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To cite this article: W Sasongko et al 2017 IOP Conf. Ser.: Earth Environ. Sci. 70 012063

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The development concept of Taman Aloon-Aloon Tulungagung based on visual accessibility, diversity of activities and perception of users

W Sasongko¹, R P Kurniasanti¹ and J P Siregar¹,²
¹ Department of Urban and Regional Planning, Faculty of Engineering, Universitas Brawijaya, Malang, Indonesia
² School of Design, Queensland University of Technology, Brisbane, Australia

sasongkowisnu@yahoo.co.id

Abstract. Tulungagung has a public space that actively used by the community named Taman Aloon-Aloon Tulungagung. The importance of research on the Development Concept of Taman Aloon-Aloon Tulungagung as open public space is requiring location structuring for appeal aspects of public space in order to spread evenly and can be enjoyed by users of public space. Therefore, this study aimed to assess users’ perceptions of the attractiveness of public space by Importance Performance Analysis (IPA) method and assess the level of users’ visual accessibility by Visibility Graph Analysis (VGA) method and assess the diversity of users’ activity by Behavior Mapping method. As this study shows that the condition of the floor surface, the location of a bird cage, shade conditions of public space and location of lighting lamp become the top priority in the development concept of Taman Aloon-Aloon Tulungagung. The location for the prioritized attributes are adjusted to the results of the visual accessibility level evaluation matrix and activities diversity.

1. Introduction
Public open space is an open space owned by all, where people perform functional activities and rituals in a community both everyday life and in the periodic celebration [1]. One of the main functions of public open space is as a place for interactions between communities for a variety of purposes, both individuals and groups. In this case the public open space is part of the public social system whose existence cannot be separated from the social dynamics. Therefore, the existence of public open space should consider a wide range of people’s needs class and status that reflects the fulfillment of needs in the community of all levels of society, both top to bottom class, from normal society until people who have different physical abilities with normal people, from children to adults and man or woman.

2. Literature Review
The public spaces are not just limited to green open spaces only, but including the private plots. Distribution and structure of public space is influenced by morphology. Social activities that supported by the existence of a public space, it can be said that the social interaction is also influenced by morphology. Social activity and private need are related to its space and access control. Connectedness each space is determined by the flow of the motion which determined by the structure of land use and street patterns. The high connectivity and flow of motion whether it can create its own public space
where humans have the opportunity to meet, engage and interact with each other. Public space is not only seen from the activity or process of communication, but based on access.

The success of creating a public space for people is not only seen in terms of physical public space, but also people's behavior in using it. Therefore, it is necessary to study the utilization pattern of Taman Aloon-Alloon Tulungagung as public open space which is certainly related to user activity and configuration support space. In solving the problems of architectural and town design currently required new approaches that more attention dialectical interaction between humans and the environment, which understands that this interaction process involves decisions of individual human which is not always can be modeled and mathematically structured [2]. Regarding to the principle, the expectation on the relationship between humans and space if all is one, then we will find the level of configuration from space more than activity individual. It is situated on the relationship between configuration from humans and the space configuration [3]. The arguments presented by the Regulation of the Ministry of Domestic Affairs No.2 year 1987 that the need to study all aspects of the problems in town planning including studying the configuration of space for urban design. These considerations are spurring the development of behavioral approaches and develop the concept of space.

Tulungagung has a public space that actively used by community which is Taman Aloon-Alloon Tulungagung. Taman Aloon-alloon Tulungagung is a public space with area of 1.3 ha which each day, especially on holidays, used by the community as a sports and leisure facilities. In addition, Taman Aloon-alloon Tulungagung also has historical value as a district center and community center since the beginning of the 20th century. Taman Alun-alun Tulungagung located in the center of Tulungagung Town. Taman Alun-alun Tulungagung is a public space that has undergone a redesign in 2007. Prior to the redesign, the public space is less well maintained and underused by the public.

