アクターネットワーク理論の方法論を用いたタイ国ノンタブリー桟橋地区における都市環境の相互関係ネットワークの分析

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https://doi.org/10.15017/6788780

出版情報：都市・建築学研究. 42, pp.1-16, 2022-07-15. 九州大学大学院人間環境学研究院都市・建築学部門
バージョン：
権利関係：

都市・建築学研究　九州大学大学院人間環境学研究院紀要　第42号，　2022年７月
J. of Architecture and Urban Design, Kyushu University, No.42, pp.1～16, July. 2022

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Analyzing the interrelationship network in the urban environment of the Nonthaburi Pier area, Thailand, through Actor-Network Theory methodology

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This research analyzed the Nonthaburi Pier by the method of Actor-Network theory as a theoretical approach to comprehend the complex interrelationship among the actors, activities, and urban elements that have emerged in the urban environment. The research identified their existence and relationship through local knowledge, experience, and the collection of photos before finding their connection on a public network. The results indicated that street vendors are the most significant urban actors with the strongest network connections in this public space. Furthermore, the findings revealed other essential items in the urban environment that will be useful for future urban development.

Keywords: Actor-Network Theory, Public space, Street vendor, Nonthaburi, Urban design
アクター・ネットワーク理論，公共スペース，
露天商，ノンタブリー，アーバンデザイン

1. Introduction

1.1 Research Background

Bangkok, Thailand's metropolitan capital, is known as one of the most vibrant cities in the world, with things in an urban context constantly changing from day to night due to a variety of activities [1]. The urban elements that have emerged in public space serve the aim of supporting a wide range of urban activities that contribute to the messiness of urban scenery [2], which comes from a variety of sources, but they are unquestionably largely given by street vendors. These situations frequently occur on the sidewalk, causing commuters to be inconvenienced [3].

Although the vendors occupied public space, in exchange, these sellers provided convenience for city residents in a mutually beneficial partnership [4]. As a result, it has become the norm for Bangkok's streets, particularly those near public transportation hubs, to be overrun with street vendors [5].

These conditions spread to Bangkok's outskirts, including the Nonthaburi pier area, where the urban fabric is densely packed with people who emerge into public space for a variety of reasons. The continual changes in urban scenery add to the intricacy of the interrelationship between people and urban surroundings. To untangle the complexities of everything on the public surface, every person as an actor, all forms of activities, and all urban objects that occur in urban space can be recognized and their connections clarified using the actor-network theory methodology.

1.2 Definition of Keywords in the Research

Urban environment: The word "urban environment" in this research refers to people, animals, activities, and objects that are a part of the urban public space.

Urban actors: The word "actor" in this study is used with the intention of referring to the actor-network theory. The definition

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of the terms "urban actor" and "actor" in this study refers to any individual who is part of the urban public space. The term also included urban animals, which, according to the actor-network theory, non-human actors have the same rights as human actors. Thus, the word "actor" in this research does not pertain or refer to any kind of actor who possesses a profession in acting on the stage, movie, or television.

Urban elements: The word "urban elements" in this research refers to any kind of object, including objects with or without a trace of ownership, that emerges in the urban public space. According to the actor-network theory, objects are equally important to urban actors because they can influence or be a cause of the actions of people in public space.

1.3 Research Objectives

The purpose of this study is to analyze the complexity of the "urban fabric" (intricate networks of interdependent parts) in the Nonthaburi Pier region from a novel perspective by using actor-network theory. It is to broaden the study's focus, which is normally on people and activities in public spaces, to include other items like urban animals or objects, which can also represent the movement of the urban surroundings. The objectives of the study, which are based on the actor-network theory, aim to achieve the following:

1) Compile a list of the actors, activities, and urban elements that have emerged in the Nonthaburi Pier area.

2) Display the overall connection of the urban fabric space of the Nonthaburi pier area.

3) To comprehend the impact of the network's connections on each of the actors, activities, and urban elements in public space.

2. Material and Methods

2.1 Actor-Network Theory

In the complex urban fabric space where everything human and nonhuman has its own role, purpose, behavior, and influence that dynamically changes throughout the day, it is not easy to trace and find the relationship of all things in the public space.

The tangle of urban fabric in the Nonthaburi pier region has resulted in an unpleasant public environment full of conflict and hardship. Due to the connection of all things, which always reflect or impact one another, it appears impossible that the source of the problem can be traced. Individuals or groups seeking opportunity have broken down the law and regulations of public space, while the state has neglected those who violate the laws. On a daily basis, the balance of power between bottom-up and top-down strategies is negotiated.

In order to comprehend the circumstances of a complex urban space, actor-network theory has demonstrated the feasibility of establishing a link between all things in public space that simultaneously influence or impact one another. Everything is equal in actor-network theory without any hierarchy, whether it is an individual, a party, or an organization [6) 7)]. Even those who are not human, such as urban animals or objects, can have an affect on or influence the decisions of others around them [6) 8)].

The network of actor-network theory is non-static; it shifts in response to the actions of each actor or actant in the network. It is feasible to trace all of the connections and relationships that occurred in public space by tracing the links of each translation [9)]. This enables us to understand the significance or roles of these connections and interconnections from a variety of angles.

Although the actor-network theory is not a method for determining the conclusion of a relationship in any particular network, it does improve the possibility to comprehend all of the connections from new angles[10)], which can be the cause of changes in the public space network.

2.2 Previous Studies

The methodology of actor-network theory was first developed as an attempt to comprehend the complexity of society. The approached from actor-network theory gave a new perspective on understanding social relationship networks. The study of actor-network theory has been applied in a broad range of fields of study, including architectural study and urban study. The methodology of actor-network theory, after having been investigated in the fields of architecture and urban studies, astonished us that the idea of the theory has the capability to explore this field of studies in various scales and aspects. From the scale of small parks to the scale of urban infrastructure. The study by Kjetil Fallen have explained the potential of actor-network theory, which some architectural researchers have already explored, to enhance our understanding of architectural processes and sociotechnical networks. Kjetil Fallen (2011) has described how the way of thinking by actor-network theory can be applied to the relevant matters throughout the architectural process. The information from this study assists us to understand the beginning of the relationship between actor-network theory and architectural studies [11)]. Jeremy Lecomte (2013) explained the actor-network theory in detail by referring to the statements or studies of Bruno Latour. Most importantly, Jeremy Lecomte pointed out that the methods of actor-network theory were not meant to solve things, but rather to describe what was happening step-by-step, by tracing the chain of connections in the network [10)]. Marija Cvetinovic, Zorica Nedovic-Budic, and Jean-Claude Bolay (2017) analyzed urban

development through the methodology of actor-network theory. They widened the possibility of actor-network theory in the field of urban studies in practical methods, which were advanced at that time [12]. The studies of Albena Yaneva and Brett Mommersteeg (2019) explain the architectural development in the state of site-ing by actor-network theory, in which a site is not just a massive ground but is shifted and modified by the involvement of entities [13]. The actor-network theory, according to Alexa Färber (2019), has aided urban studies in analyzing the complexity of urban infrastructures by tracing the changes and immanents of the city [14]. Jihyun Kim (2019) utilized actor-network theory to understand the network relationships between urban objects, their affordances, and the activities in public parks by comparing the differences, in order to understand the role of public objects that reflect the urban activities and environment [15]. Jihyun Kim's research findings indicated the possibility of applying actor-network theory to the practical study of the urban environment, which in this case was on the local scale of two public parks. Another study from Demet Dincer (2020) described the changes in the architectural process and the consequences afterward through the lens of actor-network theory, in which many factors, both human and non-human, are involved in the network of study [16].

