Architechnopreneurship: instrument calibration

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Abstract. Jakarta as the capital city of Indonesia has the potential to be prone to flooding during the rainy season. Geographical conditions, dense settlements, drainage systems and river flow conditions are various causes that require complex handling. Therefore, it needs synergy from various professions and expertise to be able to overcome problems that have social and economic impacts. Architechnopreneurship is a multidisciplinary concept developed as an effort to provide solutions for communities to survive in areas that are potentially affected by flooding. An architect's work that has a content of beauty provides education for the public to take advantage of housing as a place of refuge equipped with technology as a warning system as well as providing insights to bring the value of entrepreneurship to life. To achieve this goal, an instrument will be made that will be distributed to the wider community to assess this architechnopreneurship concept building sketch. This study aims to describe the results of the architechnopreneurship instrument calibration. The research method used is the Neuroresearch method, a mixed method with an emphasis on the exploratory and explanatory research stages. The result of this research is an architechnopreneurship standard instrument that can be used to measure the architechnopreneurship concept building sketch.

Keywords: sustainable architecture, architechnopreneurship, neuroresearch methods

1. Introduction

Floods are disasters that are not easy to avoid. Jakarta is a city prone to flooding due to the rapid growth of settlements, degradation of the drainage system, sewers, and rivers in the city center to be the causes [1], [2]. Various efforts were made to minimize the impact of the floods and some even did it through social media [3]. This shows that the complexity of the flood problem requires handling from various aspects.

Settlements located in flooded areas have the greatest social and economic impact [4]. A study states that flood management requires an adaptive and integrated method [5]. Therefore, architects have a very important role in producing residential concepts that can help the people of Jakarta to make friends with floods. The increasing population of Jakarta provides an important picture for architects in their work, especially in contributing to the idea of overcoming floods [6-7]
An architect’s work should not only be enjoyed by its beauty, but by considering the potential for flooding for several flood-prone areas, the architect must be able to adapt and his/her work shows that he/she has adapted to flooding. Incorporating design practices that consider the management, distribution, and storage of water resources to overcome potential flooding needs to be mastered [8]. Architects need to consider planning, social, ecological, and various other aspects to produce efficient work [9-10]. Residential work that is expected to be able to be presented as a good architect’s work, profitable from a business aspect, utilizing technological advances and having educational content for its residents is called Architechnopreneurship.

To be able to produce works of architechnopreneurship concept that can be accepted by the community, the sketches that are made must obtain public assessment. Therefore, this study aims to develop a standard instrument that will be used to capture public perceptions of architectural designs with the concept of architechnopreneurship.

2. Literature Review
The concept of architechnopreneurship is a combination of science in the fields of architecture, entrepreneurship and education that can provide input on urban planning policies that are adaptive to the threat of flooding. To help people face the threat of flooding, the work of architects has its own challenges. In an environment prone to flooding, architects can not only prioritize aesthetics, but architects need to have the ability to analyze works that can be utilized in force majeure conditions such as floods [11-12].

A study in Nigeria found architectural concepts for flood-resistant housing. The building is expected to have a design with an elevated floor, tiles made of concrete, an embankment, an arrangement of waterways that accommodate flooding, and high-rise kitchen utensils. Buildings are also expected to have sophisticated panels, namely automatic windows, and water sensors inside and outside the building [13]. Building designs that can generate “resilience thinking” in the context of flooding are also important [14]. The encounter of Architecture, Entrepreneurship and Education will produce an adaptive home design model with flooding accompanied by the educational process needed to be the basis of architechnopreneurship.

3. Research Method
The research method used in the entire architechnopreneurship research is neuroresearch. Neuroresearch is the mixed methods models consisting of exploratory, explanatory, and confirmatory research stages [15]. The exploratory research stage was conducted to produce a theoretical construct of architechnopreneurship. Through various qualitative studies in the form of literature reviews, the concept of architechnopreneurship is an architectural work that not only displays the aesthetic side but more on the usefulness and usability of flood-resistant buildings so that the building has entrepreneurial value, adopts technological advances, and provides education for its residents in dealing with flood disasters.

