Design positions of waste utility system that shaped the human movement patterns in traditional markets

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Abstract. Not every traditional market is equipped with sufficient waste processing utility system. The waste treatment system in Indonesia consists of five stages that include: (1) storage, (2) collection, (3) transfer, (4) transportation and (5) disposal system. Each stage involves a storage container with various capacities and different movement patterns for each processing system. Currently, merchants determine the storage placements and processing paths that depend on the market management. In general, they place them freely, not only in their stand but also in circulation space which then affected the human movement. A set of data collection, observation, and mapping were carried out in two traditional markets in Jakarta and three traditional markets in Depok. This study was aimed to identify the human movement patterns with regards to the positions of the utility system. Findings revealed two factors that influenced the human movement. Those were the availability of space in advance (the compatibility between spaces and properties of the containers), and the circulation paths (the process of waste treatment at the circulation paths that influenced human movement at certain times).

Keywords: Waste management, utility system, human movement, traditional market

1. Introduction
A traditional market is a trading place where people gather at any time and produce large amount of decomposed waste. As a place that produces large amount of waste, the traditional market needs proper utility system for processing its waste. Currently, only 51.13% of traditional markets are equipped with a temporary landfill for their waste while the rest have their waste scattered [1].

The waste treatment in Indonesia consists of five stages; namely (1) storage, (2) collection, (3) transfer, (4) transportation, and (5) disposal [2]. Nowadays, the traditional markets have implemented the waste treatment even though they are not entirely based on the national standard. They used the same step for the treatment but with a different kind of process and utility system, especially for the storage container used in each stages. Various shapes and sizes of storage containers are used for the waste treatment. The storage container used by merchants is subject to the market management decision. In fact, not all market management provides clear regulation and this leads merchants to use anything as their container for storing the waste and place it at any vacant points.

Unorganized placement can lead to spatial problems, because the properties of storage container is not in accordance with the condition of the space. In our daily live as human, we always experience the object in space through our sense [3]. Whether or not we are consciously aware of it, the object in the place where we live influences our behavior, belief, and knowledge [3]. It means that storage container as part of the physical object will interact and influence human behavior or movement [4]. The physical object in market space is not only the storage container but also all objects that support...
waste treatment. According to experts, waste treatment system has been affected by insufficient infrastructure [5], improper bin collection system, poor route planning, and lack of information about collection schedule [6]. In order to identify how these influence the human movement, this research carried out case studies in 5 traditional markets, including Pesanggrahan and Radio Dalam at South Jakarta, Kemiri Muka, Sukatani, and Pucung Raya at Depok. The traditional markets where the research was conducted have the same stage for waste treatment despite the differences in the implementation process. This study was aimed to identify the human movement patterns with regards to the positions of the utility system.

2. Methods
This study applied a qualitative approach. In this case study, observation and interview were conducted between April and May 2019. Each traditional market has an area designated as object of research. The designated area is used as vegetable and fruit sales areas. However, there is no such area designated on basis of commodity type in Kemiri Muka and Pucung Raya traditional markets. It means that the observed waste decomposed waste. The observation was conducted based on the four stages of waste treatment [2]. The observation variables included:

- The properties of circulation paths
- The position of storage for Individual level
- The position of storage for Communal level
- The route used for collection
- The position of a temporary landfill to store the whole market waste.

3. Discussion
The traditional markets had different circulation space conditions, so it was not easy to identify how treatment influenced the circulation space in this condition. It required parameters to categorize it on the same level in order to compare the existing condition of circulation space before and after waste treatment. The used parameters were the human dimension and the size of circulation space for retailer’s cubicle. According to Neufert [7], the thickness and the width of the human body are ±30 cm and ±50 cm respectively. However, those dimensions are different with the human dimensions stated by Fruin. According to Fruin, the thickness and the width of human body are ±45.7 cm and ±60 cm [8]. This dimension was used as a minimum for the boundaries of the human body. The ideal width of circulation space for retail as stated by Panero and Zelnik is 294.6-304.8 cm for the main circulation space where people passing by and moving in and out [9].

Table 1. The category of circulation condition

| Type | A      | B      | C      | D      | E      |
|------|--------|--------|--------|--------|--------|
| Dimension | 200-250 cm | 180-200 cm | 120-180 cm | 100-120 cm | 60-100 cm |

| Illustration | Condition |
|---------------|-----------|
| [Image]       | Better    |
| [Image]       | Good      |
| [Image]       | Bad       |
| [Image]       | Worse     |
| [Image]       | Worst     |

Source: Fruin (1971) and Neuffert (1996)

‘Table 1’ shows the category of circulation space condition based on the width and the way human can pass the circulation space. In type A, two humans from different direction can access and move
freely when another activities happens at the same time. This is the ideal condition. On the contrary, the worst type can only be accessed by one person while no other activity occurs in the circulation space.

