Planning and Designing UPI Science and Techno Park as a Green Campus Center in Universitas Pendidikan Indonesia

F F Devitama¹, B Paramita¹, N A Ardiani²

¹ Universitas Pendidikan Indonesia
² Architecture Program, School of Architecture, Planning, and Policy Development, Institut Teknologi Bandung, Bandung, Indonesia
E-mail: betaparamita@upi.edu

Abstract. Universitas Pendidikan Indonesia (UPI) plans Science and Techno Park to improve UPI's ranking in the Green Campus Ranking in the world. Currently, UPI is ranked 44th in Indonesia, or equivalent to 100 in Asia (1000 in the world). So, to improve UPI's ranking, an area is needed to develop research in the Green Campus field. The developed Science and Techno Park have a research focus in the fields of infrastructure, energy, waste, water, and transportation management. UPI Science and Techno Park use the High Technology Architecture Theme. So, Science and Techno Park can support the UPI area to become Green Campus based on criteria issued by Green Metric UI. Science and Techno Park UPI facilitates research collaboration with outside companies for further research by researchers. Science and Techno Park can facilitate commercialized, produced, and marketed to the public.

1. Introduction
Based on campus ranking data set by the Green Metric UI for the Green Campus Ranking, currently, Universitas Pendidikan Indonesia is ranked 44th in Indonesia, or 100th in Asia, or the equivalent of 500th in the world [1]. Several criteria determine a campus that is considered to be a Green Campus. Based on these criteria, UPI is still ranked low in the infrastructure system, energy management, waste management, water distribution, and transportation.

Based on these problems, in the Final Report on the Implementation of UI Green Metric, UPI is still ranked below in the implementation of Green Campus. The application of the Green Campus principle requires in-depth research and use of technology in the field [2]. Based on the explanation of the results of the Green Campus implementation report at the UPI, it is recommended to develop Science and Techno Park which has a research focus in the areas of infrastructure, energy, waste, water, and transportation management. The development of Science and Techno Park can support the UPI area to become a Green Campus based on criteria issued by Green Metric UI [3].

Also, UPI requires Science and Techno Park to facilitate the development of innovation and research collaboration in the Green Campus field. Thus, changes in these fields can be developed and improve the UPI ranking in the Green Campus ranking. UPI Science and Techno Park develop research fields based on Criteria Green Campus. This criterion was developed based on the UI Green Metric Standards. These fields are infrastructure, energy, waste, water, transportation, and education. Thus, studies conducted at Science and Techno Park can support the UPI campus to become a Green Campus.
in the world.

In support of the research that will be carried out in Science and Techno Park, it is necessary to apply the concept of high-tech architecture. The application of High-Tech Architecture creates a high-tech atmosphere in UPI. Also, this theme can facilitate researchers in developing innovation. Thus, this theme can encourage researchers to continue to work and innovate. Science and Techno Park UPI facilitates research collaboration with outside companies for further research by researchers. Science and Techno Park can facilitate commercialized, produced, and marketed to the public.

2. Literature Review

2.1. Science & Techno Park

Science and Techno Park is an integrated area for intermediation that is used to stimulate technological diffusion. Diffusion of technology is done by collaborative research in various fields of study. Also, research conducted based on market demand, as well as fiscal issues [4]. Science and Techno Park wants to improve the quality of the country by making technology essential for business and economic development. Stated, the Triple Helix Diagram below (fig. 1a) illustrates the work system of UPI Science and Techno Park:

![Figure 1. (a) Triple Helix diagram for Science and Techno Park. (b) Green Metric UI for Green Campus Principe.](image)

2.2. Science & Techno Park

In general, this instrument adopts the concept of environmental sustainability, which has three elements, namely environmental, economic, and social. Ecological aspects include the use of natural resources, environmental management, and pollution prevention, while financial issues include profit and cost savings. Social aspects include education, community, and social involvement. Green Metric UI criteria (fig. 1b) captured these three aspects [5]. The six elements developed base on these three aspects that become Green Campus assessment criteria, namely infrastructure, energy, waste, water, transportation, and education.

2.3. High-Tech Architecture

High-tech is a 20th-century modern thought that popularized the use of industrial materials. A book entitled “High Tech: The Industrial Style and Source Book for the Home” by Joan Kron in 1978 presented about High-Tech in Architecture. This book shows how to integrate industrial products such as warehouse shelves and factory floor coverings for a home [6].

