SPATIAL CONTEXT ANALYSIS

PROJECT DELIVERABLE D3.1

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MOVE21 – Multimodal and interconnected hubs for freight and passenger transport contributing to a zero emission 21st century

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Project Executive Summary

The main objective of MOVE 21 is to transform European cities and functional urban areas into climate neutral, connected multimodal urban nodes for smart and clean mobility and logistics. MOVE21 will do this through an integrated approach in which all urban systems are connected, and which addresses both goods and passenger transport together. As a result, MOVE21 will improve efficiency, capacity utilisation, accessibility and innovation capacity in urban nodes and functional urban areas.

The integrated approach in MOVE21 ensures that potential negative effects from applying zero emission solutions in one domain are not transferred to other domains but are instead mitigated. It also ensures that European transport systems will become more resilient. Central to the integrated approach of MOVE21 are three Living Labs in Oslo, Gothenburg, and Hamburg and three replicator cities Munich, Bologna and Rome. In these, different types of mobility hubs and associated innovations are tested and means to overcome barriers for clean and smart mobility are deployed. The Living Labs are based on an open innovation model with quadruple helix partners. The co creation processes are supported by coherent policy measures and by increasing innovation capacity in city governments and local ecosystems. The proposed solutions deliver new, close to market ready solutions that have been proven to work in different regulatory and governance settings. The Living Labs are designed to outlast MOVE21 by applying a self-sustaining partnership model.

MOVE21 Partners

The MOVE21 consortium consists of 24 partners from seven different European countries, representing local city authorities, regional authorities, technology and service providers, public transport companies, SMEs, research institutions, universities and network organisations.

- **Norway**: City of Oslo, Viken County, Ruter, Urban Sharing, Mixmove, Institute of Transport Economics, IKT Norge
- **Sweden**: City of Gothenburg, Rise Research Institutes of Sweden, Business Region Gothenburg, Volvo Technology, Renova, Parkering Göteborg
- **Germany**: City of Hamburg, City of Munich, Hafencity University Hamburg, Deutsche Bahn Station & Service
- **Italy**: Metropolitan City of Bologna, Roma Servizi per la Mobilità, Roma Tre University
- **Belgium**: Eurocities, Polis
- **The Netherlands**: TNO
- **Greece**: Hellas Centre for Technology and Research

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Deliverable Executive Summary

The main objective of Deliverable 3.1. is to perform a spatial contextualization of the Living Labs based on urban analysis and location-based needs (preferences). It is aligned with Task 3.2: Spatial context analysis assessment and framework, which also feeds into the Integrated City Assessments for Oslo, Gothenburg and Hamburg (D6.2, D6.3 and D6.4) as well as the evaluation tasks in Work Package 8. This task will provide a framework and perform assessments of Living Lab test areas based on urban analysis and considering several typologies of spatial contexts, such as areas that are currently being redeveloped, newly developed areas, urban renewal areas, socially consolidated urban environments and low-density residential developments. The location assessment of the Living Labs will be carried out by combining analytics at different levels: spatial characteristics of locations, spatial requirements of operators and users, and social characteristics of place and surroundings.

Keywords
Socio-spatial analysis, Open data, Urban analysis

Table of Contents

List of Figures

List of Tables

1 List of Abbreviations and Acronyms

Acronym	Meaning
AOI	Area of Interest
API	Application Programming Interface
FUA	Functional Urban Area
KPI	Key Performance Indicator
OSM	Open Street Map
POI	Point of Interest
WP	Work Package
ZEZ	Zero Emission Zone

2 Purpose of the Deliverable

2.1 Attainment of the objectives and explanation of deviations

The objectives related to this deliverable have been achieved in full and as scheduled.

2.2 Intended audience within MOVE21

The intended audience of this deliverable are:

- Task Forces in the Living Labs, informed by the analytics and incorporating the outcomes of this deliverable into their decision-making process.
- Knowledge transfer with stakeholders within the ICCPs, which contain a wide spectrum of stakeholders that might be interested in the information of this deliverable.
- WP6 as coordinator of the Living Lab activities. WP6 to incorporate the perspective of WP3 in the Deliverables D6.2, D6.3 and D6.4.
- Advocates for WP3 to be informed about the specific metrics and the WP3 framework.
- WP8 will be incorporating some indexes of this deliverable as strategic KPIs for the project.
- The general public and the academic community in particular, as this deliverable constitutes a body of knowledge that can be shared and replicated.

2.3 Structure of the deliverable and links to other work packages / deliverables

Deliverable 3.1 is aligned with Task 3.2: Spatial context analysis assessment and framework, which also feeds into the Integrated City Assessments for Oslo, Gothenburg and Hamburg (D6.2, D6.3 and D6.4) as well as the evaluation task T8.3. This task will provide a framework and perform assessments of Living Lab test areas based on urban analysis and considering several typologies of spatial contexts.

Urban vitality and public space usage through the strategic placement of street-scale mobility and logistic hubs: Spatial context analysis of Oslo, Gothenburg and Hamburg

3 Introduction

In the following chapter, the theoretical introduction and general embedding takes place, highlighting the meaning of public space as well as its role in aspects such as urban social identity, social behavior and the perception of privacy. The theoretical framework is followed by a link between the theoretical knowledge and the specifics of the MOVE21 project regarding the relevance of the urban-social layer.

3.1 Public Space and multimodal interconnected hubs for passengers and freight

The procedural nature of cities and their rapid evolutionary capacity has become undisguised in current times. Increasing online shopping with severe consequences for our city centers and decrease of pedestrian use as well as mobility problems in regard of increasing delivery traffic are relatively new phenomena emerging with the last years of digitalization. This condition has worsened recently, when urban spaces and societies underwent major transformation from a pre-pandemic to a pandemic, and eventually a post-pandemic, state. Not only have social relations and norms changed, but also the way society relates to the urban environment. A clear example of this process can be found in the consumption practices that range from retail to big-box surfaces. More specifically, western European countries witnessed a decrease in physical consumption especially during the second stage of the pandemic (Statista 2021a, 2021b) –e.g., the full German lockdown from November 2020 to April 2021– with consequences still noticeable. In particular, the increase of the demand for online shopping and home deliveries and a change in the modalities of transportation has also been noticed, with a strong increase in the uses of individual modes including private cars against public transport and MaaS (Carlier 2021).

We hypothesize that a shift towards private individual transport modes (door to door) and online consumption with home deliveries (shop to door), besides its negative environmental impact, might also put public space at risk, as it can damage the urban vitality levels by reducing the number of people walking, the number of randomized and semi-random encounters, and social interaction in the broader sense e.g. because comparative shopping can be easily performed from a phone, and restaurants are accessible from apps. The potential negative impact of these practices at the individual psychological level is described by Stier et al. (2021).

Against this background, MOVE21 emerges from the cooperation of public and private entities from various sectors related to mobility, infrastructure, IT, city management, and urban research, whose intention is to design and deploy solutions to offer citizens a structural adaptation that matches the current and envisioned social, consumption, and mobility practices using neighborhood-scale hubs for passenger and freight. More in detail, one specific Work Package in MOVE21 is dedicated to minimizing the potential collateral damage to public space vitality by emphasizing the pedestrian flow in public space. To do so, mobility hubs are placed strategically considering the social and spatial characteristics of the urban fabrics in which they are deployed and designing a set of complementary services embedded within the intervention spaces.

This deliverable offers an exploratory methodology to evaluate the candidate locations to host mobility hubs in the context of the MOVE21 project, and to study the way different data sources can be analyzed and combined to extract valuable insights about the performance of small-scale public open urban spaces from a social and spatial approach. To do so, we perform (1) a description of the characteristics of the built environment – namely streets and buildings¬ – incl. a network-analysis based approach to calculate which streets are more likely to gather activity, (2) a functional classification on places and activities, and (3) wide and local scale interpretation on the distribution of places and types of places in the urban fabric for understanding the relevance of places for urban-social identity generation and their likeliness to become landmarks or social hotspots. Our methodology also shows some consistent patterns across different data sources pointing towards the validity of the method itself. Each Living Lab (Oslo, Hamburg and Gothenburg) has defined candidate locations as case studies. Specifically, for the case study areas selected – 10 candidate locations for street-scale mobility and logistic hubs in Oslo, Gothenburg, and Hamburg (Table 3) – the results depict socio-spatial characteristics, which are thought to be relevant for consideration in further studies, analysis, and eventual spatial interventions and intervention proposals.

3.2 Places and people

3.2.1 Urban-social identity

Places are part of people. Identity understood as one's concept of the self is put together in relation to (1) other individuals and (2) locations. Social identity involves the feeling of belonging to a social group, incorporating features of the narrative of that group to the definition of the self (Tajfel, 1981). In a similar process, locations and spatial elements are perceived as a stable continuum, which generates place identity – or "urban identity" when in cities – through the narratives and intangible values associated with places (Lalli, 1992; Proshansky, H. M., Fabian, A. K., & Kaminoff, 1983; Proshansky, 1976, 1978). A comprehensive approach states that both social groups and the spatial context integrate the main components of urban-social identity, which along with emotional factors constitute the feeling of belonging somewhere (Vidal i Moranta & Pol Urrútia, 2005).

This feeling of belonging is a primary and natural human sentiment developed during the first early 6-12 months of an individual's development. Specifically, between 8-10 months of life, emotional responses based on the interpretation of the spatial environment start being developed along with the significance acknowledgement of the social environment (Papalia, et al. 2012). Belonging somewhere is directly linked to the symbolism of places and their intangible values, which are the center of the postmodern discourse on cities as social products generated by countless individual perceptions, interactions and emotions with a symbolic load on a continuous process (Certeau, 1984; Lefebvre, 1974; Tifentale & Manovich, 2016; Zukin, 1996). More specifically, the symbolism and the narrative of places are perceived through two key elements: (1) landmarks, elements of the landscape that stand out, and (2) place names (Bonnes & Secchiaroli, 1992; Valera, 1993). These two elements allow individuals to recognize physical spaces and link them to intangible narratives, which they might incorporate into the definition of their own personal identity and eventually develop the feeling of belonging through emotional affection.