The application of actor-network theory to architectural and urban studies is already extensive, particularly in recent years. During the early stages of actor-network theory's interdisciplinary with architectural and urban studies, the majority of research attempted to comprehend the theory's meaning and find its relevance in the field of architectural and urban studies. Recent research has begun to employ actor-network theory as a practical approach to understanding the complexities of the urban environment. Thus, this research aims to expand the possibility of actor-network theory in the field of urban study by implementing the methods to unravel the complexity of the invasion in the urban environment.

2.3 Investigation of crucial items in the network

According to actor-network theory, all things in the network, human or non-human, have important roles that can influence or have an impact on one another in the network, which makes the connection network dynamically shift and change all the time. The actors and urban elements must be clarified in order to understand the relationship network of everything in the Nonthaburi Pier. In addition, this study is focusing on the public space of the urban environment, in which activities in urban space are one of the key elements in the network. The importance of affordance from urban objects may result in variables in terms of activities and characteristics in urban space [15) 17)].

Thus, in this research, actors, activities, and urban elements were investigated for their identity, contribution, and relationships with others in the network of the Nonthaburi pier area. Moreover, the reasons that actors, activities, and urban elements are necessary to comprehend are explained as follows.

1. Actors: The urban public space is vibrant with the various types of urban actors that show up, pass by, or do many kinds of activities. It is necessary to know what types of urban actors consistently use this public space and have an essential role in the context. In addition, animals are also included as urban actors, in which they can have an impact or influence other actors in the urban environment.
2. Activities: Nonthaburi Pier's public area can accommodate a variety of events that change throughout the day, from morning to night. Thus, in order to comprehend the relationship between urban actors and urban elements, it is required to identify all of the activities that occurred in this place.
3. Urban elements: Urban elements in public space come from various sources. Many times, they become a problem in the urban environment by being improperly placed in the urban context. Therefore, it is necessary to investigate all the elements in public space in order to understand what kind of urban element existed. In addition, all of the identified urban elements will be researched further to determine their importance in public space and their relationships with other items in the networks

2.4 Methods of data collection

Fig. 1 shows the study location, which is the Nonthaburi pier, Thailand. The study site's perimeter is defined by three key areas: the sidewalk connecting the boat pier and the bus stop, the open space in front of the boat pier, and the sidewalk in front of the old town hall. Furthermore, the entire information and data in this study will be based on the defined boundary area.

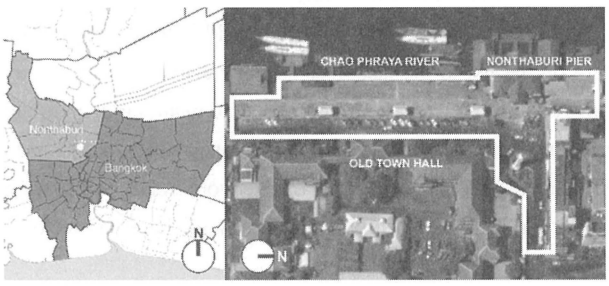

Fig. 1 The layout of the Nonthaburi Pier area.

The data of all the actors, activities, and urban elements that formed and occurred in this public space have been observed

and designated as important things in the network connection, which is presented in Table 1, once the site study's border has been defined. The methods used to conduct the observations are divided into two categories. First, local knowledge and experience. The comprehension of connection in this context has been studied and analyzed by authors who have local experience and have lived in this location for more than thirty years. The second step is data collection. From April 2020 to September 2020 and March 2021 to November 2021, this study collected images of the urban environment for further analysis and evidence of all circumstances in the urban context. Furthermore, this study has been cross-checked with a study of dynamic changes in urban layout, which identifies the sorts of invaded urban elements, reducing the possibility of objects being neglected during the earlier phase.

Table 1 A summary of the actors, activities, and urban elements in the Nonthaburi Pier area

ACTORS	ACTIVITIES	URBAN ELEMENTS	
Local	Gathering	Bench	Gas cylinder
Office worker	Leisuring	Sand bag	Bucket
Student	Transfering	Barricade	Bottle crate
Monk	Playing	Traffic cone	Cool box
Busker	Performing	Umbrella	Stool
Delivery man	Eating/ Drinking	Tarp	Trolley
Homeless	Disposing/ Littering	Tent	Litter
Street vendor	Feeding	Musical	Trash bag
Retailer	Offering	Audio device	Ladder
Pigeon	Donating	Donation box	Feces
Pangasius fish	Blessing	Buddha statue	Car
Stray dog	Receiving	Food/ Drink	Bicycle
Stray cat	Exercise	Pellet (sack)	Bike
Mice	Working	Dining	Tricycle
Bike taxi driver	Buying	Sign	Tuk tuk
Tricycle driver	Selling	Vending cart	Taxi
boat driver	Invading	Vending table	Van
Tuk tuk driver	Cooking	Vending bike	Pick-up truck
Taxi drive	Washing	Vending Stall	Boat
Van driver	Pooping	Cooking station	Bus
Pick-up truck taxi driver	Sleeping	Washing station	
Bus driver	Scavenging		
Traffic police			
City cleaner			
Garbage collector			
Municipal employee			

2.5 The methodology of network connection

The items in the network of public space in the Nonthaburi pier area will then be linked to one another using evidence from the photo collection as well as the author's local experiences and knowledge. As everything in the network is equally significant, the connecting procedure will begin from the first item on the list to the last. This strategy also allows us to pay close attention to each item's purpose and meaning in an urban environment. The connection between each category has been defined as follows to prevent the network relationship from expanding beyond the infinite boundary of the actor-network theory:

1. Actor and Actor: The connection between actor and actor is determined by the relationship of how the first actor either 1) approaches or being approached and, 2) targets or being targeted by the second actor. For example, the connection of local and street vendors. From the local's point of view, locals approach street vendors to buy something. On the other hand, street vendors also target locals as customers.
2. Actor and Activities: Actors and activities are linked, whether the actor performs the activity frequently or infrequently in public space. Frequency is not considered for the identification of connections. For instance, students frequently gather in groups at the pier, and traffic cops occasionally purchase food from street vendors. The link included the possibility that the activities could be carried out by an actor, such as a student littering in public space. In this case, there will be no link between actors and litter in such an obvious case as the bus driver (the bus that was only passing by in this location), urban animals, or monks who are unlikely to litter on the street
3. Actor and Urban elements: The actor and the object are linked in urban space if the actor has accessibility with the intention of using the object (by its purpose), if the actor is the source of the object, or if the object is meant for the actor (by purpose, or as a target customer). For instance, there are connections between students and public benches or signboards because students can access the benches and signboards, which have the purpose of public use and attract customers. On the other hand, there is no connection between the student and the vending cart since only the vendor can access it by right of ownership. In the case of actors being the source of the object, the ownership of the object can be transferred from one to another. For example, the ownership of food from vendors can be transferred to customers after purchasing has been done. Furthermore, it is included in the case if the actors could possibly be the source of the object. Locals, for example, littered in public spaces. Anyone could be the source of litter on the street. In some cases, the origin of the object can be obvious, such as when stalls are from vendors. In the case of an object that is meant for actors, connection can happen in several ways. For instance, a signboard is meant to attract regular actors as customers, or an audio device is to play some audio to attract actors for donation.
4. Activities and Activities: There are two scenarios in which two activities are linked. First, one activity leads to another or is the cause of another, and second, the two activities can take place simultaneously. Monks, for example, bestowed blessings on those who offered them food. The act of offering to monks leads to the act of

blessing in this case. For instance, street vendors invade public space to sell their merchandise. In this case, street vendors are simultaneously invading public space and selling at the same time.