The explanatory research stages were carried out in producing architechnopreneurship research instruments. The instrument that will be used to obtain community assessment is built by three main indicators, namely indicators in an architectural perspective, indicators in an education perspective and indicators in the perspective of architechnopreneurship itself. This instrument is then implemented in the trial phase and instrument calibration is carried out to produce standard instruments. The instrument calibration was carried out by using the construct validity test to a random sample of 60 people in Jakarta.

4. Results
In the construct validity test, it was carried out on a random sample of 60 people in Jakarta (Table 1). Of the 60 respondents the trial sample through 15 items. The first stage of construct validity calculation is done with Item Response Theory through Orthogonal Iteration because Architechnopreneurship is an instrument based on unidimensional theory. The determination of the criteria at the 0.05 significance level is 0.254.
Table 1. The determination of the criteria

| Respondents | Indicator 1 - Arc | Indicator 2 - Edn | Indicator 3 - ATP | Architechnopreneurship |
|-------------|------------------|-------------------|-------------------|------------------------|
| R1          | 2                | 3                 | 3                 | 3                     | 31                    |
| R2          | 5                | 3                 | 5                 | 4                     | 62                    |
| R3          | 3                | 4                 | 3                 | 4                     | 47                    |
| R4          | 3                | 4                 | 4                 | 3                     | 46                    |
| R5          | 3                | 4                 | 4                 | 3                     | 48                    |
| R6          | 3                | 4                 | 4                 | 3                     | 49                    |
| R8          | 3                | 4                 | 4                 | 3                     | 52                    |
| R9          | 3                | 4                 | 4                 | 3                     | 53                    |
| R10         | 3                | 4                 | 4                 | 3                     | 53                    |
| R11         | 3                | 4                 | 4                 | 3                     | 54                    |
| R12         | 3                | 4                 | 4                 | 3                     | 54                    |
| R13         | 3                | 4                 | 4                 | 3                     | 54                    |
| R14         | 3                | 4                 | 4                 | 3                     | 54                    |
| R15         | 3                | 4                 | 4                 | 3                     | 54                    |

Construct Validity: 0.527, 0.621, 0.633, 0.724, 0.67, 0.605, 0.538, 0.537, 0.286, 0.651, 0.643, 0.545, 0.554, 0.641, 0.443
Remarks: Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid, Valid

Based on the first approach, namely Orthogonal Iteration, 15 items are produced as valid Architechnopreneurship instruments and a Reliability Index of 0.853 is produced as a description of the consistency of measuring the Architechnopreneurship variable. The results of the reliability index are as shown in Table 2.

Table 2. Calculation of the Reliability Index for Architechnopreneurship Instruments with Cronbach Alpha Based on the Item Response Theory Method through Orthogonal Iteration

| Cronbach's Alpha | N of Items |
|------------------|------------|
| 0.853            | 15         |

The second approach is the extraction method, namely the Principle Component Axis, where the rotation technique is determined by a maximum Varimax Iteration of 25 times. The results of the exploration of empirical indicators found 4 (four) empirical indicators as shown in Table 3.

Table 3. Calculation of the First Stage of Exploration of Empirical Indicators of Architechnopreneurship through the Principle Component Axis Approach with Varimax Iteration