At this time, the space layout design of Taman Alun-alun Tulungagung forming different activity concentrations in each area so that the impact on the emergence of a crowded area and the area is deserted. The importance of studying about Development Concept of Taman Alun-alun Tulungagung as a public open space is the need of location arrangement to appeal aspects of public space in order to spread evenly and can be enjoyed by users of public space.

3. Methods
Scope of the research areas is Taman Alun-alun Tulungagung with ± 1.3 Ha wide. Method of data collection uses questionnaires and field observations.

3.1. Population & Samples Determination
The population used in this research is all Taman Alon-aloon Tulungagung users.

3.1.1. Activity mapping sampling. Behavior mapping in this study using the whole user population Taman Alon-aloon Tulungagung that perform activities on public spaces, both static and dynamic activities at 6 a.m. to 7 a.m, 12 a.m to 1 p.m, and 4 p.m to 5 p.m on holidays (weekend).

3.1.2. Questionnaires sampling. The sampling technique used is Accidental Sampling. Through consideration of the type of research, and the limitations of the study population in terms of time, cost and effort, then used a quota sampling method. Quota sampling is done if the population is not known with certainty either the number or variety of characteristics that make it homogeneous, then it is determined several number of individuals who are considered to represent [4]. Visitor population proportion of Taman Alon-aloon Tulungagung which not certainty known yet because it is not fixed so that p and q are not known, it can be replaced by 0.25 as the multiplication of 0.5 x 0.5. Total sample calculation using the above equation is:

\[ n > 0.5 \times 0.5 (1,96/0,1)^2 \]  
\[ n > 96,04 \text{ people} \]
A sample of 100 subjects classified as essential [5]. Therefore, the number of samples required rounded to 100 people.

Table 1. Sample dividing proportion.

| Day          | Morning (6 a.m-7 a.m) | Noon (12 a.m-1 p.m) | Afternoon (4 p.m-5 p.m) |
|--------------|-----------------------|---------------------|-------------------------|
|              | R D L                 | R D L               | R D L                   |
| Regular      | 2 4 1                 | 3 5 2               | 3 8 3                   |
| Holiday      | 5 13 3                | 7 10 6              | 9 13 3                  |
| Total        | 7 17 4                | 10 15 8             | 12 21 6                 |

The analytical method used is the analysis of IPA, Behavior Map and Visibility Graph Analysis.

3.2. Analysis of IPA
Evaluative analysis is used to analyze user perception of the public spaces Taman Aloon-aloon Tulungagung attractiveness through analytical methods Importance Performance Analysis (IPA). IPA analysis is an analytical method combination between aspects of the level of interest and perception of the quality or condition of an object into two-dimensional form. Aspects used is space, nature, culture and history, quietness and facilities. There are two parameters in the analysis of IPA, which are represented by the letters x and y, where x is the perception of the quality of public space that can give satisfaction to the user, while y is the level of user interest. The level of interest which meant in this case is interest according to the user toward the public space used.

3.3. Analysis of Behavior Map
Behavior mapping is a systematic observation techniques to document the use of a specific space or a location. Mapping behavior is relatively the most useful way lately in the evaluation process, after the specific location within the local area identified as a place which has a problem, successful or as a place which present opportunities to be redesigned or re-used. This process requires Incentive time on activity observed in a region that has been determined and recorded on maps, with details regarding the activity captured through symbol, notes and photos. Behavior mapping in this study using Place-centered way of mapping.

3.4. Visibility Graph Analysis (VGA)
The purpose of the Visibility Graph Analysis (VGA) is to analyze the extent to which each point in the network spatial visible from any other point. In this research aims to identify the VGA visual access to the garden. VGA can see the value of linkages (connectivity) and integration values (integrity) and intelligibility value that indicates the level of correlation between the measurements of a local scale (connectivity) to the global scale measurements (integrity) [6]. This analysis is a visual approach using open source applications DepthmapX 0.30.