5. Activities and Urban elements: The connection between activities and objects is established if the objects are required for the act in urban space or if the object is the consequence of the action.
6. Urban elements and Urban elements: When objects are regularly seen together or as part of a set, they are linked. For example, 1) street vendors sell food and beverages from their carts, and 2) taxi bikers park their bikes behind the barricades. The first example indicates the obvious situation that vendors need the cart to sell things. Two objects already exist as a set. The second example shows objects related to the place that they are usually seen together, which are owned by bikers. For example, students eat and leave some litter on the street, or taxi bikers gather and wait for customers under their umbrella.

The items in the network of public space in the Nonthaburi pier area will then be linked to one another using evidence from the photo collection as well as the author's local experiences and knowledge. As everything in the network is equally significant, the connecting procedure will begin from the first item on the list to the last. This strategy also allows us to pay close attention to each item's purpose and meaning in an urban environment.

2.6 Comparison results with external juries for validation checking

After the connection result from the author had been made, three external judges with local knowledge and experience, as well as the author, were invited to work on and compare the connections of urban networks with the author to confirm the data's validity. The juries were invited to allocate the collection of photos, which in total there are over 6,500 photos that taken from the site study in order to reassure that connection that occurred in this public space (See Fig. 2 for example). Moreover, the instruction that included basic idea of the research, introduction of actor-network theory, description and contribution of each actor, activity and urban element (See Fig. 3), and the rule of network connection were provided for the juries to have common understanding.

Fig. 2 Example of photos provided for juries

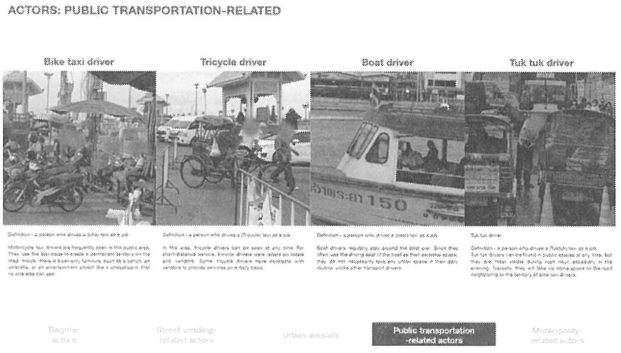

Fig. 3 Example of description and contribution of public transportation-related actors that provided to juries

Following the completion of the external juries' results, a discussion session will be arranged to convey the material and the concept behind the connection's outcome. Then, based on the consensus reached throughout the discussion, the result of the connection between the author and the juries was amended. Finally, according to the data, 81.07 percent of the links from total of three juries matched the author's conclusions, as shown in Table 2, which indicates the percentage before and after the discussion. Based on the matching data and collaborative discussion with external juries, the final judgement of the connection of every combination was decided by the author.

Table 2. The comparison of the results with the three juries

	Jury A		Jury B		Jury C	
	Before	After	Before	After	Before	After
ACTOR	78.47%	80.59%	82.78%	84.28%	81.53%	82.86%
ACTIVITIES	71.47%	76.82%	79.07%	81.59%	81.53%	80.06%
URBAN ELEMENTS	80.09%	80.09%	77.57%	81.02%	81.53%	81.84%
Total	80.93%	82.58%	77.36%	79.49%	79.73%	80.98%

As a result, this study's operation approach tended to narrow down the objects in the network and the possibilities of connection to the clearest and most comprehensible as much as possible. The result of this method's examination of the connection network may not necessarily represent the conclusion of this urban context network for the time being or in the future, because urban public space is continually evolving and changing.

3. Result

In this section, the findings from the network connection based on actor-network theory will be divided into four parts based on the overall network and the main categories of actors, activities, and urban elements. The data from each category will indicate the critical linkages with items in specific categories of actors, activities, and urban elements, as well as the entire network.

3.1 The interrelationship of entire network

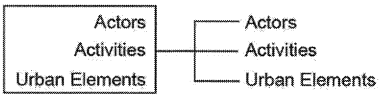

Fig. 4 A diagram depicting the entire network's interdependence.

Table 3. The number of connections and the percentage of all the items in the entire network.

Items	Connection	Percentage	Items	Connection	Percentage
Street vendor	70	79.55%	Trash bag	25	28.41%
Working	70	79.55%	Tarp	24	27.27%
Food/ Drink	63	71.59%	Vending table	24	27.27%
Retailer	62	70.45%	Washing station	24	27.27%
Local	60	68.18%	Bucket	24	27.27%
Student	59	67.05%	Trolley	24	27.27%
Office worker	57	64.77%	Tricycle	24	27.27%
Invading	57	64.77%	Tuk tuk	24	27.27%
Eating/ Drinking	55	62.50%	Stray cat	23	26.14%
Selling	55	62.50%	Bench	23	26.14%
Bike taxi driver	51	57.95%	Pick-up truck	23	26.14%
Gathering	47	53.41%	Delivery man	22	25.00%
Transfering	46	52.27%	Cooking	22	25.00%
Buying	45	51.14%	Bicycle	22	25.00%
Tuk tuk driver	44	50.00%	Bike	22	25.00%
Litter	44	50.00%	Cool box	21	23.86%
Tricycle driver	43	48.86%	Stool	21	23.86%
Van driver	43	48.86%	Taxi	21	23.86%
Disposing/ Littering	41	46.59%	Offering	20	22.73%
Boat driver	40	45.45%	Musical instru.	20	22.73%
Sign board	39	44.32%	Gas cylinder	20	22.73%
Busker	36	40.91%	Bottle crate	20	22.73%
Pellet (sack)	36	40.91%	Van	20	22.73%
Leisuring	35	39.77%	Bus	20	22.73%
Barricade	35	39.77%	Municipal officer	19	21.59%
Traffic cone	35	39.77%	Audio device	19	21.59%
Pick-up taxi d.	34	38.64%	Car	19	21.59%
Receiving	34	38.64%	Bus driver	17	19.32%
Taxi driver	33	37.50%	Sand bag	17	19.32%
Traffic police	33	37.50%	Boat	17	19.32%
Vending cart	33	37.50%	Blessing	16	18.18%
Umbrella	32	36.36%	Sleeping	16	18.18%
Homeless	30	34.09%	Feces	16	18.18%
Stray dog	30	34.09%	City cleaner	15	17.05%
Donation box	30	34.09%	Playing	15	17.05%
Dining table	30	34.09%	Performing	15	17.05%
Vending bike	30	34.09%	Mice	14	15.91%
Buddha statue	29	32.95%	Washing	14	15.91%
Pigeon	28	31.82%	Scavenging	13	14.77%
Monk	27	30.68%	Pangasius fish	12	13.64%
Feeding	26	29.55%	Garbage coll.	12	13.64%
Donating	26	29.55%	Pooping	10	10.23%
Tent	26	29.55%	Exercising	9	10.23%
Cooking station	26	29.55%	Ladder	3	3.41%
Vending Stall	25	28.41%			

■ Actor ■ Activity □ Urban element

The information in Table 3 demonstrated the relationship between actors, activities, and urban components in Nonthaburi Pier, which was arranged by item from the most to the least connection. The percentage in the table represented the overall connection of that specific item with other items across the whole network (See Fig. 5). With 79.55 percent of the total connection, street vendors as actors and working as an activity are the most connected objects in the network at Nonthaburi Pier's public area. It is understandable given that the presence of street vendors in urban settings is linked to a variety of characters, activities, and urban factors.