3.1. The existing condition of circulation space in traditional markets

The existing condition of the circulation space before the activity occurs should be recognized beforehand in order to identify the influence of the design position of utility system. The condition classification is based on category type in Table 1.

Table 2. The types of existing circulation

| Traditional Market | Pesanggrahan | Sukatani | Pucung Raya | Radio Dalam | Kemiri Muka |
|--------------------|--------------|----------|-------------|-------------|-------------|
| Dimension          | 120          | 200      | 100         | 150         | 200         |
| Illustration       |              |          |             |             |             |
| Condition Type     | Worse        | Good     | Worse       | Bad         | Better      |
| Type               | D            | B        | D           | C           | A           |

‘Table 2’ shows the existing condition of circulation space in traditional markets where research was conducted. Kemiri Muka traditional market has the best existing condition in term of the width of circulation space while Pucung Raya has the worst existing condition. This condition serves as the basis for showing the changes in space that take place during the waste treatment process.

3.2. Storage process in traditional markets

This is a process where merchants place the waste in a container or at some places temporarily. The storage process consists of two levels. The first level is the storage process for individual waste source and the second level for communal waste source. Various shapes and dimensions of containers are used to put the waste. Based on the observation, the position of containers generally used the space for circulation space.

Table 3. The comparison of the storage position influences

| Traditional Market | Pesanggrahan | Sukatani | Pucung Raya | Radio Dalam | Kemiri Muka |
|--------------------|--------------|----------|-------------|-------------|-------------|
| The existing condition | Worse | Good     | Worse       | Bad         | Better      |
Figures (individual storage)

| Type of Storage | Bin | Bin | - | Bin | - |
|-----------------|-----|-----|---|-----|---|
| The use of space | 0   | 0   | 40-50 cm | 0 | 80-120 cm |
| The current condition | Worse | Good | Worst | Bad | Bad |
| Influence on the human movement | No | No | Yes (waited for each other to pass to avoid the waste) | No | Yes (walked aside to avoid the waste) |

‘Table 3’ shows the comparison of circulation space regarding the influence of the storage position. The storage process influenced the circulation space in Pucung Raya and Kemiri Muka traditional markets. The storage process did not involve containers in Pucung Raya and Kemiri Muka, the merchants used the side of circulation space to put and pile up the waste. They did it because there were no supporting facilities, regulation from the management, and designated space for the utility.

On the contrary, in Pesanggrahan, Sukatani and Radio Dalam traditional markets the storage processes did not influence the circulation spaces. The merchants in these markets put their storage containers inside their stand even though they used various types of containers. This is because the management of the market has planned the space for the utility system. Market visitors kept moving as usual while waste treatment processing took place even though the storage process occurred simultaneously with the trading activity.

| Traditional Market | Pesanggrahan | Sukatani | Pucung Raya | Radio Dalam | Kemiri Muka |
|--------------------|--------------|----------|-------------|-------------|-------------|
| The existing condition | Worse | Good | Worse | Bad | Better |
Figures (Communal storage)

| Time of occurrence | during the trading activities | during the trading activities | during the trading activities | during the trading activities |
|--------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Type of Storage    | Bin                            | Bin                            | -                              | -                              |
| The use of space   | 0                              | 0                              | 40-50 cm                       | 30-60 cm                       | 80-100 cm                       |
| The current condition | Worse                       | Good                           | Worst                          | Worse                          | Bad                             |
| Influence on the human movement | No                          | No                              | Yes (walked away to avoid the waste ) | Yes (walked away to avoid the waste) | Yes (passed each other by tilting the body) |

‘Table 4’ shows a comparison of circulation conditions with regards to the position of the communal storage containers. It was found in Pesanggrahan traditional market that the position of storage containers at the communal level was still within the stand area, thus it did not disturb the circulation space. This is not the case at Pucung Raya, Kemiri Muka, and Radio Dalam markets. The management of these markets did not prepare the space for storage containers properly. In Sukatani market the space for storage containers was determined with big capacity to store a lot of waste and it has been planned since the beginning.

After observing both situations, it could be concluded that the availability of space in advance was the main factor that influenced the human movement in these two stages. It means insufficient infrastructure and facilities to support the system directly affect the storage process [8] and cause indirect impact to the human movement in the traditional market.

**Table 5.** Position of individual and communal storage containers towards human movement.
Table 5 shows the relation of human movement towards storage position in traditional markets. There were three types of storage position that caused two different kinds of human movement. In the first type of human movement, people tilted their body and wait to pass each other. And in the second type, they just walked straight to pass each other without any additional movement.