The application of High-Tech to architecture can chlorinate technological advancements. Building systems show the progress of developing the technology. Technology is the main feature in the
implementation of this theme [7]. Besides being applied as a style, the Buildings system must implement a High-Tech Architecture system. So, this theme becomes more comfortable for users to feel.

The realization of the theme of High-Tech Architecture into an architectural design is to apply the following rules:

- Modern architecture style;
- Renewable Energy implementation;
- Shows structural and service element
- Expose the structure and construction of buildings;
- Use of glass and steel materials;
- Inside-out;
- Contrasting and evenly coloring;
- Monumental scale;
- Application of geometric shapes in buildings and facades.

2.4. Location Review

The planning and design location is on Jl. Dr. Setiabudhi no. 229 Sukasari District, Bandung, West Java. Location coordinates are at 6° 51'35.21" S, and 107° 35'37.10" E. The location is within the campus area of Universitas Pendidikan Indonesia (fig. 2a), Bumi Siliwangi, Bandung. The site is determined based on the UPI 2019 Strategic Plan, which is the Science and Techno Park Plan to support the realization of UPI as a Green Campus in the world.

Based on the mapping above, the most important electricity use is the FPMIPA and UPI administration building, which consumes almost 50% of the total electricity usage at UPI. UPI has a large area, a climate that has sun exposure throughout the year so that solar energy can be utilized to help meet the electricity needs at UPI.

UPI has experts in the field of energy processing, namely the Department of Mechanical Engineering Education, Universitas Pendidikan Indonesia. However, they do not yet have adequate facilities to research the energy sector (fig 2b). In the field of waste, UPI currently has 2 tons of garbage/day and has not been able to be processed optimally. Also, UPI already has garbage processing equipment, but it requires skilled experts and researchers in the field.

3. Methods

In the discussion and discussion of UPI Science and Techno Park can be seen in Figure 5. The first step
proposed in the introduction sections and discussed the purpose and purpose of the design to answer questions in the introduction sections. Then the authors conducted a literature review and comparative study related to the design project and the theme. After conducting this research, the authors conducted a location analysis related to the problem that had to be solved. Then, the solution to the problem is answered using the design concept that will be applied.

![Diagram](image)

**Figure 3. Author’s methods**

4. Results

4.1. Site Concept

The planning and design area of UPI Science and Techno Park located in Universitas Pendidikan Indonesia’s area. Therefore, the approach used is to maintain the old buildings that are included in the design of Science and Techno Park as contextual in site design.

![Images](image)

**(a)** Site existing  **(b)** Zoning concept

**Figure 4. (a) Site existing (b) Zoning concept**
Based on an analysis of the condition and function of buildings on the existing site, the site divided into exhibition management and research zones, research and training zones, production development zones, and additional function zones. The Science and Techno Park maintains existing buildings included in the design site. This existing building has a function following the service of Science and Techno Park is Museum Pendidikan Indonesia, Fakultas Pendidikan Seni dan Desain (FPSD), Fakultas Pendidikan Ekonomi dan Bisnis (FPEB), Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM), dormitory, parking area, shuttle bus terminal, and water treatment plant.

The management and exhibition zone are close to the Indonesian Education Museum because it has the same nature, namely the public. Thus, the Science and Techno Park management and exhibition zone located next to the museum. This zone is placed in front near the UPI entrance because this zone functions as the first zone visited by visitors and is public.

The research zone, business incubator, and training locate close to the FPSD, FPEB, and LPPM. This research zone is closer to LPPM because it has the same function, namely research. The business and training incubator zones are placed in this section because they have the same zones, namely semi-public zones. The production development zone locates close to the PAP, which later functions as a regional service zone. This zone is located close to the service zone because this production zone must keep away from the public area.

The additional zone is placed in the dormitory zone because it has the same function, namely as a temporary residence for researchers and trainees who come to this area. In the existing service of the building, there are residential units and public spaces at the bottom of the floor so that they can develop into additional zones within the design area.