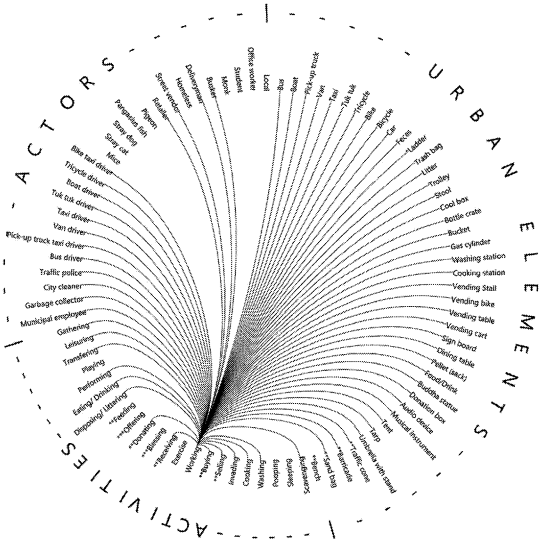

Fig. 5 The diagram of the working activity network displays the relationship between working activity and other actors, activities, and urban elements.

According to the findings, street vendors had the most connections between the category of actors and urban elements, while the relationship with activities came in second, trailing only bike taxis and tuk-tuk drivers. Furthermore, regardless of the results, by looking at the urban environment of the Nonthaburi pier district, we can quickly see items that are associated to street vendors, whether they exist or not. Street vendors frequently leave their wares in public places, disregarding all laws and regulations.

While the highest connection in the network among urban elements is working, which is significantly high at 97.56% of the total connection. It's understandable given that everything in the public realm was part of a working environment. Although the connection between actors and activities itself is not the highest, the amount of connection from working activity is still considered in the highest group.

The ladder, on the other hand, had the fewest connections in the network. It has a specific link to certain things in the category of actors and activities, resulting in a total of three connections with everything in the network. Municipal officers have ignored this object, which has been placed in the public space with no connection to its surroundings. Overall, this data illustrates the interdependence of all items in the network of

urban public space of the Nonthaburi pier area, reflecting on the significance of specific things in connection to the surrounding environment. Nonetheless, this information only describes the connection in terms of relationship, not quantity.

3.2 The interrelation of networks originates with actors

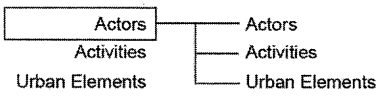

Fig. 6 The diagram of the interrelation network originates with actors.

In this phase, all the three categories in the network were analyzed to see the relationship connections in the Nonthaburi pier area. Since the Nonthaburi Pier region is a public transportation hub, many people come to this spot with a variety of goals and objectives. It is critical to understand the interaction between the actors and the group of actors, activities, and urban elements in the network in order to realize the value of each actor.

Table 4 depicts the relationship of the network that originated with the actors. The actors with the most links to actors are street vending-related actors, which include street vendors and retailers, with 92.31 percent and 88.46 percent, respectively. followed by a group of regular actors and public transportation-related actors with a percentage ranging from 69.23% to 57.69%. The delivery man, with only three linkages in the network and 11.54 percent of the total, is the actor with the fewest connections. Garbage collectors and mice were followed by 4 connections (15.38 percent). In these findings, the greatest linkage actors are the group of actors who have undoubtedly greater engagement with other actors in the public space. Particularly street vending-related actors whose major objective for being in public space was to rely on or target other actors. The group of actors with fewer ties, on the other hand, tends to have the goal of existing in the public area and does not necessarily intervene with other actors. For instance, a garbage collector only shows up in the area to collect garbage from particular actors, or a delivery man whose objective in this area is to collect food from the vendors. They will leave the area as soon as they have completed their tasks.

The connection that originates from actors to activities provided an unexpected result: the greatest actors with connections were not regular actors, but public transportation-related actors such as bike taxi drivers and tuk-tuk drivers. This is understandable given the current situation, in which bike taxi and tuk-tuk drivers spend the majority of their time in public waiting for passengers. They may spend more time in public than normal actors, such as locals, office workers, or students, who will spend it on something else. The group of actors with the fewest activities, on the other hand, are those who will appear in public space under particular conditions and then swiftly leave the urban setting.

The actors with the most links to urban elements in this area are the groups of street vending-related and regular actors. This finding corresponds to urban scenery, where the majority of the urban items that appeared in public space were associated to or owned by the vendors. Furthermore, the majority of the urban aspects are tied to the group of regular actors, with the exception of those related to street vending goods. Urban animals, on the other hand, are the group of actors with the least link to urban components. It is apparent that these urban animals do not require a large number of urban objects to exist in an urban environment. While the bus driver had a little relationship in this scenario because the bus was merely going through an area where the driver could not interact with most urban aspects.

Table 4. The interrelation of networks originating with actors as foci.

Actors	Connection	Percentage	Actors	Connection	Percentage	Actors	Connection	Percentage
Street vendor	24	92.31%	Bike taxi driver	15	68.18%	Street vendor	32	78.05%
Retailer	23	88.46%	Tuk tuk driver	15	68.18%	Local	28	68.29%
Local	18	69.23%	Local	14	63.64%	Office worker	28	68.29%
Office worker	17	65.38%	Student	14	63.64%	Student	28	68.29%
Student	17	65.38%	Street vendor	14	63.64%	Retailer	26	63.41%
Bike taxi driver	17	65.38%	Tricycle driver	14	63.64%	Bike taxi driver	19	46.34%
Tricycle driver	17	65.38%	Van driver	14	63.64%	Busker	15	36.59%
Tuk tuk driver	17	65.38%	Homeless	13	59.09%	Traffic police	15	36.59%
boat driver	16	61.54%	Retailer	13	59.09%	Van driver	14	34.15%
Taxi driver	15	57.69%	Office worker	12	54.55%	Tricycle driver	12	29.27%
Van driver	15	57.69%	Boat driver	12	54.55%	Boat driver	12	29.27%
Pick-up truck taxi driver	15	57.69%	Pigeon	10	45.45%	Tuk tuk driver	12	29.27%
Pigeon	13	50.00%	Stray dog	10	45.45%	Pick-up truck taxi driver	12	29.27%
Traffic police	13	50.00%	Busker	9	40.91%	Delivery man	11	26.83%
Monk	12	46.15%	Delivery man	8	36.36%	Homeless	11	26.83%
Busker	12	46.15%	Stray cat	8	36.36%	Monk	10	24.39%
Stray dog	11	42.31%	Taxi driver	8	36.36%	Taxi driver	10	24.39%
Bus driver	11	42.31%	Pick-up truck taxi driver	7	31.82%	Stray dog	9	21.95%
Stray cat	10	38.46%	Mice	6	27.27%	Municipal officer	9	21.95%
Pangasius fish	7	26.92%	Monk	5	22.73%	City cleaner	6	14.63%
City cleaner	7	26.92%	Traffic police	5	22.73%	Garbage collector	6	14.63%
Homeless	6	23.08%	Pangasius fish	4	18.18%	Pigeon	5	12.20%
Municipal officer	6	23.08%	Municipal officer	4	18.18%	Stray cat	5	12.20%
Mice	4	15.38%	Bus driver	2	9.09%	Mice	4	9.76%
Garbage collector	4	15.38%	City cleaner	2	9.09%	Bus driver	4	9.76%
Delivery man	3	11.54%	Garbage collector	2	9.09%	Pangasius fish	1	2.44%

3.3 The interrelation of networks originates with activities

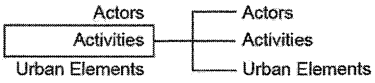

Fig. 7 The diagram of the interrelation network originates with activities

In this section, the relationship of activities in Nonthaburi Pier were analyzed through all particular groups in the network. The activities that occur in this urban context are very varied due to the urban space that is provided. All of the activities that are necessary, optional, and social can be seen in this public space throughout the day [18]. Thus, the purpose of this section is to explore the significance of the relationship between activities and actors, and between urban elements and urban activities, in particular.