| Component | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
|-----------|-------|---------------|--------------|-------|---------------|--------------|-------|---------------|--------------|
| 1         | 5.171 | 34.475        | 34.475       | 5.171 | 34.475        | 34.475       | 3.639 | 24.263        | 24.263       |
| 2         | 2.854 | 19.024        | 53.499       | 2.854 | 19.024        | 53.499       | 3.211 | 21.405        | 45.686       |
| 3         | 1.260 | 8.442         | 61.941       | 1.260 | 8.442         | 61.941       | 2.149 | 14.328        | 59.996       |
| 4         | 1.074 | 7.163         | 69.104       | 1.074 | 7.163         | 69.104       | 1.386 | 9.107         | 69.104       |
| 5         | .949  | 6.321         | 75.425       | .949  | 6.321         | 75.425       |       |               |              |
| 6         | .735  | 4.900         | 80.325       | .735  | 4.900         | 80.325       |       |               |              |
| 7         | .685  | 4.303         | 84.358       | .685  | 4.303         | 84.358       |       |               |              |
| 8         | .559  | 3.718         | 87.074       | .559  | 3.718         | 87.074       |       |               |              |
| 9         | .484  | 3.225         | 90.299       | .484  | 3.225         | 90.299       |       |               |              |
| 10        | .347  | 2.313         | 92.612       | .347  | 2.313         | 92.612       |       |               |              |
| 11        | .290  | 1.866         | 94.478       | .290  | 1.866         | 94.478       |       |               |              |
| 12        | .247  | 1.645         | 97.122       | .247  | 1.645         | 97.122       |       |               |              |
| 13        | .209  | 1.396         | 98.518       | .209  | 1.396         | 98.518       |       |               |              |
| 14        | .147  | .990          | 99.499       | .147  | .990          | 99.499       |       |               |              |
| 15        | .075  | .501          | 100.000      | .075  | .501          | 100.000      |       |               |              |

Extraction Method: Principal Component Analysis.
Based on Table 3, then the recalculation process was carried out by setting the cumulative number of indicator contributions above 50%, namely 3 indicators were found. The observed result is the "new item" grouping based on "three new indicators", the determination is based on the loading factor through an eigen value of 0.600. The result of the second stage is a rotational "new grain grouping". The results are as shown in Table 4.

**Table 4. Calculation of the Second Stage Based on the Cumulative Contribution of Architechnopreneurship Forming Indicators through the Principle Component Axis Approach with Varimax Iteration**

| Component | Initial Eigenvalues | Extraction Sums of Squared Loadings | Rotation Sums of Squared Loadings |
|-----------|---------------------|-------------------------------------|----------------------------------|
|           | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1         | 5.171 | 34.475 | 34.475 | 5.171 | 34.475 | 34.475 | 3.993 | 26.817 | 26.817 |
| 2         | 2.654 | 19.024 | 53.509 | 2.654 | 19.024 | 53.509 | 3.548 | 23.651 | 50.269 |
| 3         | 1.266 | 8.442 | 61.941 | 1.266 | 8.442 | 61.941 | 1.751 | 11.873 | 61.941 |
| 4         | 1.074 | 7.163 | 69.104 |                   |                   |                   |                   |                   |
| 5         | 2.654 | 19.024 | 53.509 |                   |                   |                   |                   |                   |
| 6         | 0.948 | 6.321 | 75.425 |                   |                   |                   |                   |                   |
| 7         | 0.735 | 4.909 | 80.325 |                   |                   |                   |                   |                   |
| 8         | 0.605 | 4.030 | 84.365 |                   |                   |                   |                   |                   |
| 9         | 0.598 | 3.718 | 88.074 |                   |                   |                   |                   |                   |
| 10        | 0.484 | 3.225 | 91.268 |                   |                   |                   |                   |                   |
| 11        | 0.347 | 2.313 | 93.612 |                   |                   |                   |                   |                   |
| 12        | 0.280 | 1.868 | 95.478 |                   |                   |                   |                   |                   |
| 13        | 0.217 | 1.485 | 97.123 |                   |                   |                   |                   |                   |
| 14        | 0.147 | 0.980 | 99.459 |                   |                   |                   |                   |                   |
| 15        | 0.075 | 0.501 | 100.000 |                   |                   |                   |                   |                   |

Extraction Method: Principal Component Analysis.

**Table 5. Rotated Component Matrix Calculation Results for Architechnopreneurship Formation**
Out of the 15 items, one item, number 12, is invalid. Thus, the valid Architechnopreneurship instrument through Varimax iteration is described with 14 items. The distribution includes the first indicator drawn by points 4, 13, 15, 1, 2, and 5. The second indicator is described in points 6, 7, 8, 3, and 11. While the third indicator is described in points 10 and 9. The details can be seen in Table 5, with the results of the reliability index (in Table 6) are 0.845.