4. Results

4.1. Scope of Research Region
Taman Aloon-aloon Tulungagung placed in Kelurahan Kampungdalem Kecamatan Tulungagung Kabupaten Tulungagung. The limitations of Taman Aloon-aloon Tulungagung are below:
North: Jalan RA. Kartini;
East: Jalan RA. Kartini;
South: Jalan RA. Kartini and Kelurahan Kauman;
West: Jalan RA. Kartini and Kelurahan Kauman

Map of the research region is shown by Figure 1.
4.2. IPA Analysis
To analyze visitor perceptions about the attractiveness of public spaces Taman Aloon-aloon Tulungagung used IPA analysis. Taman Aloon-aloon Tulungagung condition assessed through 5 variables of the public space attractiveness, namely space, nature, culture and history, quietness, as well as facilities with a total of 22 attributes.

Table 2. Attribute development based on IPA quadrant.

| Code | Variable                  | Level of Compliance (%) | x     | y     | IPA Quadrant               |
|------|---------------------------|-------------------------|-------|-------|----------------------------|
| C4   | Culture and History       | 84                      | 364   | 433   | Quadrant I (Keep Up the Good Work) |
| A3   | Space                     | 92                      | 398   | 433   |                            |
| C2   | Culture and History       | 94                      | 372   | 394   |                            |
| B1   | Nature                    | 100                     | 399   | 401   |                            |
| E8   | Facilities                | 100                     | 399   | 401   |                            |
| B2   | Nature                    | 102                     | 381   | 375   | Quadrant II (Possible Overkill) |
| E1   | Facilities                | 102                     | 375   | 366   |                            |
| E2   | Facilities                | 106                     | 376   | 355   |                            |
| C1   | Culture and History       | 107                     | 393   | 369   |                            |
| E3   | Facilities                | 108                     | 386   | 359   |                            |
| C3   | Culture and History       | 109                     | 372   | 342   |                            |
| C5   | Culture and History       | 109                     | 393   | 362   |                            |
| E5   | Facilities                | 110                     | 400   | 363   |                            |
| E4   | Facilities                | 115                     | 408   | 355   |                            |
| A2   | Space                     | 69                      | 263   | 380   | Quadrant III (Low Priority) |
| D1   | Nature                    | 72                      | 276   | 384   |                            |
| A1   | Space                     | 61                      | 261   | 426   | Quadrant IV                |
4.2.1. **Quadrant I.** Attributes that go into quadrant keep up the good work is an attribute that is considered as important and was able to meet users’ satisfaction. In order of priority, namely: the condition of the monument as a garden center (C4) – location of public spaces shade (A3) – existence of routine activity (C2) – the diversity of vegetation (B1) – existence of PKL (E8).

4.2.2. **Quadrant II.** Attributes that go into quadrant possible overkill indicating that attributes of the public space are less important to the users but has good quality so that it can be ignored. In order of priority, namely the condition of vegetation shade (B2) – the existence of the entrance / main road (E1) – the location of the entrance / main road (E2) – the existence of diverse visitor activity (C1) – the location of the fountain (C3) - the location of the monument (C5) - the location of the trash can (E5) - the trash can existence (E4).

4.2.3. **Quadrant III.** Attributes that go into quadrant low priority which indicates that some attributes decreased, due to both the level of interest and the quality is lower than the average value. In order of priority, namely the condition of public spaces guardrail (A2) – condition of trees as a noise reducer (D1).

4.2.4. **Quadrant IV.** Attributes that go into quadrant concentrate here is an attribute that is considered important and low satisfaction levels. In order of priority, namely: the condition of the floor surface (A1) – the location of bird cage (B1) – conditions of public spaces shade (A4) – location of lighting (E6).