Table 5 displays the result of the connection that originated with the activities. Activities with a stronger connection to actors are those with a broader range of accessibility. It is not necessary that the linkage between activities and actors be relevant to the crucial point of the public space, such as a public transportation hub, which transfers activities only in the middle of the table. While activities with the least relation to the actors are usually restricted or occur infrequently in public settings.

As for the relationship between activities and activities, the activities that have a higher degree of connection are more likely to be done simultaneously with other activities. The activities with the least connection, on the other hand, tend to be irregular activities that are rarely seen in public settings and are most often done alone with little reference to other activities.

The data in Table 5, which shows the relationship between activities and urban elements, provides a clear result. Working has the highest connection, accounting for 97.56 percent of the overall connection, implying that everything in public space relevant to the working activity is most likely presented. Invading activity was followed by 85.37%, which is considered very high when compared to the remaining activities, which did not exceed 58.54%. On the other hand, the activities that had only one connection with urban elements were those that were relevant to religion, offering and blessing.

3.4 The interrelation of networks originates with urban elements

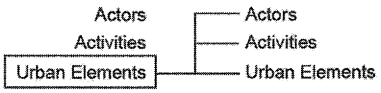

Fig.8 The diagram of the interrelation network originates with urban elements

Urban elements or objects also have an important role in determining the acts that occur in public space. The objects, which can be accessible to various actors, can define the connections and relationships in the network. While objects can also influence people to act or use them differently in public spaces, it led to the various activities that can be derived from just one urban element [15]. As an affordance, the role of urban elements in public space for people is similar to that of the environment and animals, which provide diverse opportunities for them to use for various reasons and purposes.

Food and drink are the urban elements with the strongest ties to actors, as illustrated in Table 6. It's understandable given that every actor has access to food and drink on a daily basis. Following that was a collection of common objects that may be used by any type of actor. Furthermore, litter, as an urban element, has a strong connection due to the likelihood that any actor could litter in public space. On the other hand, the objects with limited accessibility, such as ladders, which are only used

Table 5. The interrelation of networks originating with activities as foci.

Activities - Actors			Activities - Activities			Activities - Urban elements		
Activities	Connection	Percentage	Activities	Connection	Percentage	Activities	Connection	Percentage
Eating/	22	84.62%	Eating/	19	86.36%	Working	40	97.56%
Disposing/ Littering	21	80.77%	Leisuring	15	68.18%	Invading	35	85.37%
Receiving	17	65.38%	Working	14	63.64%	Transfering	24	58.54%
Buying	17	65.38%	Selling	14	63.64%	Selling	24	58.54%
Selling	17	65.38%	Disposing/ Littering	13	59.09%	Gathering	23	56.10%
Working	16	61.54%	Gathering	11	50.00%	Buying	17	41.46%
Feeding	15	57.69%	Buying	11	50.00%	Eating/	14	34.15%
Donating	14	53.85%	Transfering	10	45.45%	Cooking	13	31.71%
Gathering	13	50.00%	Receiving	10	45.45%	Leisuring	8	19.51%
Invading	13	50.00%	Invading	9	40.91%	Disposing/ Littering	7	17.07%
Leisuring	12	46.15%	Feeding	8	36.36%	Receiving	7	17.07%
Transfering	12	46.15%	Playing	7	31.82%	Sleeping	7	17.07%
Offering	12	46.15%	Performing	7	31.82%	Performing	6	14.63%
Blessing	11	42.31%	Offering	7	31.82%	Washing	6	14.63%
Sleeping	8	30.77%	Donating	7	31.82%	Donating	5	12.20%
Scavenging	5	19.23%	Cooking	7	31.82%	Playing	4	9.76%
Playing	4	15.38%	Washing	6	27.27%	Scavenging	4	9.76%
Pooping	4	15.38%	Exercise	5	22.73%	Feeding	3	7.32%
Performing	2	7.69%	Blessing	4	18.18%	Exercise	3	7.32%
Cooking	2	7.69%	Scavenging	4	18.18%	Pooping	3	7.32%
Washing	2	7.69%	Pooping	3	13.64%	Offering	1	2.44%
Exercise	1	3.85%	Sleeping	1	4.55%	Blessing	1	2.44%

Table 6. The interrelation of networks originating with urban elements as foci.

Urban elements - Actors			Urban elements - Activities			Urban elements - Urban elements		
Urban elements	Connection	Percentage	Urban elements	Connection	Percentage	Urban elements	Connection	Percentage
Food/	22	84.62%	Food/	20	90.91%	Umbrella	22	53.66%
Barricade	21	80.77%	Litter	14	63.64%	Food/	21	51.22%
Traffic	21	80.77%	Pellet	13	59.09%	Vending	18	43.90%
Litter	21	80.77%	Dining	9	40.91%	Vending	16	39.02%
Sign	18	69.23%	Sign	9	40.91%	Cooking	16	39.02%
Donation	17	65.38%	Cooking	8	36.36%	Dining	15	36.59%
Buddha	17	65.38%	Washing	8	36.36%	Vending	15	36.59%
Pellet	15	57.69%	Feces	8	36.36%	Bucket	15	36.59%
Bench	13	50.00%	Musical	7	31.82%	Washing	14	34.15%
Sand bag	13	50.00%	Audio	7	31.82%	Stool	14	34.15%
Tarp	11	42.31%	Donation	7	31.82%	Trolley	14	34.15%
Tent	11	42.31%	Bucket	7	31.82%	Bottle	13	31.71%
Vending	11	42.31%	Bicycle	7	31.82%	Cool box	13	31.71%
Vending	10	38.46%	Umbrella	6	27.27%	Sign	12	29.27%
Vending	9	34.62%	Tarp	6	27.27%	Gas	12	29.27%
Trash bag	9	34.62%	Tent	6	27.27%	Bike	12	29.27%
Musical	7	26.92%	Buddha	6	27.27%	Barricade	11	26.83%
Audio	7	26.92%	Vending	6	27.27%	Traffic	11	26.83%
Tricycle	7	26.92%	Vending	6	27.27%	Car	11	26.83%
Tuk tuk	7	26.92%	Gas	6	27.27%	Bicycle	11	26.83%
Pick-up	7	26.92%	Cool box	6	27.27%	Tricycle	11	26.83%
Dining	6	23.08%	Trolley	6	27.27%	Tuk tuk	11	26.83%
Bike	6	23.08%	Trash bag	6	27.27%	Taxi	11	26.83%
Bus	6	23.08%	Tricycle	6	27.27%	Van	11	26.83%
Feces	5	19.23%	Tuk tuk	6	27.27%	Pick-up	11	26.83%
Taxi	5	19.23%	Vending	5	22.73%	Bus	11	26.83%
Van	5	19.23%	Vending	5	22.73%	Trash bag	10	24.39%
Umbrella	4	15.38%	Bottle	5	22.73%	Boat	10	24.39%
Trolley	4	15.38%	Stool	5	22.73%	Tent	9	21.95%
Car	4	15.38%	Taxi	5	22.73%	Vending	9	21.95%
Bicycle	4	15.38%	Pick-up	5	22.73%	Litter	9	21.95%
Boat	4	15.38%	Bench	4	18.18%	Pellet	8	19.51%
Vending	2	7.69%	Car	4	18.18%	Tarp	7	17.07%
Cooking	2	7.69%	Bike	4	18.18%	Bench	6	14.63%
Washing	2	7.69%	Van	4	18.18%	Musical	6	14.63%
Gas	2	7.69%	Barricade	3	13.64%	Donation	6	14.63%
Bucket	2	7.69%	Traffic	3	13.64%	Buddha	6	14.63%
Bottle	2	7.69%	Boat	3	13.64%	Audio	5	12.20%
Cool box	2	7.69%	Bus	3	13.64%	Feces	3	7.32%
Stool	2	7.69%	Sand bag	2	9.09%	Sand bag	2	4.88%
Ladder	1	3.85%	Ladder	2	9.09%	Ladder	0	0.00%

by municipally connected actors, and objects exclusively related to vendors, are the category of urban elements with the least connection with actors.