3.3. Collection and transfer process in traditional markets
The collection process involved various shapes and dimensions of containers and modes of transportation. The capacity of the containers affected the frequency of collection and provided different efficiency. It was not only the type of containers that mattered but also the route for collecting that determined the efficiency. In general this process naturally affected human movements in traditional markets, as the process took place in the circulation spaces of all markets. This process depended on where the merchants placed the storage containers and how the collection system worked.

Table 6. The influences of human movements on the collection positions

| Traditional Market | Pesanggrahan | Sukatani | Pucung Raya | Radio Dalam | Kemiri Muka |
|--------------------|-------------|----------|-------------|-------------|-------------|
| The existing condition | Worse | Better | Worse | Bad | Better |

Figures

| Time of occurance | The type of modes | The use of space | The current |
|------------------|------------------|-----------------|-------------|
| when trading activities took place | Plastic bag | 0 | Worse |
| when trading activities took place | Bin | 60-70 cm | Good |
| when trading activities took place | A cart | 40-70 cm | Worst |
| when trading activities took place | A cart | 50-70 cm | Worst |
| when trading activities took place | A cart | 100-150 cm | Worst |
‘Table 6’ shows the influences of various containers and modes of transportation. Almost all traditional markets were influenced by them. In Pesanggrahan, this process did not influence circulation space because the merchants did the process individually and without using a fixed container. They used a temporary container like a trash bag with flexible shape so it could be adjusted according to the available space. This was not the case with another market. The use of a fixed container and transportation influenced the circulation in a short time. Even though the intervention happened in circulation space for 10-15 minutes, if it happened frequently in one day it might disturb human movement in the circulation, such as in Kemiri Muka market.

Here the laborer conducted the collection process from one stand to another so that it happened frequently in the same area. The process took place more than one time within the same day. Initially, the market visitors might see the container but after some time this awareness would fade when the process became daily routine and at this point the human movement occurred regularly.

The next process of waste treatment was transfer. This was when the waste was taken to the temporary disposal site [2]. The route chosen for the transfer process was one of the aspects that influenced human movements. Actually, the route depended on the position of the communal storage container. From the observation, it was found that there were two ways of placing the communal storage container: at the end of the shop aisle or between two shops. Therefore, the route naturally influenced with other activities that took place in circulation space. The mode of transportation used to intervene the human movement was not compatible to the circulation space.

| Traditional Market | Pesanggrahan | Sukatani | Pucung Raya | Radio Dalam | Kemiri Muka |
|--------------------|--------------|-----------|-------------|-------------|-------------|
| The existing condition | Worse | Better | Worse | Bad | Better |
| Figures | ![Figures](image1) | ![Figures](image2) | ![Figures](image3) | ![Figures](image4) | ![Figures](image5) |
| Time of occurrence | At the end of trading activities | when trading activities took place | when trading activities took place | At the end of trading activities | when trading activities took place |
| The type of mode intersect with the human circulation | Bin | Cart | Cart | Cart | Cart |
| The condition when process influence on | Yes | Yes | Yes | Yes | Yes |
| The condition when process influence on | Worse | Good | Worse | Bad | Worst |

Table 7. The influences of transfer route to the circulation
the human movement crossed path with a cart) No of transfer overlapped with the human circulation)

‘Table 7’ shows the route used for transfer in traditional markets. Pesanggrahan traditional market was not influenced by this process as there was no mode of transportation used for transferring the waste to the temporary disposal site, which meant that there was no object in the circulation space. In Sukatani, a moveable bin was used to transfer the waste. When it interacted with the activity in circulation space, such bin did not influence the human movement. The influence of the transfer process in Pucung Raya and Radio Dalam did not give significant impacts as the process took place in the outer part of the markets. It only interacted once with the human activity and movement in circulation space and within a short time. Kemiri Muka had different situations compared to other markets. The influence of transfer had a significant impact on the condition of circulation space as the process took place frequently within one day that the container used for waste transfer regularly interacted with the human activity and movement.

Tabel 8. Influences of transfer mode type towards human movement.

| Position | Non permanent container | Trash Bin | A Cart |
|----------|-------------------------|-----------|--------|
| Human movement | Walking straight | Walking straight | Walking straight |
| | Move the bag According to the condition of circulation space | Tilt the body | Change direction |
| | Tilt the body Get in between | Stop and wait To pass | Passing each other |
| | Tilt the body | Get in between | Change direction |
| | Walking straight | Passing each other | Walking straight |

‘Table 8’ shows the types of transfer modes and the differences of human movement towards transfer modes. The use of non permanent containers, such as trash bag gave advantage to the movement in traditional markets. Trash bag could be moved flexibly so it could be adjusted to the condition of circulation space. It was different with trash bin and cart that had fixed shapes so they could not be moved flexibly according to the condition of circulation space.

