sile is located Obhor 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.

Keywords -- Multidisciplinary, Interdisciplinary, Research Centre, Innovation

DOI: http://dx.doi.org/10.31838/jcr.07.08.152

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 and students of different fields for project collaboration [6].

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 catalysis, 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 Sainsbury laboratory, Cambridge, United Kingdom

The Cambridge University Botanic Garden was conceived by Charles Darwin and Professor Henslow in 1831. This is an effective research tool that can systematically classify and classify the diversity of plant species. Sainsbury Lab has set Henslow's agenda to deepen its understanding of this diversity. Therefore, the purpose of its design is to enable the laboratory building to express an inseparable connection with the garden (Figure 1) [7].

The technical features of building sustainability have been carefully integrated into the overall design rather than being publicly expressed. Special attention is given to maximizing sunlight and collecting rainwater for irrigation purposes. On-site renewable energy is provided by 1000m2 photovoltaic panels installed on the roof of the laboratory, which can provide 10% of the building energy consumption [7].

The Plant Science Research Center located at the Botanic Garden of Cambridge University. The design harmonizes complex scientific requirements with the building’s needs in response to its landscape settings. It provides an exciting university environment for innovative research and collaboration. The building is located in a private "working" area of the garden and houses a research laboratory and related support areas. It also includes the university's herbarium, meeting rooms, auditoriums, social spaces and advance ancillary areas for staff in the botanical garden, as well as new public cafes [7].

Lowy Cancer Research Centre, Sydney, Australia

The themes of "Scientific Knowledge Bank" and "Human Cooperation Chain" recognize that one of the main advantages of any research organization such as CCIA is the tacit knowledge of its research scientist team. The theme of "Science to the street and People to the courtyard" is a strong recognition of the social responsibility of science and its readers in the wider community. the theme of "A Landscape Driven Solutions" shows how the site background and landscape have a positive effect on the regular "Lab Box" (Figure 2). The purpose is to generate a building at a specific location and graft it to that location [8].

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 [7]

Figure 2. Lowy Cancer Research Centre, Sydney, Australia [8]

Figure 3. Loyola science centre, Scranton, Pennsylvania, USA [9]

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 1. Space program

Zone	Use Percentage (%)	Builded Use Area (BUA) (m²)	Number of floors	Foot Print (m²)
Public spaces	15	2600	2	1300
Research offices	7	1702	1	1702
Research spaces	70	20400	2	10400
Business spaces	5	1538	1	1538
Support spaces	3	1200	2	600
Total	**100**	**27440**		**15540**

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 1is located in Obhor Street in an imperative area in Jeddah. It is located next to Al Batterjee Medical College. Figure 5 shows site 2is located in Thuwal near King Abdulla University of science and technology. Figure 6 shows site 3is located near King Abdulaziz University.

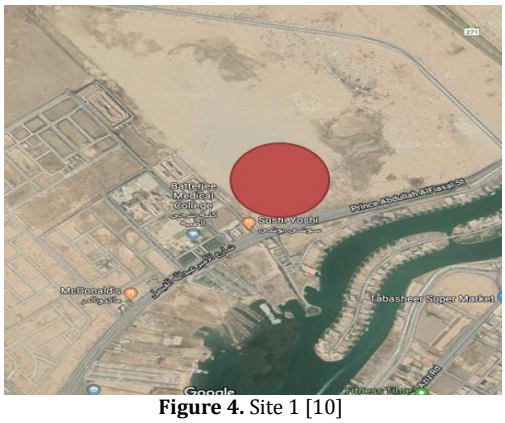

Figure 4. Site 1 [10]

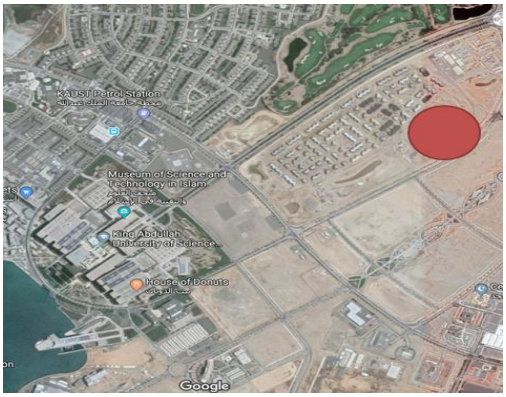

Figure 5. Site 2 [11]

Figure 6. Site 3 [12]

The site selection criteria were based on the case studies and the building program. The site evaluation criteria that adopted from case studies are accessibility, adjacency to related research facilities, potential for views, visibility, noise at site and the utilities. While, the site evaluation criteria that based on site efficiency is site capacity for GFA, capacity for parking, relationship to an academic core and future expansion capability. Table 2 shows the site evaluation result for each site and each of the criteria have its own weightage.

The site must vehicular accessible and availability for walk able connections. The site must be capable for adjacency to related research facilities, where the site is proximity to other research facilities. The site should have good quality of view and the site is visibility along the major road. The noise level should be as low as possible. The site should have utilities such as municipally owned water supply, sanitary sewer system, electricity and other services availability in the site.

Besides that, the site should have reasonable size and shape to allow suitable professional site planning, and have sufficient open space and circulation space. Also, the site should have sufficient availability to accommodate parking, exclusive of parking in primary drives. The site should located proximity to an academic building. The site must have sufficient space availability for future expansion.

Table 2. Site Evaluation

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

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 38000m^2. 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.

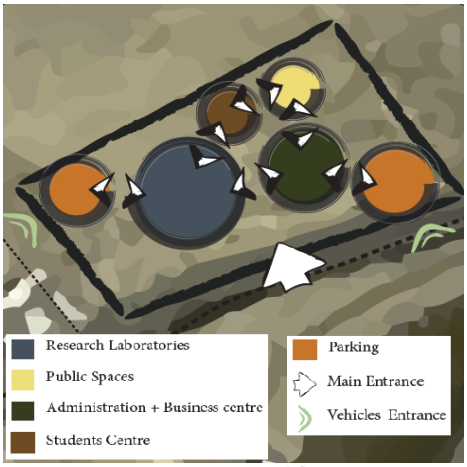

Figure 7. Site zoning of the project

Figure 8. Master plan of the project

Figure 9. Night view of research laboratories

Figure 10. Public spaces

Figure 11. The main perspective of the project

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