The connection of relationships between urban elements and activities produces an intriguing result. Although food and drink remain the most common association, at 90.91 percent, they are followed by litter and pellet sack, at 63.64 percent and 59.09 percent, respectively. The remaining items in the table had a tighter range of connection from 9-2 connections, indicating no hint of significant clustering. However, things designed for public usage, such as sandbags, traffic cones, barricades, and benches, are seen as having very minimal connection. Since these objects make little contribution to the linkages between activities.

The consequence of the relationship connection between urban elements provided a remarkable result. The umbrella has the strongest relationship in this category, as it correlates with the urban environment of the public place. That umbrella is essential for survival in the hot climate. Then comes a group of objects related to street vending activities. Furthermore, the findings revealed that the municipal officer's ladder, which exists in public space, has no association with any other object in this place. It is due to the unusual circumstances in which actors or actants have no relationship with others in the entire network.

3.5 Diagram of the Nonthaburi pier area's network

In this section, the result of all the connections will be illustrated in a diagram in order to visualize the overall connections and simplify the complexity of the data. Figure 6 illustrates the overall network connection of the Nonthaburi pier areas, which is based on the results of the data. The diagram indicated the entangled relationships of actors, activities, and urban elements that take place in this urban context.

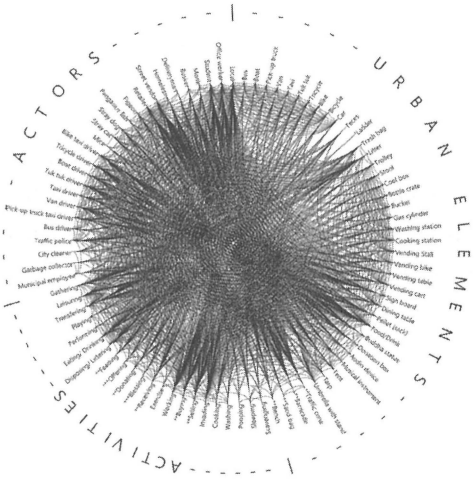

Fig. 9 The diagram shows the overall network connection in the Nonthaburi Pier area (See appendix A).

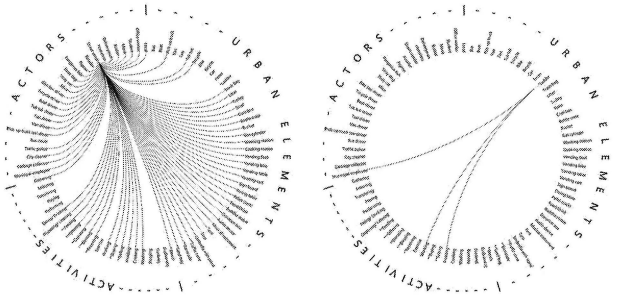

Fig. 10 The comparison of the two diagrams showing the most and least connections in the network. [left] street vendors [right] ladder (See appendix B and C).

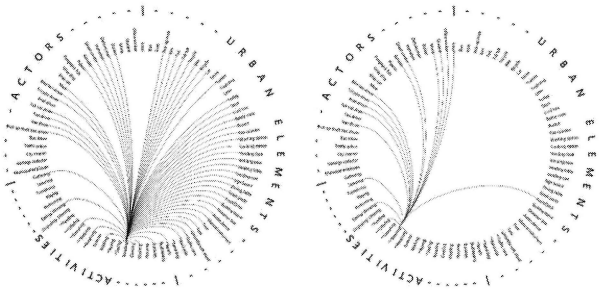

Fig. 11 The comparison of the [left] invading activity and the [right] blessing activity (See appendix D and E).

Figure 7 displayed the difference between the diagrams of the highest and the least connected parts of the network, which are the street vendors as actors and the ladder as urban element. The diagram helps us to understand the importance of each individual actor, activity, and urban element in this public space, by the density of the connection. Furthermore, each of the connection lines can also let us trace the connection from one individual actor, activity, or urban element to another, in order to understand what the impact might be caused if something in the urban context changes.

Moreover, the result of the diagram can let us comprehend the importance of each individual actor, activity, and urban elements in the particular group in the overall network. For instance, in Figure 8, the network of invading activity and blessing activity can provide us with important information by comparative analysis. In terms of relationships with actors, these two activities have a slightly different number of connections for this particular group. However, the relationship of these two activities with urban elements drastically differs. The invading activity was relevant to many urban elements that emerged in public space, while the blessing activity showed the insignificant relationship with urban elements in the Nonthaburi pier area.

In conclusion, the transformation method of quantitative data into diagrams helps us to understand visually the relationships in the network from different perspectives. It enhances the possibility of comprehending the network in detail and focusing on individual items in the network.

4. Discussion

According to the findings, there is a substantial relationship in the specific connections of various groups in the network, which fits with the urban scenery of the Nonthaburi pier area, making it understandable as it occurs regularly. Actor-network theory can reveal important urban elements in the context regardless of whether the item is already known to be significant. On the other hand, it can also detect some key elements that are hidden and unnoticed in the chaotic public space. Furthermore, the connections by the method of actor-network theory allow us to visualize the relationships of all things in the network, which could improve our understanding of the complexity in the urban environment in various aspects.

The study of the overall network in the diagram revealed the crucial information which is hidden from the quantitative data. By analyzing the network of each individual actor, activity, and urban element, the diagram will indicate the importance of each item in the network, and most importantly, it will also indicate the importance of a particular group of actors, activities, and urban elements in the network as well. These findings may lead to the crucial strategy of tracing the connection of one item to another in order to see the impact that each actor, activity, and urban element might cause in the case of changing something in public space. Additionally, based on the network's results for each actor, activity, and urban element, the result suggests some clusters of objects that have more connections than others. It defines the significance of their function in public space, which requires more attention or knowledge to really comprehend the complex condition of this urban setting.

Furthermore, research based on Actor-Network theory has previously been studied in the fields of architecture and urban design. The outcome of the research can reveal different findings, such as the role of objects in public space, which can produce various activities through the context and purposes by comparison of the two study locations [15], or the process of architectural design, whether it is visible or invisible, which influences the behavior of actors (humans and non-humans)

[16]. It is vital that the Actor-Network theory approach to architecture or urban planning can reflect many outcomes depending on the methodology chosen. Thus, depending on the research methodology, actor-network theory can be applied in numerous techniques to unravel complex situations in the field of architectural studies and urban planning.

To summarize, the results of actor-network theory methodology assist us in comprehending the complicated relationships of all things in public space, which are not easily observable and accessible to our comprehension. These findings, which reveal the critical roles of everything in the urban fabrics, will be useful for future research or urban development plans. Such endeavor will enable us to address the situation correctly based on the network's results, in which each actor, activity, and urban element could be traces as having a different impact in the urban context and, in particular, relationships within the network.