4.2. Building Concept

Building mass is a general form of a building that is influenced by several factors such as climate, culture, and building orientation towards the site [8]. Based on the results of simulations carried out by the author carried out in chapter 2, the primary form of building mass used is the box, 'H,' 'L,' and the Box with Deep Field with Wall to Window Ratios 30% in all facades of the building, and orientation facing north-south [9].
The shape of the building is chosen based on the results of the research conducted. The research did a study of 4 types of forms, with three kinds of WWR percentages, and two kinds of building adjustments. These Combined Parameters produce 24 varieties of shapes with different parameters. The way chosen is a building that uses the lowest energy and has thermal comfort with a "neutral" sensation.

| Research Result | Existing Building | New Building |
|-----------------|-------------------|--------------|
| MUSEUM          | exhibition & administration |
| FPEB            | Business incubator |
| LPPM            | research center |
| DORMITORY       | production warehouse |

The steel structure in the building is exposed using glass wall material so that users can see it from the outside. The purpose of the building structure's exposure is to foster high-tech impressions on buildings according to Norman Foster's theory.
Figure 7. (a) Inside-out concept (b) contrast color on facade.

To reduce solar radiation entering the building, the authors add shade to the facade. The application of this shade aims to respond to the glass walls of buildings with exposure to incoming solar radiation. The location of the building is in a tropical climate, so that the building will expose to solar radiation for a long time. Thus, this shade serves to reduce solar radiation entering the building.

The building facade uses glass material. This material selection aims to make activities, activities, and systems inside the building visible from the outside (inside out implementation, on fig 7a). Besides glass, the author uses steel as column material. The selection of steel and glass materials is one of the implementations of high-tech themes in buildings.

The colors used in building facades and building interiors are contrasting colors such as white, gray, and black. This color is the original color of fabrication material that the author applies to the building. The use of contrasting colors is one of the high-tech building implementations (fig. 7b).

The author applies the scale of impressive buildings to the building (fig 8a). Human height ratio 170: building height of 2000 is 1:11. Based on the comparison theory of the range between the length of the road and the height of the building, (road width = 12m and building height 38m, ratio X = 3.1). Thus, the premise that the author designed belongs to the scale of monumental buildings (X> 1). Impressive scale buildings can create a magnificent and high atmosphere [10]. The geometric shape on the façade also uses as the implementation of the high-tech building (fig. 8b).

Figure 8. (a) Impressive scale implementation. (b) The geometric shape on the facade.

4.3. Utility Concept
Clean water utility system in the region uses a smart water grid system (fig. 9). The smart water grid system is an irrigation system in the area by using various combined water sources, then distributed throughout the region with an internet network control system. Based on location analysis, UPI has several water sources, namely rivers, PDAM (local water company), and artesian wells. The author combines these three water sources into the Smart Water Grid System. Besides that, the author uses rainwater harvesting as a water source based on climate analysis on-site.
The author divides four zones within the UPI Science and Techno Park area. Zones are classified based on the functions of each zone. Zone 1 is an exhibition, research, and management zone. Zone 2 is a research and incubation area. Zone 3 is a private area. Zone 4 is a production and utility area. The author divides the area into four zones based on consideration of the strength of the water distribution pump from the utility center.

Water Purification Center pumps water from rivers. Whereas runoff and rainwater, the author first accommodates them in sewers (large reservoirs). The author places sewers in the FPSD area based on drainage analysis on-site. The author added the source of water from the PDAM (Local water company) as a source of backup water.

The author combined these sources in a water purification center. This water purification center serves to clear water. Then, the central pump distributes water to each zone tank. In each zone, there are distribution pumps that function to distribute water to each building tank.

The author divides the dirty water system into three systems, namely used water utility systems, sewage water utility systems, and hazardous chemical waste utility systems. The water utility system flows through pipes in the building shaft, and then the author treats the water in the water purification center. Then, the water purification center distributes the water to the toilet as a source of flushing.

The author applies a grid system in the electrical energy distribution system. This grid system is an electrical energy distribution system sourced from various sources of electrical energy. The author
applies electricity sources from PLN (local electricity company), solar panel systems, and generators. Utility center functions to combine the three sources. Then, the transformer equalizes the three mains voltage. This transformer system functions to process electricity from various sources so that it becomes one of the same electrical energy voltage. After having the same voltage, the author supplies the power source to each panel of the building through an underground electricity network.