**Table 3. Top Priority IPA Result**

| Quadrant | Priority Order | Level of Compliance | Attribute                                      |
|----------|----------------|---------------------|------------------------------------------------|
| IV       | 1              | 61%                 | A1. Conditions of floor surface                |
|          | 2              | 62%                 | B3. Location of bird cage                      |
|          | 3              | 65%                 | A4. Conditions of public space shade           |
|          | 4              | 67%                 | E6. Locations of lighting                      |
| I        | 5              | 84%                 | C4. Condition of monument as the garden center |
|          | 6              | 92%                 | A3. Location of public space shade             |
|          | 7              | 94%                 | C2. Existence of routine activity              |
|          | 8              | 100%                | B1. Diversity of vegetation                    |
|          | 9              | 100%                | E8. Existence of PKL                           |

4.3. **Behavior Map**

User behavior on holidays in the morning, majority are in the zone 3 while during the noon and afternoon, majority are at zone 5. Here is a map of Behavior Map in the afternoon with the most number of users and their diverse activity value calculation using Simpson's diversity index.
**Figure 2.** Behavior map weekend – afternoon.

**Table 4.** Simpson’s diversity index value of user activity.

| Zone | Simpson’s Diversity Index | Variety Activity |
|------|----------------------------|------------------|
| 1.   | 0.695                      | Very high        |
| 2.   | 0.426                      | Very low         |
| 3.   | 0.689                      | Very high        |
| 4.   | 0.667                      | Very high        |
| 5.   | 0.701                      | Very high        |
| 6.   | 0.681                      | Very high        |
| 7.   | 0.733                      | Very high        |
| 8.   | 0.609                      | High             |
| 9.   | 0.457                      | Very low         |

Parameter:
- Very high: 0.656 – 0.733
- High: 0.578 – 0.655
- Low: 0.500 – 0.577
- Very low: 0.422 – 0.499

4.4. **Visibility Graph Analysis (VGA)**

By using the Visibility Graph Analysis (VGA), known the extent to which each point in the network spatial visible from any other point so that it can determine the concept location of development direction Taman Aloon-aloon Tulungagung. Connectivity is shown in Figure 3, integrity shown in Figure 4 and intelligibility scatter plot shown in Figure 5.
Figure 3. (a) Result of connectivity on VGA (b) Result of integrity on VGA (c) Scatter plot intellibility

4.4.1. Connectivity. Space which has a red color are most common in the zones 7 and 8. This indicates that the space in this zone have visual access to the most excellent in the local scale, meaning that space in this zone has a good visual access to the space around it. Whereas in zone 3, 4 and 6 have a considerable blue. This shows that the space in the zone have a poor visual access within a local scale, meaning that space in this zone has a poor visual access to the space around it.

4.4.2. Integrity. Space which has a red color are most common in the zones 7 and 8. This indicates that the space in this zone has the most excellent visual access on a global scale, meaning that space in this zone has a good visual access to the entire space on the entire zone. Whereas in zone 3 and zone 6 has a blue color which is quite a lot. This shows that the space in the zone have a poor visual access on a global scale, meaning that space in this zone has a poor visual access to the entire space on the entire zone.

Table 5. Integrity value each zone.

| Zone | Integrity Average Value | Visual Access |
|------|-------------------------|---------------|
| 1    | 13.585                  | Low           |
| 2    | 12.240                  | Very low      |
| 3    | 11.440                  | Very low      |
| 4    | 15.070                  | High          |
| 5    | 16.491                  | Very high     |
| 6    | 13.488                  | Low           |
| 7    | 16.324                  | Very high     |
| 8    | 17.195                  | Very high     |
| 9    | 14.982                  | High          |

Parameter:
Very High: 15.756 – 17.194
High: 14.316 – 15.755
Low: 12.876 – 14.315
Very Low: 11.436 – 12.875

4.4.3. Intelligibility. The distribution of the connectivity and integrity value produce high intelligibility (R2 = 0.861364) which situate that the correlation is strong. This strong correlation means that connectivity can explain integrity, so that the local position can explain orientation globally.
4.5. Evaluation of Visual Accessibility and Diversity Activities

Once known the value of the diversity of activities from the calculation of Simpson's Diversity Index and the accessibility value of the average room space integrity of each zone, so it can be described by the following diagram.