**Table 6. Calculation of the Reliability Index for Architechnopreneurship Instruments with Cronbach Alpha Based on the Principle Component Axis Method through Orthogonal Iteration**

| Reliability Statistics |
|------------------------|
| Cronbach's Alpha       | N of Items |
|                        | 0.845      | 14          |

The third Construct Validity approach is carried out by using Hierarchical Cluster Analysis, the type is Cluster Average Linkage (Between Groups), with Dendogram using Average Linkage (Between Groups). The results are as in Figure 1.

**Figure 1. Calculation of Construct Validity for Architechnopreneurship Instruments**

The third stage is carried out by Hierarchical Cluster Analysis, the type is Cluster Average Linkage (Between Groups), with Dendogram using Average Linkage (Between Groups). From Figure 1 it can be explained that with the Hierarchical Cluster Analysis approach, the type is Cluster Average Linkage (Between Groups), with a Dendogram that uses the Average Linkage (Between Groups) resulting in 3 (three) new indicators. The first new indicator is reflected in item numbers: 7, 8, 3, 6, 11, 10, 13, 14, 2, 12, and 5. The second new indicator is reflected in items: 9. And the third new indicator is reflected by item number: 5, 15, and 1. Based on the results of the aforementioned calculations, the Cronbach Alpha Reliability Index (Table 7) is produced of 0.853 through 15 items on the valid Architechnopreneurship instrument.
Table 7. Calculation of Reliability Index for Architechnopreneurship Instruments with Cronbach Alpha Based on Hierarchical Cluster Analysis, Types of Cluster Average Linkage (Between Groups), with Dendogram using Average Linkage (Between Groups)

| Reliability Statistics |
|------------------------|
| Cronbach’s Alpha | N of Items |
| 0.853 | 15 |

Based on the 3 approaches to calculate the construct validity of the Architechnopreneurship Instrument, the researcher concluded that the results of the construct validity used were in the first calculation, namely with 3 (three) indicators, a total of 15 items with a level of consistency measuring Architechnopreneurship (Reliability Index) of 0.853 (Table 7).

5. Discussion and Conclusion
Architechnopreneurship is a new construct that is expected to help architects when creating designs that are suitable for people living in settlements with the potential for flooding. Residential design that can be a comfortable residence but has various functions is the basis for the concept of architechnopreneurship. This building can adopt technological advances with various devices that can be useful when a flood hits. In addition, this building is also expected to provide insight into the value of entrepreneurship for its residents so that when floods hit, economic losses will be minimized. These various functions are expected to form a new culture through education in utilizing architechnopreneurship concept housing so that it will produce people who are alert and able to survive when exposed to floods [10],[16].

The results of instrument calibration that produce valid and standard instruments can sharpen the development of the architechnopreneurship concept to be implemented and accepted by the community. It is hoped that the concept of architechnopreneurship can provide insight and inspiration for the government in implementing various policies to manage flood disaster prevention and management [17-18]. So that human settlements in any city will be built with the concept of sustainable housing because they already have various adaptive and anticipatory concepts in dealing with various disaster situations, especially flood disasters but also consider ecological and socio-cultural aspects [19-20].

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References
[1] I. Riyanto, L. Margatama, R. Arief, D. Sudiana, and H. Sudibyo, “Pesanggrahan River Watershed Flood Potential Mapping in South and West Jakarta with LiDAR Data Segmentation,” *J. Phys. Conf. Ser.*, vol. 1201, no. 1, 2019, doi: 10.1088/1742-6596/1201/1/012028.
[2] V. Pratiwi, B. P. Yakti, and B. E. Widyanto, “Flood Control Reduction Analysis using HEC-RAS due to Local Floods in Central Jakarta,” *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 879, no. 1, 2020, doi: 10.1088/1757-899X/879/1/012167.
[3] W. Maharani, “Sentiment Analysis during Jakarta Flood for Emergency Responses and Situational Awareness in Disaster Management using BERT,” in 2020 8th
International Conference on Information and Communication Technology (ICoICT), 2020, pp. 1–5.

[4] K. Marko, E. Kusratmoko, M. Parlindungan Tambunan, and R. Pahllevi, “A Spatial Approach in Assessing Flood Losses in Floodplain Area of Pesanggrahan River (Case Study on Ulujami and Cipulir Urban Villages, South Jakarta),” IOP Conf. Ser. Earth Environ. Sci., vol. 338, no. 1, 2019, doi: 10.1088/1755-1315/338/1/012030.