3.2.2 Social behavior and perception of privacy

Beyond the composition of urban identity, the perception of the spatial context also plays a role in the manners of social behavior (Goffman, 1959). For example, places perceived as intimate condition individuals to socially perform differently than public places. "Front- and backstage" are different ways of behaving and showing our persona being inhibited or casual. Intimate places, places that we own, and places that we feel we belong to are more likely to host individuals' "true self" or "backstage behavior", with a minimum performance driven by social norms and others' judgment. In contrast, front stage behavior is what we decide to show to others in public.

Goffman's point, however, must be considered within its context. Modern and early post-modern architectural theory approach home as the private space for dwelling and escaping from a public world through solitude and anonymity. Following a similar discourse, behavioral and cognitive theories considered the relation between self and spatial context rather under an inductive, generalized, and static perspective. Over thirty years after Goffman, Colomina (1994) poses a new theoretical framework on the intersection between privacy and publicity by conceptualizing the built environment as a frame and a mechanism of representation. The distinction of what's public and private is questioned – it is no longer one or the other, but a continuum – and an individual's perception starts playing a defining role taking over the formal spatial condition and the presence of other persons. Therefore, space is not public or private by itself, but we make it public or private by perceptive valuation. Hence the perceptual difference between being from a place and being a visitor to an alien place conditions social behavior, with an explanation rooted at the psycho-social level of urban-social identity.

3.2.3 Good public space

Acknowledging the value generation associated with urban-social identity and their role in behavior, one might question the impact of these processes for specific places, and particularly the perceived quality of them; How good are spaces for individuals? To answer that question, Martí et al. (2017) deepen into the definition of spaces of success and deploy a methodology to quantify and qualify characteristics of outdoor urban public plazas as probes, enabling them to eventually theorize about life in the city. Looking back to Gehl & Svarre (2013), Carmona et al. (2010), Mehta (2013), Lang (2005) among others, Martí et al. (2017) state that successful public spaces are those containing social life and being highly frequented by the public. More specifically, good public places must be attractive (Carmona et al. 2010), animated by public transit, accessible, comfortable, safe (Lang 2005) and show a high level of social relevance and liveliness (Martí et al. 2017). These affirmations are consistent with Cerrone's (2015) work when claiming that spatial configuration is not the engine of urban life, but social actions, interaction, and the establishment of relations are determinant.

Public space vitality is related to economic and social sustainability at a local level, enhancing the opportunities to meet other people, purchase goods and services, establish social links, promote cultural exchanges, and consequently create spaces of serendipity (Ascher, 2007) that allow individuals to make unplanned spontaneous

decisions and be exposed to semi-random social interactions. These last two factors are correlated to mental health indicators (Stier et al., 2021)

Ultimately, vital and socially active urban spaces are related to a positive environmental impact by people walking more and using fewer motorized transport modes. Attractive, popular, comfortable and livable urban spaces are indeed relevant nudges to activate pedestrian flow towards a sustainable future (López Baeza et al., 2021).

3.3 The urban-social layer

In this context, the ultimate goal of Work Package 3 on the urban-social layer is to help cities achieve and maintain high social qualities in public space, by increasing walkability in order to enhance the diversity of people (Bartzokas-Tsiompras & Photis, 2020), social cohesion and collective engagement (van den Berg et al., 2017; Amin, 2008), quality of life (Rogers et al., 2011), and other positive aspects related to the potential encounter of people in public space (Amin, 2008), randomized social interaction (Kashdan & Farmer, 2014), and serendipity and capacity of spontaneous action (Gumpert & Drucker, 2000).

In order to do so, a comprehensive approach is needed, in order to understand the nature and the characteristics of the candidate locations (test sites) in the different Living Labs.

This deliverable evaluates locations under the urban-social approach. This work is exploratory research combining different data sources to analyze and extract valuable insights about the performance of small-scale public open urban spaces from a socio-spatial perspective. Our methodology provides a wider city-scale narrative needed to comprehend the results on a local neighborhood scale. It also shows some consistent patterns when observing different data sources pointing towards the validation of the method. More specifically about the cases, the results depict some socio-spatial characteristics of the hub candidate locations, that are relevant for consideration in further studies, analysis, and spatial intervention proposals, such as:

- The inverse correlation between spatial network relevance and socio-economic relevance poses the paradox of people choosing to visit places that gather people, regardless of the pure spatial configuration of those i.e., how well connected they are to the rest of the city.
- Even though balanced in general amounts, a mismatch is produced in the spatial distribution of optional and necessary activities (e.g., leisure and social versus workplaces) deriving in functional segregation of some places.
- The core areas are polycentric. Neighborhood centers emerge in the intersection of axes that gather optional activities along with them, while necessary activities tend to cluster around transport hubs.

4 Methodology

4.1 Methodological framework

The case-study areas are approached from different levels of analysis: urban and local. The urban-scale level considers the areas within the greater urban context with measurements such as its impact on the social fabric or its level of physical integration within the overall city street network. The evaluation of relevance or impact of the case-study area as an individual distinguishable landmark in a broader context is performed following the methodology explored by Carpio-Pinedo and López Baeza (2021) from a cluster calculation on places registered in social media using urban-scale quantitative data of the times that places have been visited and the engagement ratio of visitors (i.e. same individuals visiting the same places). In a later step, the measurement of integration or relevance for the street network is performed through standardized Space Syntax calculations on the street network of the cities processed by the tool OSMnx developed by Boeing (2017). The local-scale level focuses on activities performed in the spatial environment surrounding the case-study locations. Two levels of current activities are considered: (1) what people can do – supply of activity as the presence of places, (2) what people do – demand of activity as actual visits to those places. The distribution and quantitative definition of these places define the functional characterization of areas.

4.2 Datasets

Data downloads have not only been limited to the administrative boundaries of the cities. The boundaries of the cities should not be considered abstract political lines but rather focusing the consistency of the urban fabric with the capacity to influence the socio-spatial patterns of urban life suggesting including those neighboring areas within the boundaries of a functional urban area (FUA), according to the definition by the OECD (2020). Within the three FUAs, the following data has been utilized (see Table 1).

4.3 Metrics and locations

These data have been used to calculate and map the metrics described in the following section (Section 5), which we have grouped in four metric categories (Table 2). As stated above, the current contribution considers ten different “candidate locations” for mobility and logistic hubs, in three different cities: Oslo Hamburg Gothenburg (Figure 0). Each of this candidate locations are approached from three different levels of definition, urban scale, district scale, and plot level (Table 3).

Source	Oslo FUA	Gothenburg FUA	Hamburg FUA
OSM: Buildings Layer	186619 buildings	131859 buildings	375213 buildings
OSM: Streets Layer	299734 street segments	230504 street segments	390573 street segments
Foursquare: Places API	31274 places	23704 places	73254 places
	3313022 visits	1573488 visits	8260278 visits
	2245833 visitors	971811 visitors	4101081visitors

Table 1: Description of the main datasets utilized. Source: Authors

Metric	Data Source	Calculation Method
Building types and sizes	OSM Buildings Layer	Basic Spatial Operations
Network Relevance	OSM Streets Layer processed by OSMnx	Space Syntax
Functional distribution of Activities	Foursquare Places	Cluster calculation
Socio-Economic Relevance	Foursquare Places	FS Visits / FS Venues

Table 2: Summary of methodology implemented. Source: Authors.

Name	Description	Cartographic Scale
FUA: Functional Urban Area	Urban scale and commuting area	1 : 200 000
AOI: Area of Interest	District scale	1: 50 000
POI: Point of Interest	Plot and immediate walkable distance	1: 15 000

Table 3: List of scales of approach. Source: Authors.

Figure 0: Candidate Locations. Source: Authors

5 Results

5.1 Building Morphotypes

5.1.1 Building sizes and types

Diversity of building types is a known desirable characteristic of urban space. Jacobs (1969) defended the relation between diversity at several levels, connecting the social fabric and its intangible values with the built environment, through the perception of it. She acknowledges the importance of a diverse urban environment, for instance, in terms of building types. In this context, areas with unequal building fronts, styles, widths, heights, and uses, tend to be more entertaining and attractive from the pedestrian perspective and therefore, more attractive for a wider range of people. Socioeconomically speaking, this line of thought would transfer to a direct correlation between the building type diversity and social diversity. In this deliverable and due to the characteristics of the data available, we were capable of mapping areas of the city by the diversity of building types. It is assumed a certain relation between the surface occupied by a building on its footprint, and the typology of the building defined by its morphology (number of stories, width of street front, size of windows, etc.).

Observing the results from the three cities mapped, larger building footprints tend to be connected to shopping malls and big-box stores when isolated or different from its surrounding building types, and industrial uses when clustered in an area with similar building sizes. Areas with small (light color buildings in Figure 1) tend to represent residential low-density fabrics. Particularly those with near-white color represent single-family estates.

Having a closer look at the areas surrounding the hub locations, a typological classification is observable:

- The city centers and consolidated urban fabrics have a higher density and higher diversity of morphological types (Figure 2, three above). The three of them share proximity to a central train station, and combine, to a certain extent, residential types and commercial facilities and large-scale functions (shopping malls, universities, etc.). These areas gather, in the three cases, more than one candidate location for a hub.
- The lower density areas (Figure 2, three below), among which we find (1) purely industrial fabric, (2) residential single-family suburb with shopping mall, and (3) modern-era fabric, have large buildings fronts and extensive green spaces in between.

Oslo

- A higher mixture of typologies is in the city center.
- A large industrial surrounding extends from Alnabru station towards the northeast.
- Shopping malls in single-family residential fabrics in car-oriented areas with low density.
- Sub-centers that aggregate higher density are distributed randomly in the city.

Hamburg

- Industrial uses are clearly visible in the port and in industrial parks.
- Single-family houses and residential fabrics determine large parts in the north and west side of the city.
- Multifamily low-density houses are predominant in the east of the city.
- A greater variety of types is in the city center of Hamburg and Altona.

Gothenburg

- Larger buildings and a higher variety of types are along the main roads (see section 5.2).

Figure 1: Building sizes at FUA scale (1 of 3)
Source: Authors.

Figure 1: Building sizes at FUA scale (2 of 3)
Source: Authors.