![Figure 4. Matrix diagram of evaluation of visual accessibility and diversity activities.](image)

![Figure 5. Overlay of visual accessibility – diversity activity.](image)

4.6. Development Concept of Taman Aloon-aloon Tulungagung
1. Garden floor surface pavement Taman Alloon-aloon Tulungagung using grass-block with striking colors, especially in zones that have a high usage patterns of space, especially in zones prone to inundation that zone 7 and 9.
2. Maintenance bird cage conditions so as not to disturb the garden cleanliness and comfort of the user.
3. Location birdhouse transferred to zone 9 which has a low space usage patterns but the visibility value is fair.
4. Improvements of shelter in zone 4 and zone 6 at the entrance. These improvements include the addition of a clump of shade shelter located near a parking lot.
5. Addition massive shade as gazebo directed in zone 7 and zone 9.
6. The addition of lighting in zones 1, 3, 7, and 9 who have low visibility level to avoid a negative impression of space. With the direction, the user is expected to be felt safe being in zones located on the corner of Taman Alloon-aloon Tulungagung which has low level of visibility.
7. Maintenance conditions monument located in zone 5, to make it more aesthetically pleasing and able to add value to the attractiveness of the monument as well as the garden center is able to provide value sense of place to the users of Taman Alloon-aloon Tulungagung
8. Location of public spaces shade (trees) focused on space that has a high space usage patterns with low visibility, which is in zone 1 and zone 3.
9. Conducting routine every week to increase the attractiveness of Taman Alloon-aloon Tulungagung directed at the plaza which is located in zone 8.
10. Adding more diversity of vegetation in zone 2 and zone 9. The two zones have low visibility and low usage pattern. With this directive, the expected diversity of vegetation can still be enjoyed by users without disrupting user activity because it is allocated in a zone that has a variety of low activity.
11. PKL arrangement in zones 7 that have high visibility. This will facilitate user access to the location of PKL to trade.

5. Conclusion
Based on the results and discussion, the following conclusions are discussed based on the research objectives:

1. Based on the analysis results obtained through Importance Performance Analysis (IPA) on the user’s perception obtained the following results:
   Based on visitor perceptions about the results of the perception of visitors through the analysis of Importance Performance Analysis (IPA) have been the priority attribute of variable attractiveness of public space that will develop as follows:
   a. The condition of the floor surface
   b. Location of birdhouse
   c. The condition of public space shade
   d. Location of lighting
   e. The condition of the monument as a garden center
   f. Location of public space shade
   g. The existence of routine activity
   h. The diversity of vegetation
   i. The existence of PKL
   For attributes that are not mentioned, the development would be done in the last years of planning as the visitors and the community felt that the presence or absence of these attributes is not very significantly effect on Taman Alloon-aloon Tulungagung public space optimization.
2. Based on the analysis results obtained through the space syntax and behavior mapping about space configuration and user activity patterns obtained the following results:
   a. Results of space syntax, regarding the configuration of the room by using the Visibility Graph Analysis (VGA) showed that the zone which has the highest integrity value is zone...
5, zone 7, and zone 8. From these results, it can be concluded that zone 5, zone 7, and zone 8 can be more easily accessible from all other zones (globally). It also means that from that space, all kinds of facilities and the attractiveness of the garden can be easily viewed without vertical barriers or it can be said excellent movement and visual access.

b. The results of the behavior mapping, about the user activity patterns of Taman Aloon-aloon Tulungagung can be concluded that the peak user activity most crowded and diverse is in the afternoon at the weekend. From the results of the calculation of user activity value on weekends in the evening using Simpson's Diversity Index is concluded that, a zone that has the highest user activity value is zone 8. This is due to the diversity of facilities that are in the zone 8 so as to support the many activities of the user.

c. The concept of the development direction Taman Aloon-aloon Tulungagung as a public open space is based on result of IPA and combined with Matrix of Evaluation of Visual Accessibility and Diversity Activities. Concept development direction Taman Aloon-aloon Tulungagung as public open space directed by customizing the user's perception of the attractiveness of public spaces and inter-related user activity.

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