[5] A. Wicaksono and H. Herdiansyah, “The impact analysis of flood disaster in DKI Jakarta: Prevention and control perspective,” J. Phys. Conf. Ser., vol. 1339, no. 1, 2019, doi: 10.1088/1742-6596/1339/1/012092.

[6] W. S. Pradafitri and S. S. Moersidik, “Potential of east flood canal as provider of drinking water ecosystem services for DKI Jakarta,” IOP Conf. Ser. Earth Environ. Sci., vol. 306, no. 1, 2019, doi: 10.1088/1755-1315/306/1/012005.

[7] E. Adeline, H. Hasibuan, and S. Moersidik, “Infiltration Capacity in Flood Mitigating Jakarta,” no. January, 2020, doi: 10.4108/eai.22-10-2019.2292391.

[8] W. Yi-xi and S. Ying, “The Role of the Landscape Architect in the 21st Century Fight against Climate Change,” vol. 7, no. 10, pp. 27–35, 2019.

[9] F. Bahrami, A. Alehashemi, and H. Motedayen, “Urban Rivers and Resilience Thinking in the Face of Flood Disturbance The Resilience Planning of the Kan River,” Manzar, vol. 11, no. 47, pp. 60–73, 2019, doi: 10.22034/manzar.2019.182617.1948.

[10] Y. Budiyono, J. Aerts, J. Brinkman, M. A. Marfai, and P. Ward, “Flood risk assessment for delta mega-cities: a case study of Jakarta,” Nat. hazards, vol. 75, no. 1, pp. 389–413, 2015.

[11] W. Menteth, “Eight perspectives: What benefits could flood resilience bring to your life/industry: The architect: Walter Menteth,” in Retrofitting for Flood Resilience: A Guide to Building & Community Design, RIBA, 2020, p. IX.

[12] L. Hobeica and A. Hobeica, “How adapted are built-environment professionals to flood adaptation?,” Int. J. Disaster Resil. Built Environ., 2019.

[13] F. O. Ezeokoli, K. C. Okolie, and S. U. Onwuka, “Flood Resilience Measures in Buildings on the Flood-plains of Ogbaru, Anambra State, Nigeria,” Adv. Res., pp. 1–10, 2019.

[14] K. Potter and T. Vilcan, “Managing urban flood resilience through the English planning system: insights from the ‘SuDS-face,’” Philos. Trans. R. Soc. B, 2016, doi: 10.1098/not.

[15] Sasmoko, Y. Indrianti, R. Karsidi, D. Wuisan, and P. Ruliana, “Neuroresearch: Another form of mixed method,” Int. J. Eng. Technol., vol. 7, no. 2, pp. 134–138, 2018, doi: 10.14419/ijet.v7i2.10.10971.

[16] A. N. Karanci, B. Aksit, and G. Dirik, “Impact of a community disaster awareness training program in Turkey: Does it influence hazard-related cognitions and preparedness behaviors,” Soc. Behav. Pers., vol. 33, no. 3, pp. 243–258, 2005, doi: 10.2224/sbp.2005.33.3.243.

[17] P. J. Ward, W. P. Pauw, M. W. van Buuren, and M. A. Marfai, “Governance of flood risk management in a time of climate change: The cases of Jakarta and Rotterdam,” Env. Polit., vol. 22, no. 3, pp. 518–536, 2013, doi: 10.1080/09644016.2012.683155.

[18] R. Van Voorst, “Formal and informal flood governance in Jakarta, Indonesia,” Habitat Int., vol. 52, pp. 5–10, 2016.

[19] S. Wijaksono, Sasmoko, Y. Indrianti, and S. A. Widhoyoko, “Jakarta socio-cultural ecology: A sustainable architecture concept in urban neighbourhood,” in IOP Conference Series: Earth and Environmental Science, 2018, vol. 109, no. 1, doi: 10.1088/1755-1315/109/1/012044.

[20] B. Edwards, “Sustainable housing: architecture, society and professionalism,” Sustain. Hous.Princ. Pract. London E F Spoon, 2000.