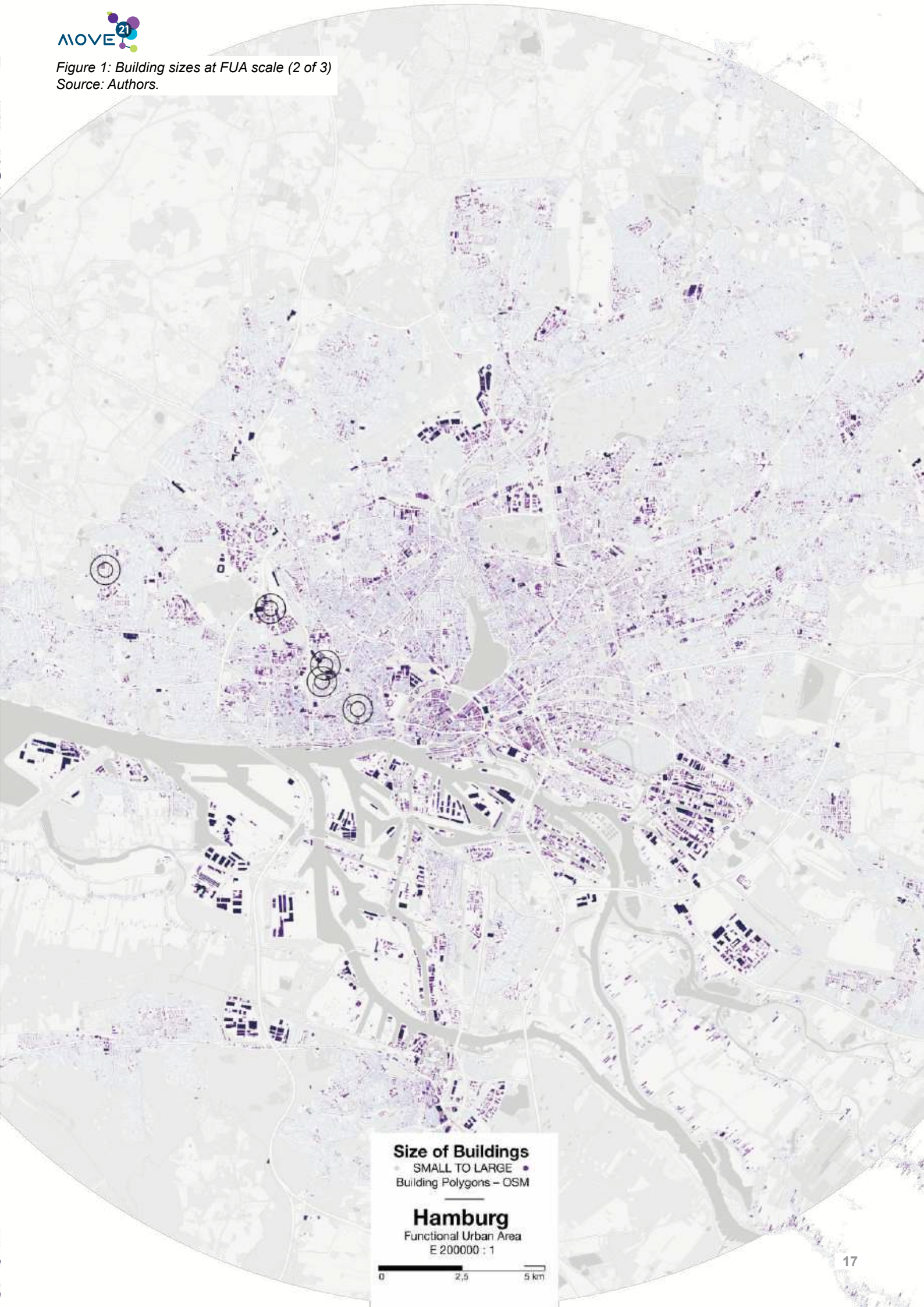


Figure 1: Building sizes at FUA scale (3 of 3)
Source: Authors.

Figure 2: Building sizes at POI scale (1 of 6)
Source: Authors.

Figure 2: Building sizes at POI scale (2 of 6)
Source: Authors.

Figure 2: Building sizes at POI scale (3 of 6)
Source: Authors.

Figure 2: Building sizes at POI scale (5 of 6)
Source: Authors.

Figure 2: Building sizes at POI scale (5 of 6)
Source: Authors.

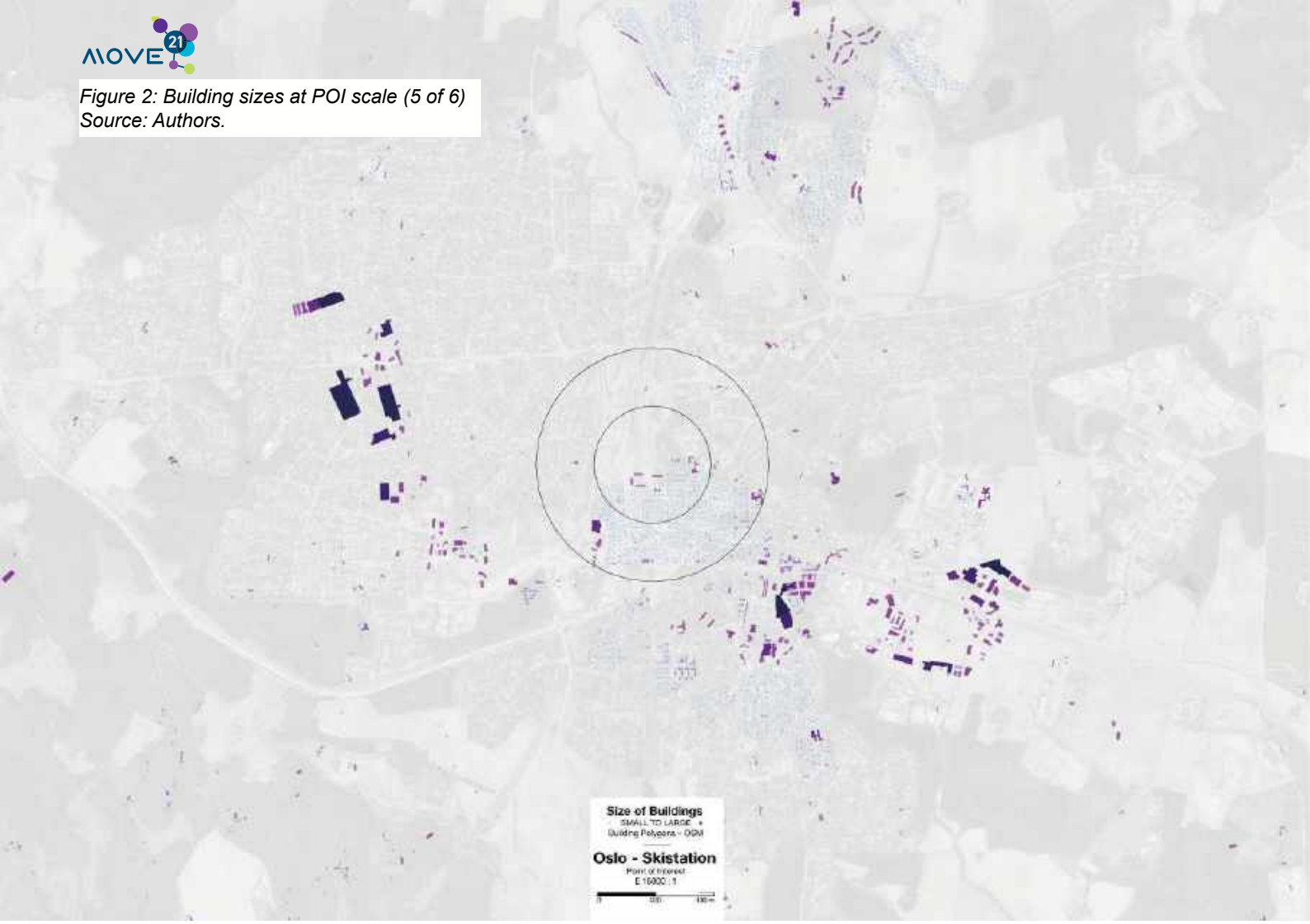


Figure 2: Building sizes at POI scale (6 of 6)
Source: Authors.

5.2 Network Relevance

Space Syntax and Segment Analysis are used to establish measurable indexes to define the purely spatial role of streets and street segments taking the entire city network into consideration. In this context, these calculations would show the relevance of some streets compared to others, regarding potential pedestrian and transport flow based on connectivity between them. More specifically, Integration and Choice indexes are computed. Integration measures the number of turns required from each street segment to reach all the others. A higher Integration is accomplished when a maximum number of segments can be reached with a minimum number of turns. Integration is generally utilized to 'predict' pedestrian flow, as turns are believed to raise cognitive resistance of the network to pass by. Similarly, Choice indexes are related to flow measurements, considering an equal weight for every street segment that is aggregated when streets converge in an intersection. Considering the entire network, complex intersections –several streets converging– would theoretically gather higher flow, generally related to traffic. In this context, Choice would be related to the number of intersections to cross needed for reaching a street segment, measured from all the other streets segments in the network.

Integration and Choice are related to how accessible streets are, thus their likability to gather higher pedestrian and traffic flow levels. However, the pure spatial approach lacks the social component, and does not take into consideration crucial factors such as places being popular, attractive, containing landmarks or basic services, etc. For this reason, we later propose a comparison between spatial network measurements and the spatial distribution interpretation of venues, places, and their activeness.

5.2.1 Connection to the rest of the city

We measure the connection of each street segment with every other place in the city by computing the Integration metric. Integration is the result of normalizing the distance from every location to every other location in the street network (Hillier & Hanson, 1984). It can be seen as how close one segment is to all others, or how connected one space is to the rest of the city. It is also a normalized measure of Mean Visual Depth that allows the direct comparison of different configurations.

This might be of special relevance when observing the potential connections by road traffic (Barros et al., 2006; Leccese et al., 2020), from each hub test site to the rest of the city, as passengers and freight need to arrive to and depart from these locations. In this context, locations closer to highly integrated streets are therefore more accessible and easier to reach, which can be understood as a positive factor.

However, we must acknowledge the impact focus at different levels, thus neighborhood or local connections (See 5.2.2) are also imperative. The results of this metrics can be found in Figure 3.