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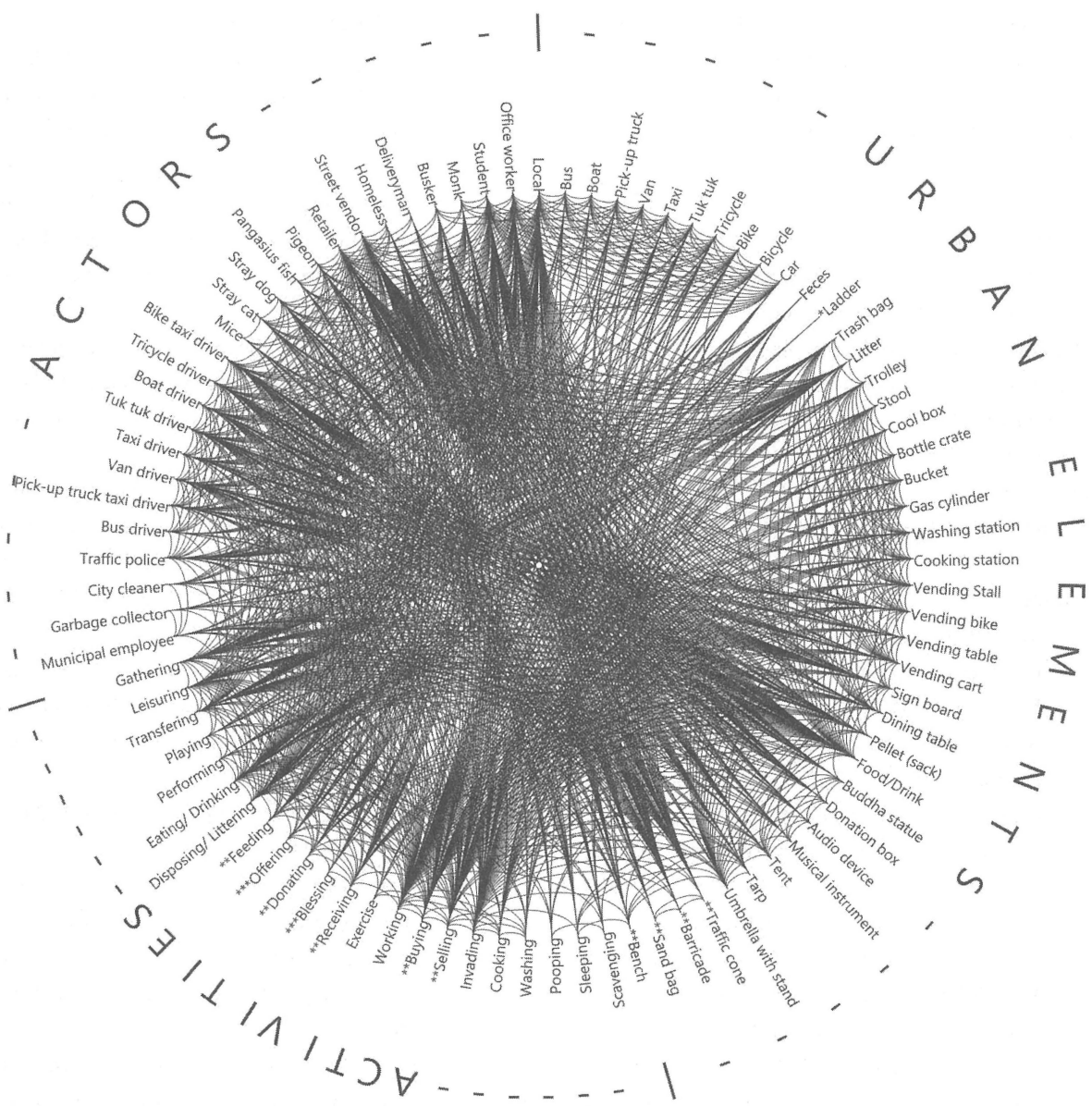
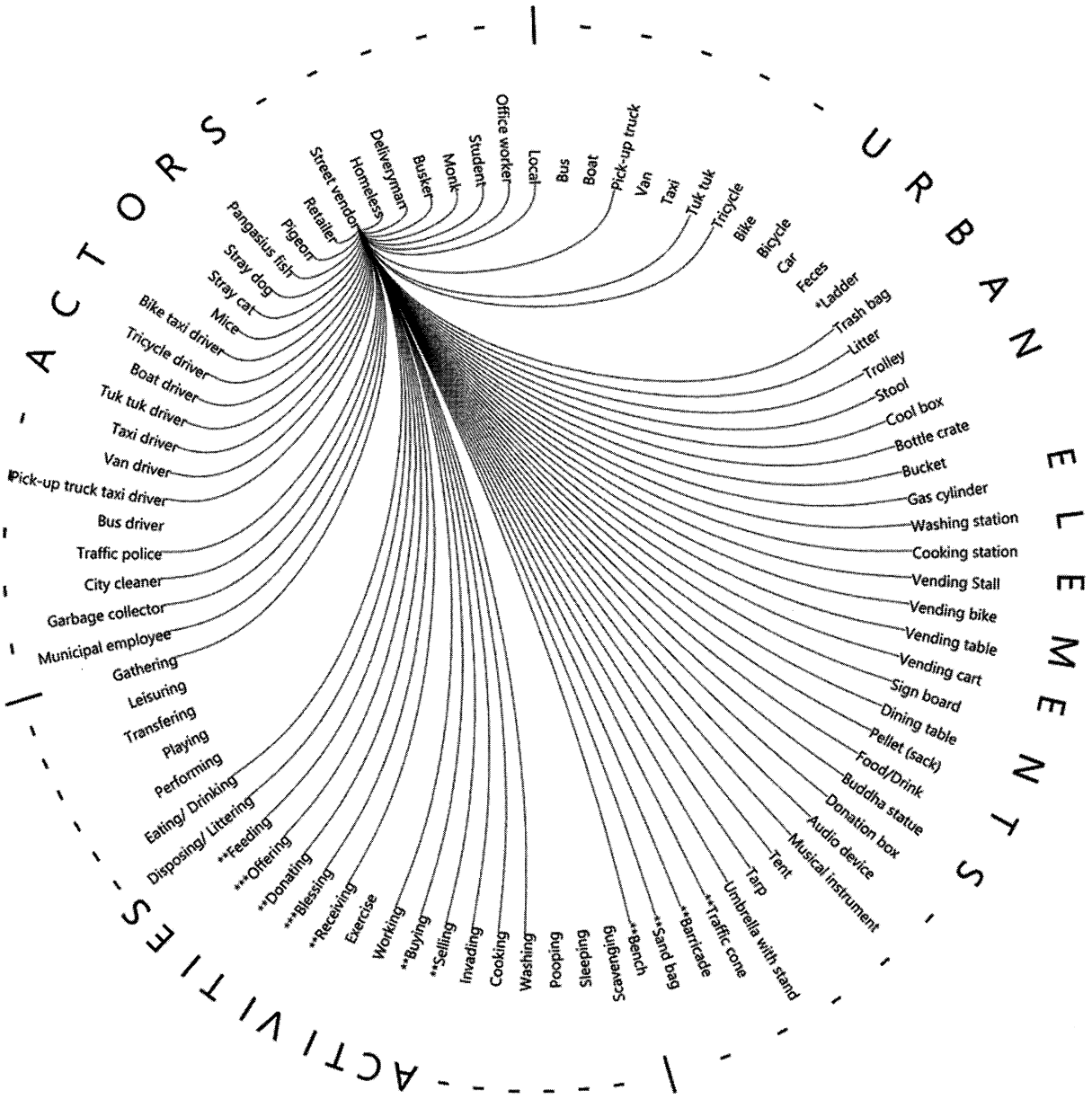
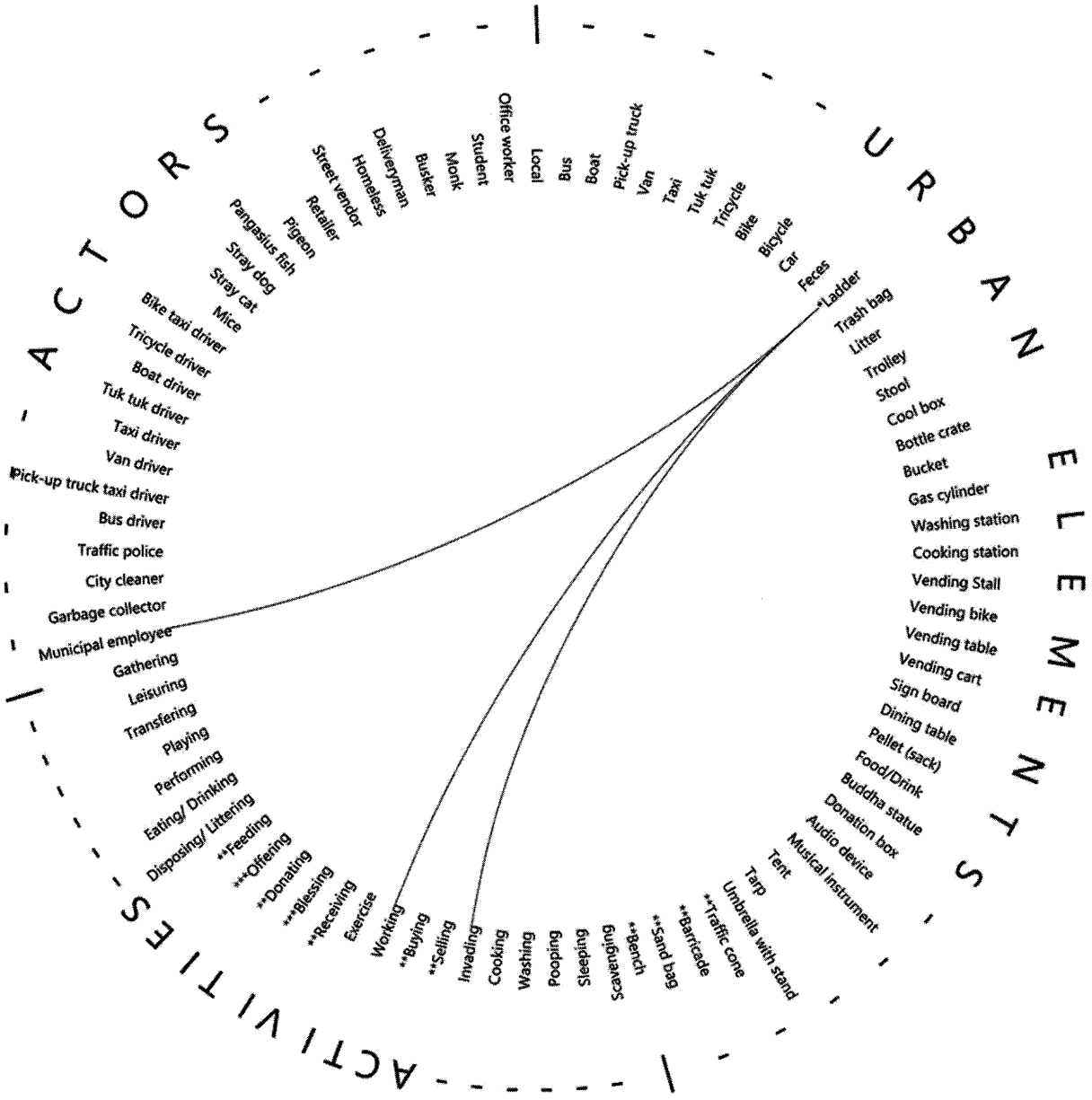
Appendix A The diagram shows the overall network connection in the Nonthaburi Pier area