The function of the generator is to provide a backup supply of electricity in the region. The generator works with an auto-switch system. This system activates so that the electrical energy flowing in the area is not interrupted.

The author applies a waste management system within the UPI Science and Techno Park area. First, this system separates waste based on its type, namely organic and inorganic. Waste is then collected using a garbage truck and then processed in the production warehouse — biological processing systems such as food scraps and leaf litter into biofuels. Waste processed into biofuel then distributed to the shuttle bus center as a fuel source. Besides, this system processes waste into organic fertilizer for reforestation in the region. This fertilizer can be sold to other companies.

This system separates inorganic waste based on its type. Plastic waste such as beverage bottles, food containers, and styrofoam processed into plastic ores for later sale. Iron and glass waste transformed into ore and then sold to companies in need. Paper waste processed into the tissue for cleaning purposes in the area.

![Figure 11. Grid electricity system scheme.](image)

![Figure 12. Waste treatment scheme.](image)
The Planning and Design of UPI Science and Techno Park in the University of Indonesia's Education area is a medium for conducting "green campus" research in the region. By applying technology and research in the fields of infrastructure, energy, waste, water, and transportation, UPI's ranking as a green campus in Indonesia, even the world, will improve. Buildings provided to support these activities are Management and Exhibition Buildings, Business and Training Incubator Buildings, Research Center Buildings, and Production Buildings. While developing the quality of green campus through the application of solar panels on each roof of the building, the use of wind turbines and utility centers to process the energy and water treatment, as well as waste treatment and electric vehicle parking areas.

![Figure 13. Green Campus implementation on UPI Science and Techno Park area.](image)

5. Conclusion
The function of UPI Science and Techno Park is as a means for the diffusion of technology that accommodated in co-working space, collaborative research in related fields which author covers in research laboratory space, business incubation that provided in the business consultation room and discussion room, as well as products supplied in the production warehouse. Besides, UPI Science and Techno Park have become a means of education both for UPI students and for the general public to know the development of related field technology in this day and age, so that the author provides exhibition spaces and visitation spaces for general users.

Acknowledgment
The authors would like to thank all the Department of Architectural Engineering Education who have assisted for site survey, designing, analyzing, and providing the opportunity to conduct the study of Final Project as well as facilitate all the needs undertaken in the preparation of this Paper. The authors would like to thank Dr. Eng. Beta Paramita, S.T., M.T. and Restu Minggra, S.Pd., M.T. as author’s supervisor to finish this final project. We gratefully acknowledge the support from USAID through the SHERA program – Centre for Development of Sustainable Region (CDSR). In the year 2017-2021, CDSR is led by the Centre for Energy Studies – UGM.
References
[1] UI Green Metric Secretariat 2018 UI Green Metric, World University Ranking
[2] Maryani E and Paramita B 2018 Laporan Akhir: Penerapan UI Green Metric University Ranking Pada Kampus Universitas Pendidikan Indonesia Bandung
[3] Maryani E, Paramita B and Sugito N 2018 Studi Penerapan UI Greenmetric World University Ranking pada Kampus Universitas Pendidikan Indonesia (UPI) Bandung
[4] Soenarso and Sardjono W 2011 Science and Technology Park
[5] Zhu J et al. 2006 Reusable Conceptual Models - Requirements Based on the Design Science Research Paradigm *IEEE Transactions on Software Engineering*.
[6] Asmoro B B 2015 High-Tech Architecture *E-Journal Teori Arsitektur UAJY* pp 68–95.
[7] Dewidar K 2017 Hi-Tech Architecture and Its Characteristics
[8] Devitama, Fauzan F, Fukuda H, Paramita B, and Suryandono A R 2019 Study of Building Shape Parameter on Energy and Thermal Comfort in Bandung, Indonesia *Journal of Asian Institute of Low Carbon Design II (II-15 Original Design Article)*
[9] Qingsong M and Fukuda H 2016 Parametric Office Building for Daylight and Energy Analysis in the Early Design Stages *Procedia - Social and Behavioral Sciences* 216: 818–28. http://linkinghub.elsevier.com/retrieve/pii/S187704281506259X.
[10] Carmona M, Tiesdell S, Heath T and Taner O 1988 Public Places Urban Spaces: The Dimensions of Urban Design *In Public Places Urban Spaces*, ed. Routledge Taylor & Francis Group New York