3.4. Transportation process in traditional markets
The transportation process was the last stage of waste treatment in the traditional markets. In this stage, the positions of temporary disposal site, the routes for transportation mode had been observed to identify the influence on the human movement and circulation space. There were a lot of transportation modes and every type had different capacity.

Tabel 9. The positions of temporary dumpsite and its accessibility

| Traditional | Pesanggrahan | Sukatani | Pucung Raya | Radio Dalam | Kemiri Muka |
|-------------|-------------|----------|-------------|-------------|-------------|
|             |             |          |             |             |             |
The existing condition

| Market | Better | Better | Better | Good | Better |
|--------|--------|--------|--------|------|--------|

Figures

| Figures | Before trading activities started | when trading activities took place | At the end of trading activities | when trading activities took place | when trading activities took place |
|---------|----------------------------------|-----------------------------------|---------------------------------|----------------------------------|----------------------------------|
| Time of occurrence | Motorcycle with cart | Truck | Truck | Truck | Truck |
| The type of modes | No | Yes | No | No | Yes |
| Intersect with the entry | Better | Better | Better | Good | Worst |
| The condition when process | No | No | No | No | Yes |
| Influence on the human movement | |

‘Table 9’ shows the positions of the temporary dumpsite in regards to circulation space for the visitors. The best condition was shown in Pucung Raya market with its path that was not crossing each other. In Sukatani, the one entrance was used for human and transportation modes so there was possibility that both are interacting, even though the loading process in that space did not make them both cross each other. The different condition was found in Kemiri Muka market, where the paths for transportation and human crossed each other and affected the human movement. The flow of human circulation occurred in the same place with the truck because the dimension of the truck did not fit in the available space for the temporary disposal site.

Table 10. The path of transportation mode towards human movement.

| Path of transportation mode | Different path with visitor circulation | Same path with visitor circulation |
|-----------------------------|----------------------------------------|----------------------------------|
Human movement

Table 10 shows two types of transportation mode’s path in traditional markets. The traditional markets with two different waste transportation paths had positive impact on the human movements in the circulation spaces. People did usual activities, without any interference. Then, the traditional markets which had the same circulation as visitors influenced the human movement in circulation space, such as blocking the flow of circulation.

Table 11. The condition of traditional markets

| Traditional Marker | Pesanggrahan | Sukatani | Pucung Raya | Radio Dalam | Kemiri Muka |
|--------------------|--------------|----------|-------------|-------------|-------------|
| The condition of existing circulation | Worse | Good | Worse | Bad | Better |
| The current condition of individual storage position | Worse | Good | Worse | Bad | Better |
| The current condition of communal storage position | Worse | Good | Worst | Worse | Bad |
| The condition during the collection process | Worse | Good | Worst | Worst | Worst |
| The condition during the transfer process | Worse | Good | Worse | Bad | Worst |
| The condition during the transportation process | Better | Better | Better | Good | Worst |

‘Table 11’ shows all conditions of circulation space during the waste treatment process. The condition of circulation space in Sukatani was the best compared to other object studies. In this traditional market, the market management provided a proper storage container and space for handling utilities system. Compared to Kemiri Muka, it could be found that the proper system as well the availability of space for utilities and sufficient infrastructure gave impacts on the process of waste treatment and human movement in circulation space.
4. Conclusion
The findings of this study revealed three factors that influenced the human movement, namely the shape of the container, the size of the container and the circulation paths. Their influences could be seen from the position of objects in the waste treatment process with regards to the circulation space and awareness of the merchants. In the storage process, the condition of the circulation and human movement depended on the shape, capacity, and dimensions of the used container. The placement of individual and communal storage containers was found in various types; some were placed inside the stand, outside the stand, and at the end of the shop aisle. The best position for individual storage container was inside the stand, and for the communal storage container, the space must be prepared as early as the planning stage by the market management. This way, there was no storage container that blocked the circulation space.

In the collection and transfer stages, the circulation space depended on the size of the used container and the transportation modes. In those stages, there were two patterns of collection that included individual and communal collection. The use of individual pattern for collection process would need merchants’ awareness to manage their waste. It was different from the communal pattern that required transportation support. The planning of the route must be carried out without interfering the circulation space and human movement during the collection process.
In the transportation stages, aspects affecting the circulation space were the positions of the temporary disposal site and entry paths for transportation and human. Separate transportation routes and human movement path resulted in better circulation in the entry lane and prevented blockage in the loading process of the waste.

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