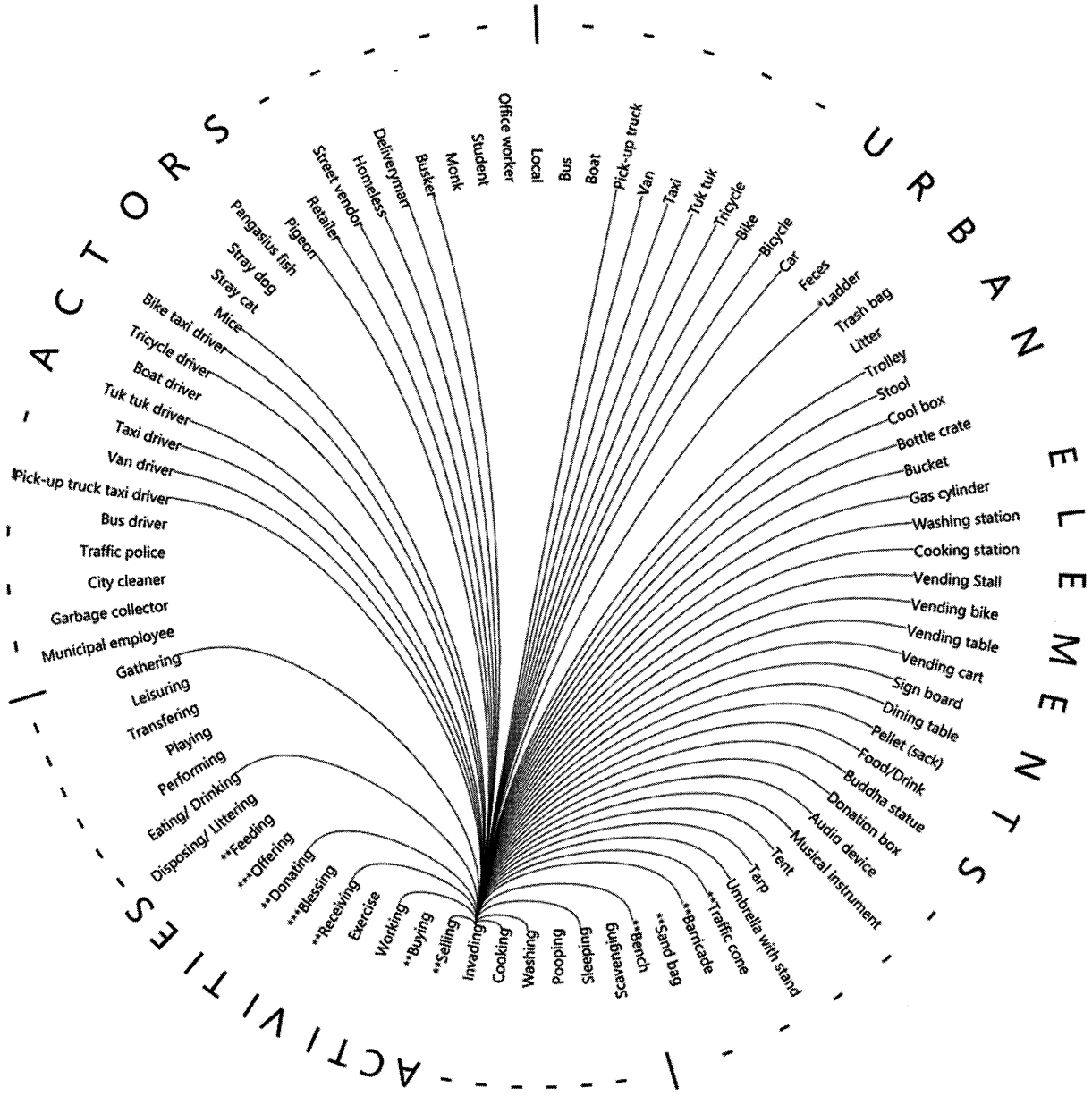
Appendix B The diagram of street vendors as foci in the overall network connection of the Nonthaburi Pier area



Appendix C The diagram of ladder as foci in the overall network connection of the Nonthaburi Pier area



Appendix D The diagram of invading activity as foci in the overall network connection of the Nonthaburi Pier area



Appendix E The diagram of invading activity as foci in the overall network connection of the Nonthaburi Pier area