Oslo

- The central area is limited by a loop formed by the ring-road in the north and the seaside road in the south. The area inside the loop is the city center and the most connected part of the city. This loop is also connected to two major arms that run south of the location Ski station and to the southwest.
- The city center and the location of Filipstad are connected by major arteries, and they are the most connected parts of the city. TEN-T major nodes are to be considered in these locations, ad their connections to major highways is high, as well as the proximity to the port and the central railway station as Scan-Med corridor nodes.
- The location Alnabru is near an integrated area. The Location Ski station is far outside the city and disconnected from the rest of the city. But both locations Alnabru and Ski station are also accessible by railway, which is not considered in this analysis.

Hamburg

- Two major roads that run from north to south connect the city with the port. The location and size of the port of Hamburg determine the road structure and hierarchy of streets of the rest of the city. The area between these two main axes is the most connected, it includes the central districts and half of the Altona district (with four hub locations).
- The highway from north to south is the most connected road in the city. In this regard, the location in Schnackenburgallee is the most connected potential hub location, in terms of accessibility to the rest of the city. Considering the connection to the TEN-T network , the proximity to a major highway and the convenient access towards the Port of Hamburg as a Scan-Med node must be noted. However, aiming for local hubs with neighborhood impact, connection to the rest of the city is not to be the only relevant factor.
- The location of Osdorfer Born is disconnected and far away from the city center
- The three locations near Altona are more or less connected to the rest of the city.

Gothenburg

- Two major roads run parallel to the river borders and the port. The area around the port, where the main roads meet, is the most connected in the city.
- A radial structure of roads connects the city center to the suburbs.
- The locations Nordstan and Jaegedorf have a high connection to the rest of the city due to the highway that runs parallel to the river. Both locations also should be considered within the TEN-T corridor nodes, for their proximity to the central railway station and the port, respectively.
- The location of Lindholmen has a lower connection but it is still close to one major road that connects the rest of the city.

Figure 3: Connection to the rest of the city. Integration at FUA scale (1 of 3)
Source: Authors.

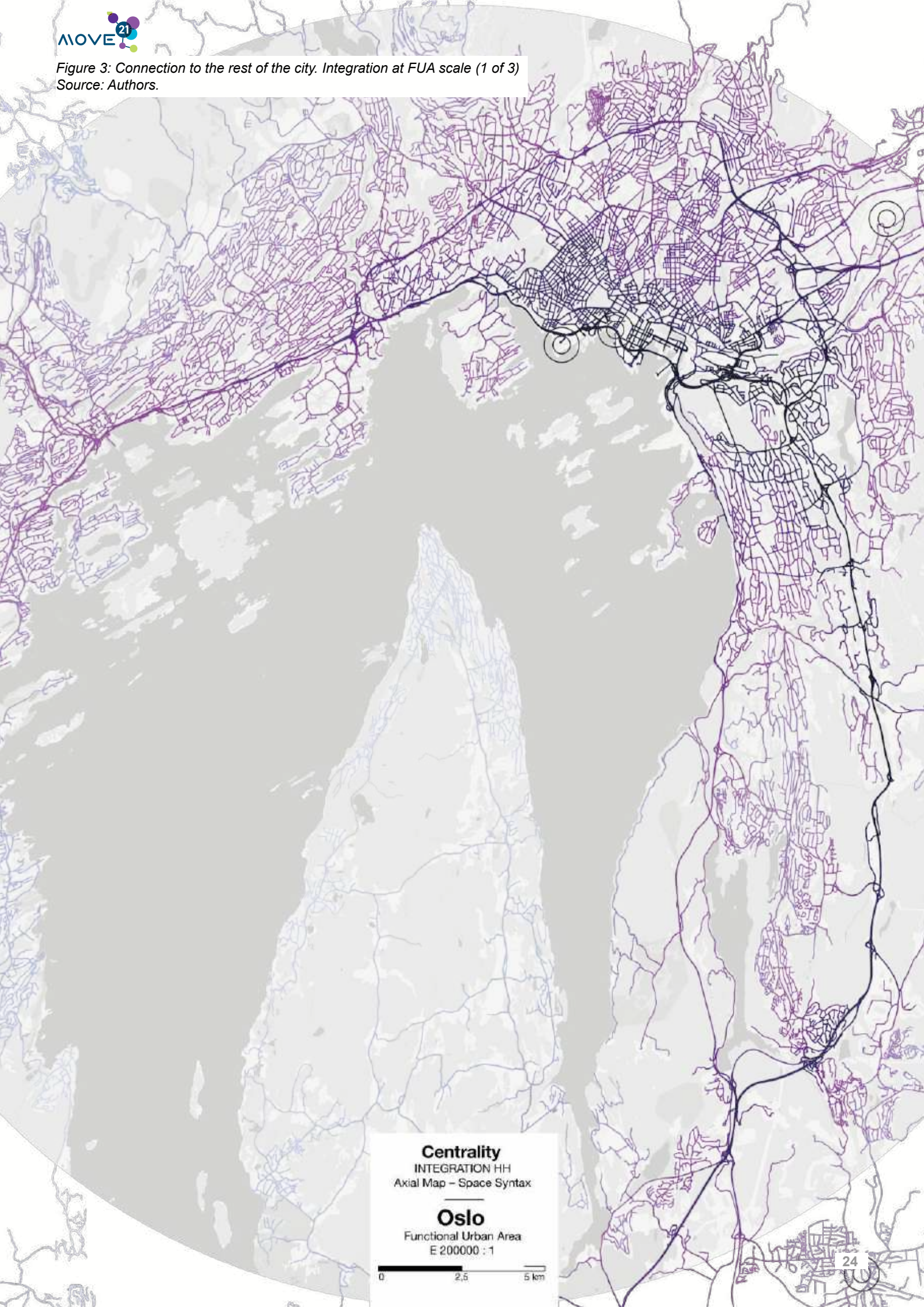


Figure 3: Connection to the rest of the city. Integration at FUA scale (2 of 3)
Source: Authors.

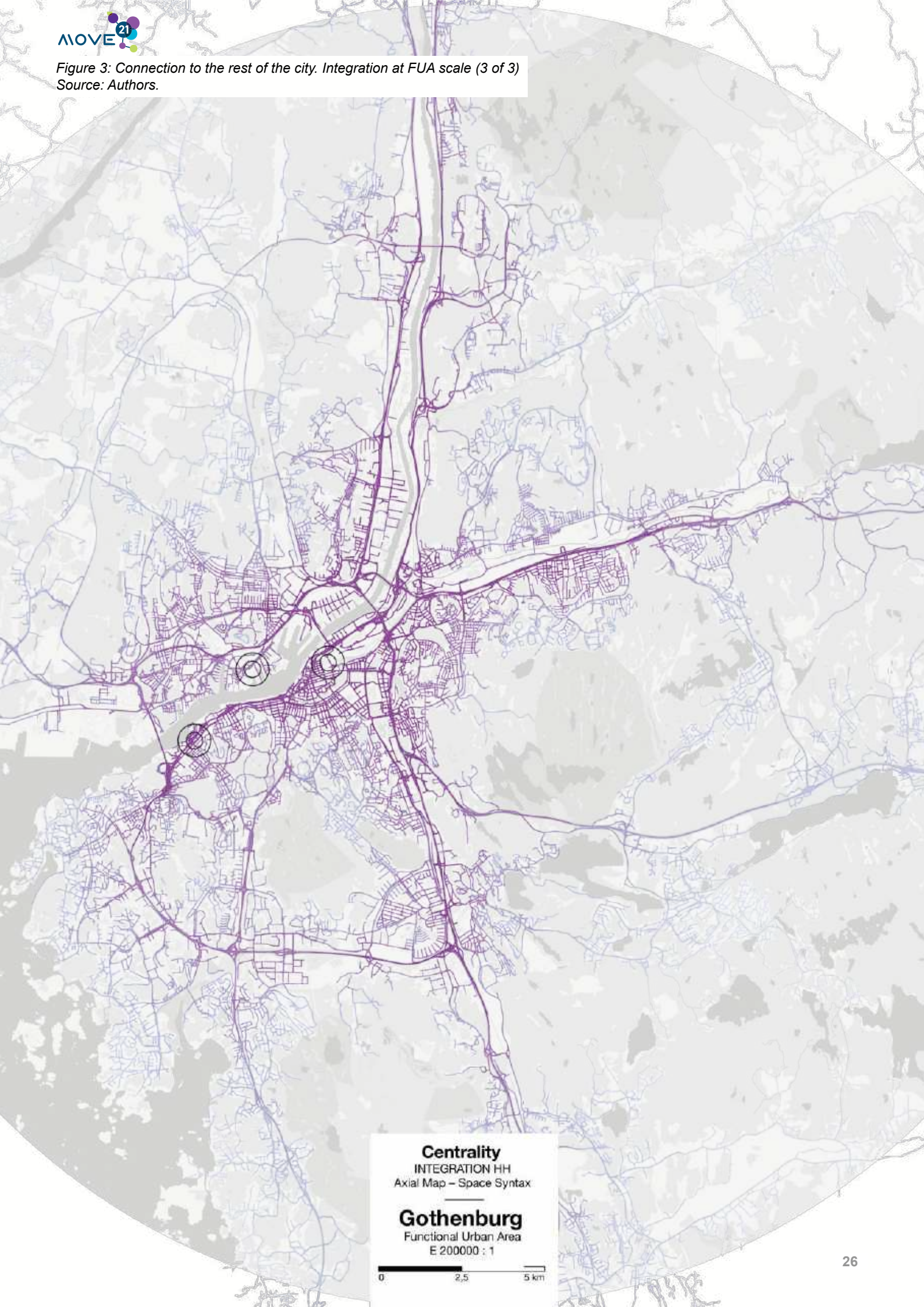


Figure 3: Connection to the rest of the city. Integration at FUA scale (3 of 3)
Source: Authors.

5.2.2 Connection at the local scale

Connection at the local scale is calculated by measuring local integration with a maximum of three road turns. As a result, this computation shows how connected each street segment is at a local level, highlighting areas that are more reachable or more central within a shorter axial distance (three turns). In this context, local integration i.e. short-distance reachability can be related to the potential of streets to host the flow of pedestrians and active modes of transportation (Raford & Ragland, 2004; Lee et al., 2020). Naturally, streets that are connected to more streets at a short distance, would tend to gather a higher flow of people walking from and to places. When several "walkable" streets are concentrated in areas, we refer to them as "walkable areas" or "walkable units". Observing the results in the figure below, one can appreciate the presence of these "walkable units" distributed around the three cities. The results of this metric can be found in Figure 4.

Oslo

- The city center of Oslo presents a relatively large "walkable area" meaning that the length of the street segments and their connection to other streets make the area potentially comfortable to walk around.
- Therefore, the hubs in the city center and Filipstad are easily accessible by a short distance walk, they can be reached by walking from a large number of places.
- The hubs in Alnabru and Ski Station do not present a high local integration index, in this regard, they are more accessible by other transport modes. The presence of a railway station constitutes a major node regarding TEN-T and commuter connections.

Hamburg

- In comparison to Oslo, walkable units have smaller sizes and are more dispersed. In consequence, a reduced number of places are reachable on foot that leads to better accessibility when using other transport modes.
- The locations in Osdorfer Born and Schnakenburgallee have a low level of local integration.
- The three hubs in the Altona center have a higher level of local integration than the other two, but they are still quite low. The hub that can be reached best on foot is Neue Mitte Altona.
- The hub in Holstenstrasse is located on a street with low local integration, but it is to consider that it is in the middle of two "walkable units" in the east and west.

Gothenburg

- A concentration of several walkable units forms a large walkable area along the southern border of the river. Walkable units have a size between those in Oslo and Hamburg.
- Especially the city center is walkable. Consequently, the Nordstan hub has a high potential to be accessed by active modes.
- Jaegedorf has a high local integration towards the south. In addition, it includes major waterway connections both al local and TEN-T level, along with Lindholmen (local waterway travel).
- Lindholmen has a low local integration.

Figure 4: Connection at the local scale (1 of 3)
Source: Authors.

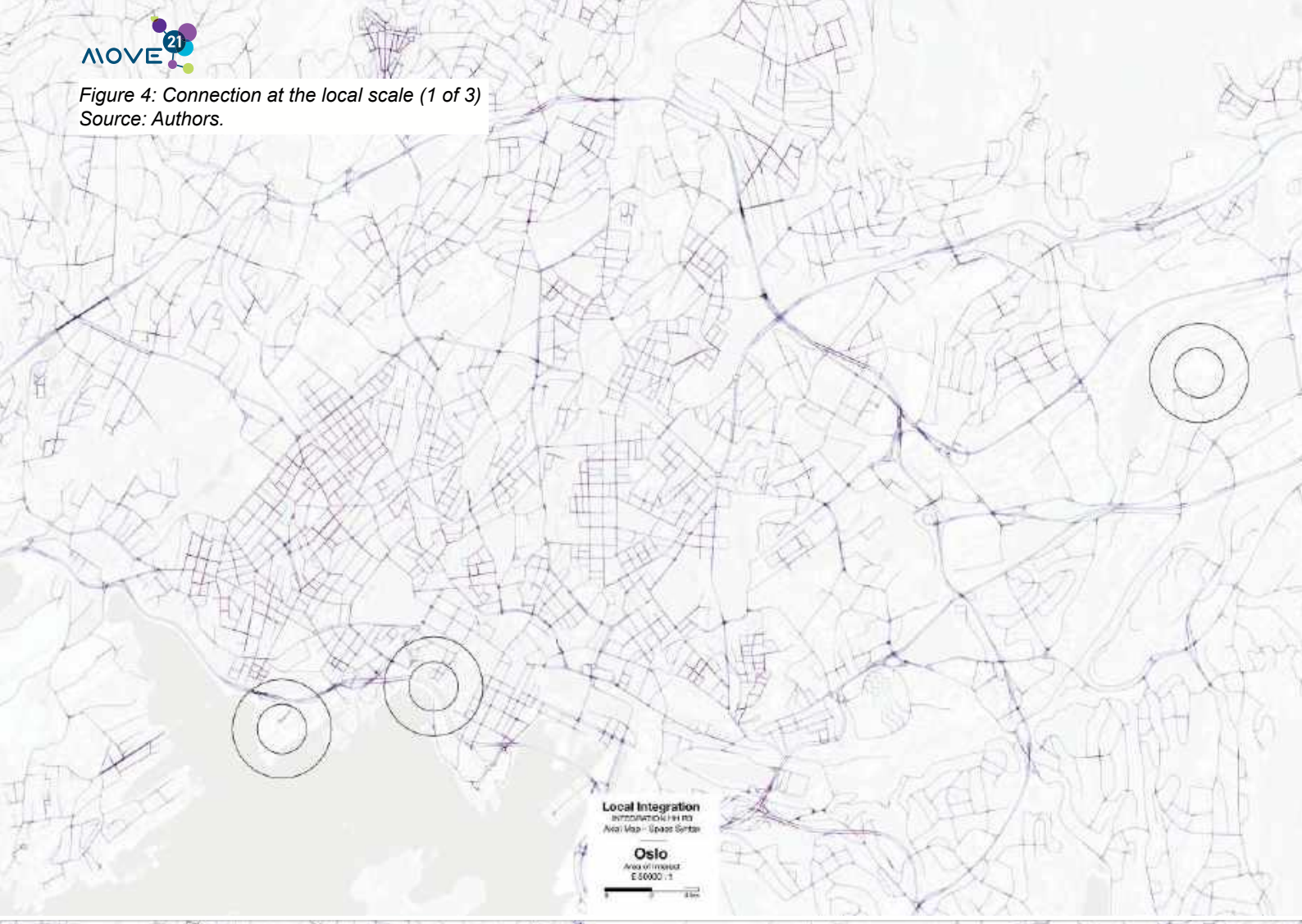
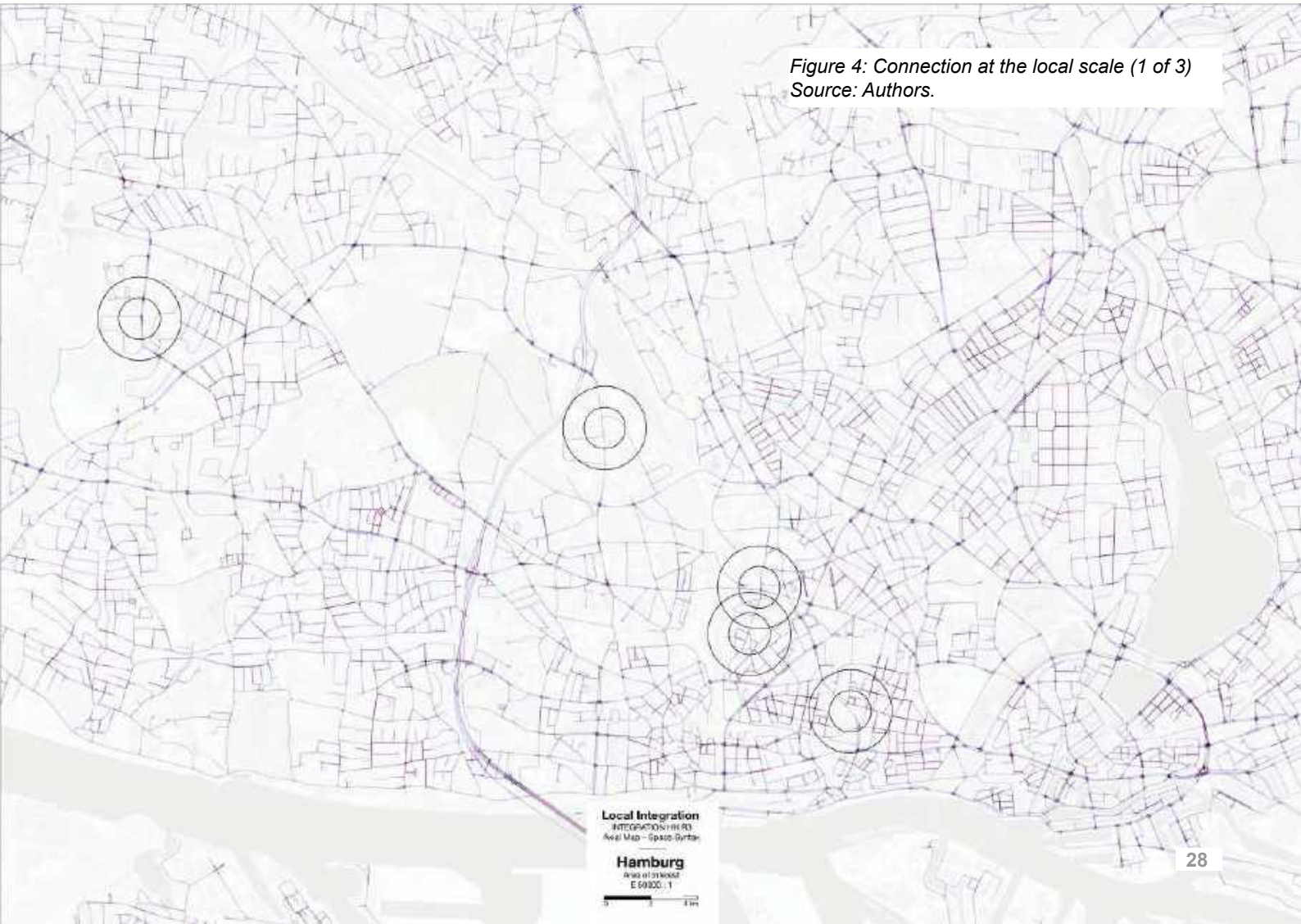


Figure 4: Connection at the local scale (1 of 3)
Source: Authors.



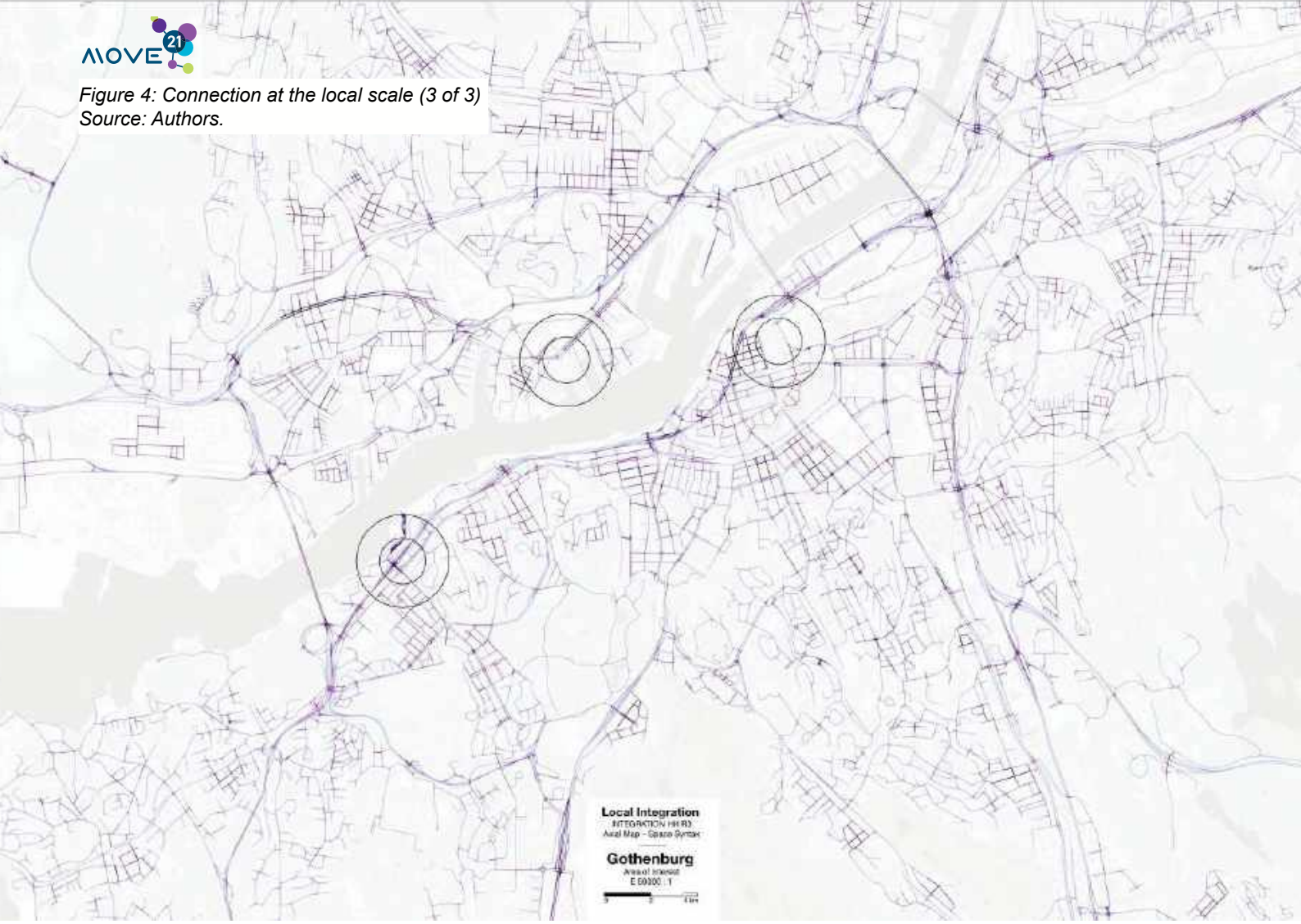


Figure 4: Connection at the local scale (3 of 3)
Source: Authors.

5.2.3 Connection to main streets and circulations

The main streets are detected by computing the angular choice measure, which calculates the number of times that a street segment is the shortest path between two pairs of street segments, calculated for all street segments in the system. The result of this calculation can be found in Figure 5.

Oslo

- The hub locations Filipstad and the city center (as one of the hub locations) are directly linked to the main street, which is as well passing near the Ski Station.

Hamburg

- The hub location Schnackenburgallee is directly linked to the main street.
- The other locations are not connected to the highway.

Gothenburg

- The hub locations are not linked to the main streets.

Figure 5: Connection to main circulations (1 of 3)
Source: Authors.

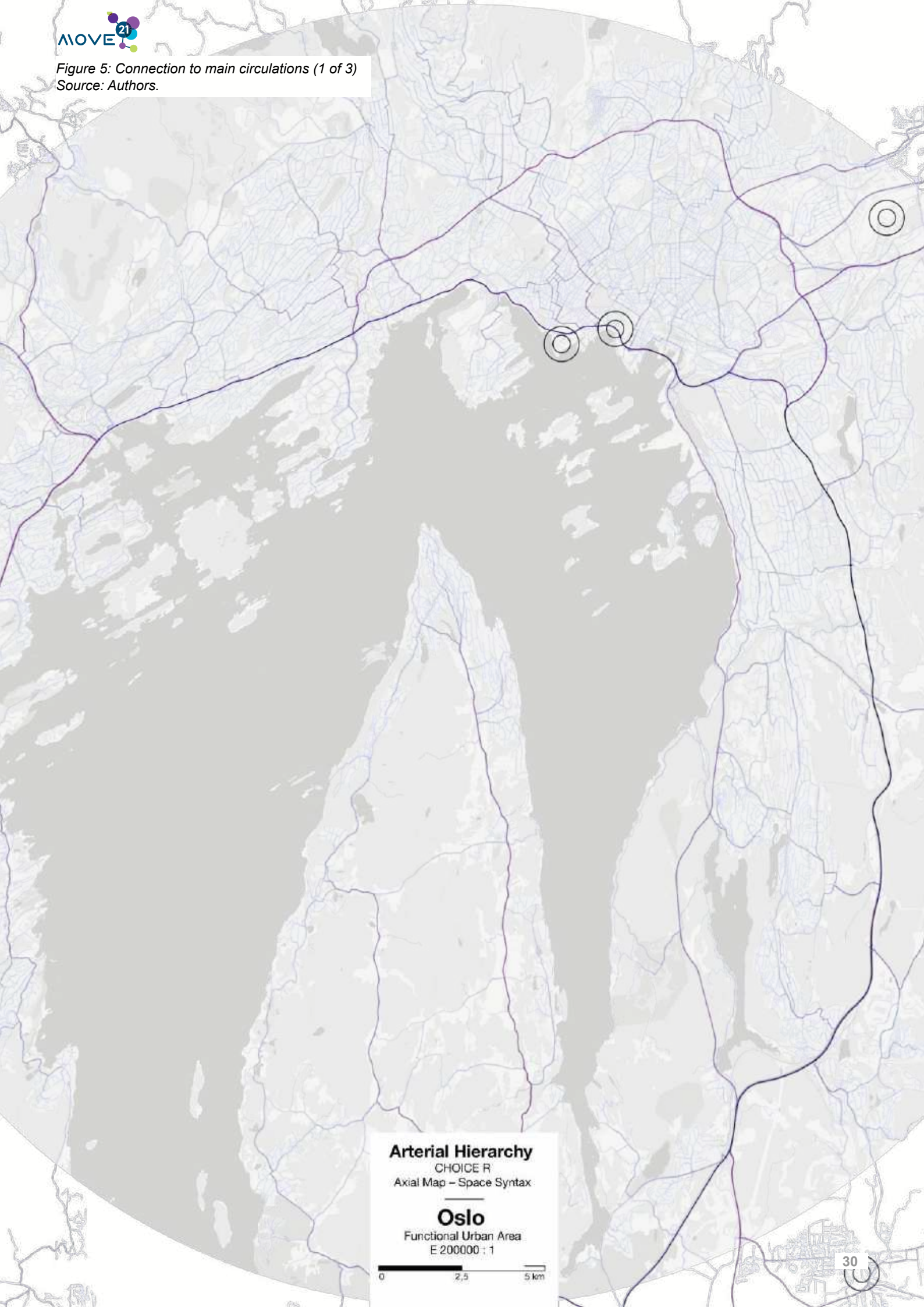
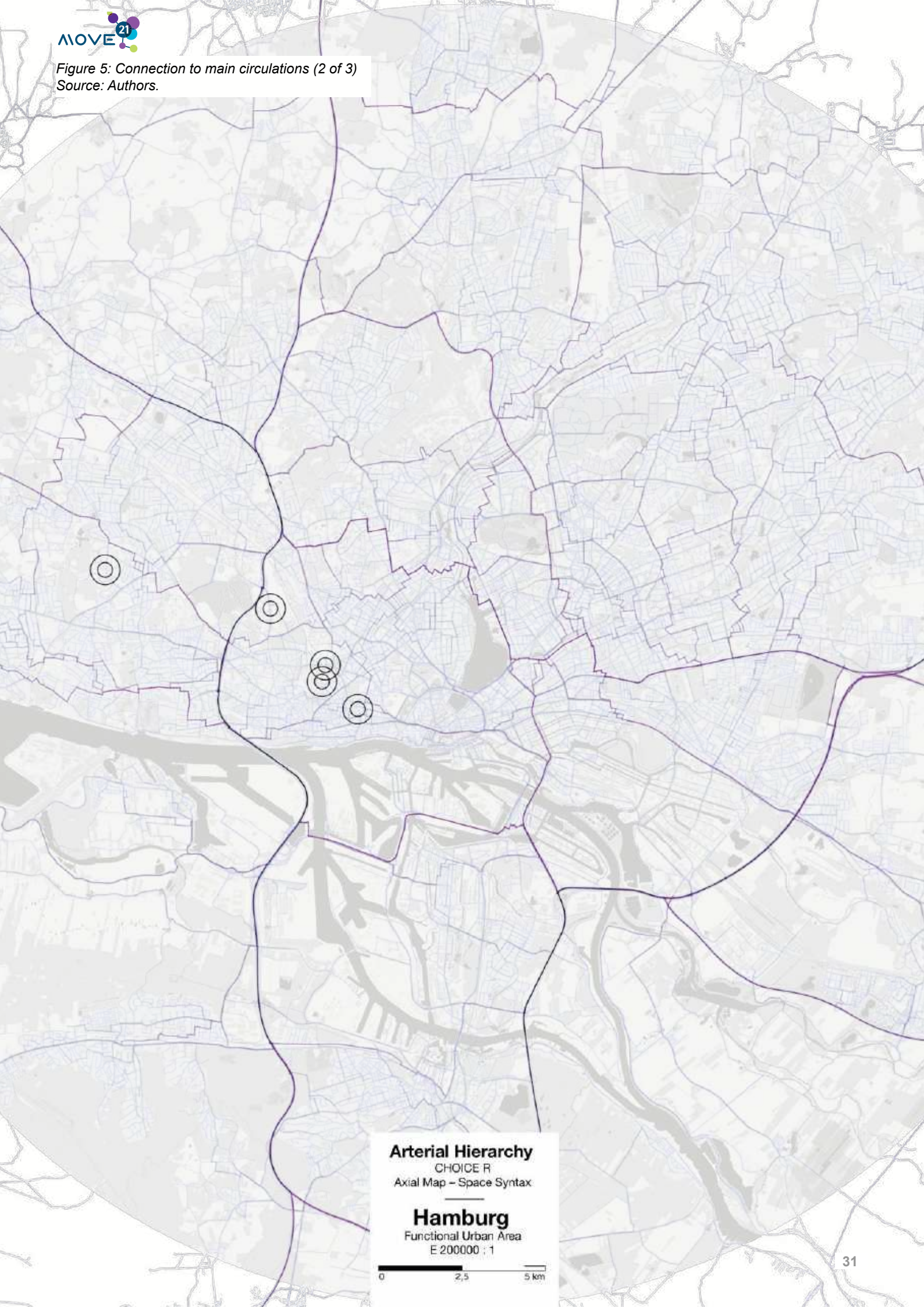


Figure 5: Connection to main circulations (2 of 3)
Source: Authors.



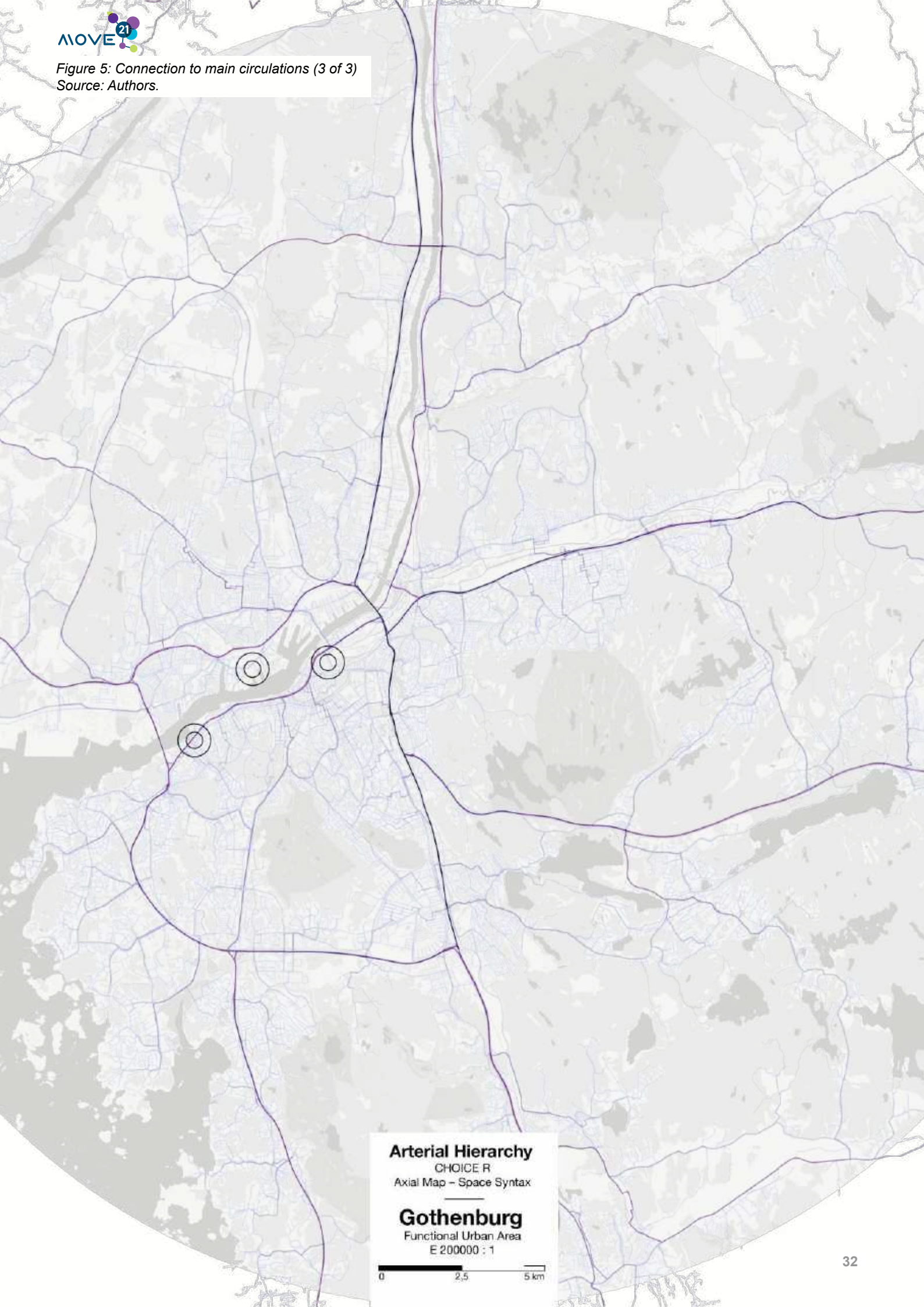


Figure 5: Connection to main circulations (3 of 3)
Source: Authors.

5.3 Functional Distribution

The study of the types of activities performed in urban space within the urban discipline has been addressed previously by focusing on the primary function of the places, the correspondence with the normative categories of land use, or the importance of the activity in the daily routine or its degree of need (Seamon, 1979; Buttimer and Seamon, 1980; Gehl, 2011; Ben-akiva and Bowman, 1998; Jiang, Ferreira and González, 2012). These references are taken by Cerrone et al. (2018) in the development of a classification of activities in urban space based primarily on the need for action originated in the first classification of Gehl (2011), which attempts to cover all the spectrum of urban activities regardless of the nature of the space in which they are carried out. Cerrone et al. (2018) propose a classification based on two categories: Necessary and Optional and deploy it in Foursquare datasets. From an urban-social standpoint, the functional distribution is approached from the perspective of its capacity for creating pedestrian flows. Segregation of functions or the high concentration of one function in a specific area, would offer fewer possibilities of action and therefore would reduce the capability of people of making spontaneous choices, serendipity, and randomness. Furthermore, segregation of functions in urban spaces can be a major driver towards motorized traffic modes and consequent congestion. Firstly, multi-purpose trips would require visiting different areas of the city at a non-walkable distance. Secondly, the temporal entropy would be reduced, meaning that the specific areas of the city would be visited by people at the same times of the day causing significant temporal-activeness imbalance (e.g. shopping areas deserted during closing times) and traffic congestion in the roads connecting areas with subsequent functions in the daily routines (e.g. roads from/to residential areas and business districts in rush hours) (Estrada et al., 2016; Rhee at al., 2014). In contrast, areas with a higher mix of functions (e.g. residential, commercial, and services) offer a more sustainable possibility of everyday dynamics (Warren, 1977), are more walkable (Choi, 2012), and therefore are in line with the 15-minute city approach (Balletto et al., 2021).

"The variety of uses close by and the implied opportunities for serendipitous interaction may also make a neighborhood more interesting" (Walking the Walk, 2009:24)

5.3.1 Clusters of activity, monofunctional vs mixed areas

In all three cities, the highest concentration of different activities can be observed in the city centers. Isolated hot spots can be found in shopping malls and big-box stores as well as large urban-scale equipment such as railways and airports. The results of this metric can be found in Figure 6.

Oslo

- The highest concentration of different activities is in the city center.
- Activities are also concentrated along the main street corridors creating a cartwheel distribution with its radiuses meeting in the center. The density increases progressively towards the city center.
- The hub locations Filipstad and Alnabru are located in monofunctional areas (industrial without any proper cluster of other activities). But it must be considered that Filipstad is located at a walkable distance to the city center.
- The case study next to the Ski Station has its own cluster of activities due to the aggregation of services related to the shopping center, albeit with a much lower density in comparison to the city center.

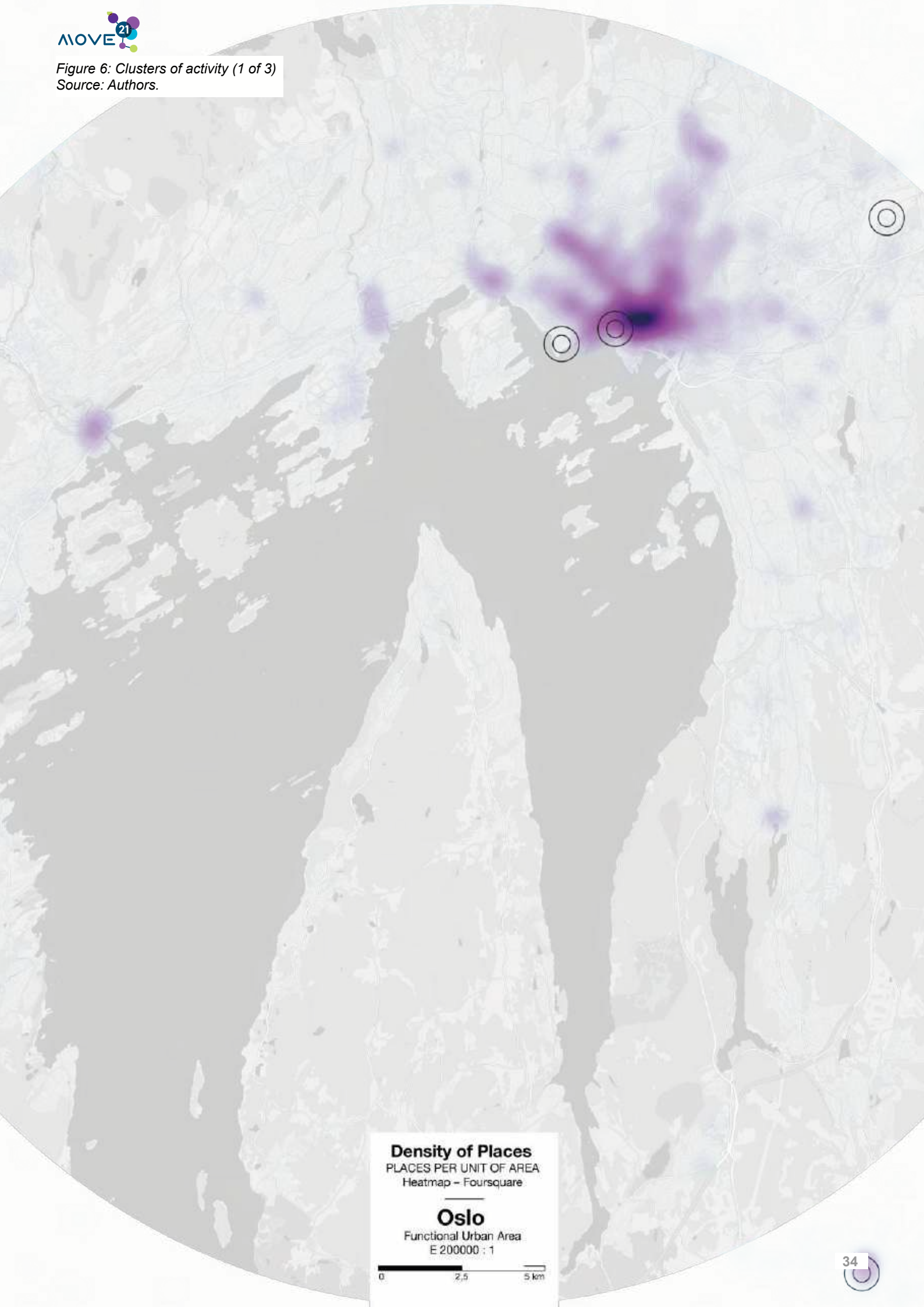
Hamburg

- The highest concentration of activities is in the city center between the north border of the river and the lake Alster.
- Hotspots can also be found on the intersection of the main roads, which also act as neighborhood centers (of smaller significance) thus creating a polycentric distribution of activities throughout the city. The most relevant sub-center is the old town of Altona (Ottensen and Altona Altstadt).
- Apart from the city center a high concentration of activities and clusters is observable in the centers of Altona, St. Pauli and Sternschanze. Three of the hub locations are located next to mixed areas and do benefit from the density in Altona and Sr. Pauli.
- The hub locations Schnackenburgallee und Osdorfer Born are located in monofunctional areas.
- A lack of activities is observable in the south of the city.

Gothenburg

- The highest concentration of activities is in the city center, at the south border of the river.
- The hub location Nordstan is directly located in the city center and benefits from this centrality and its cluster of activities.
- The other two case-studies Lindholmen and Jaegerdorf are located in more monofunctional and isolated areas.

Figure 6: Clusters of activity (1 of 3)
Source: Authors.



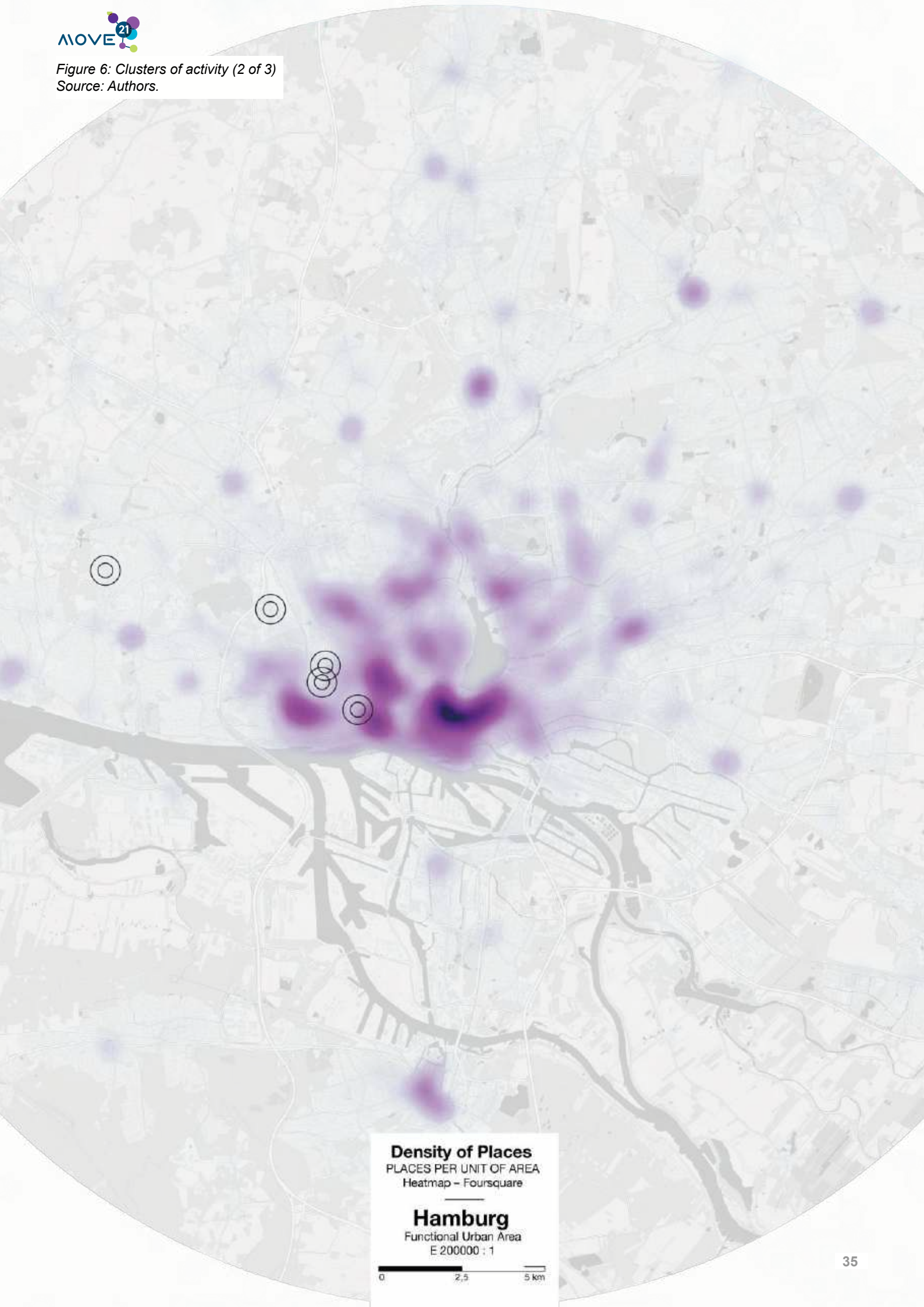
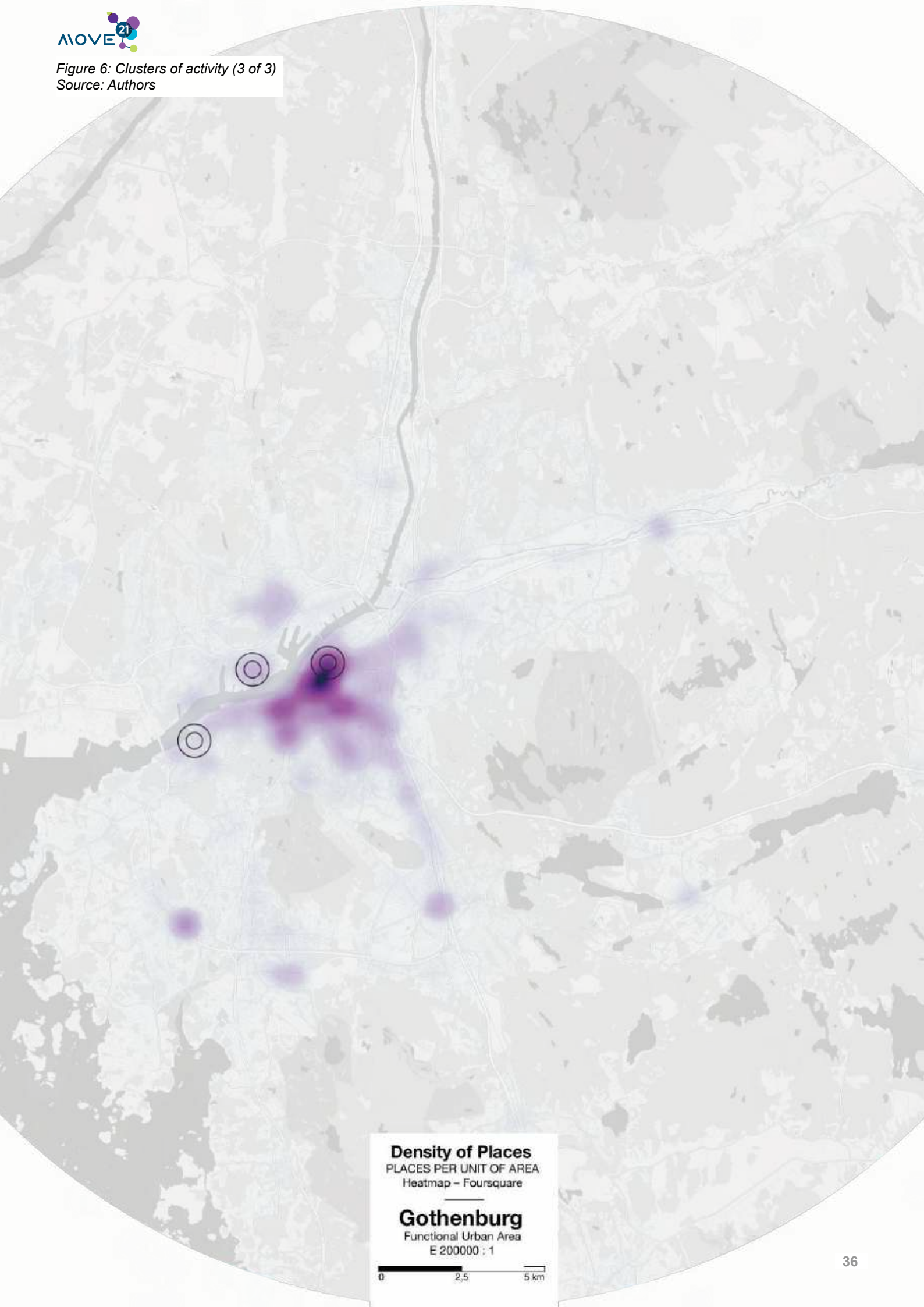


Figure 6: Clusters of activity (2 of 3)
Source: Authors.

Figure 6: Clusters of activity (3 of 3)
Source: Authors



5.3.2 Distribution of optional and necessary activities

Cerrone et al. (2018) deployed a methodology to classify places by the nature of the activities able to be performed in them, looking back at end-of-20th century urban research on activities by city users. They establish Optional – related to leisure, consumption, self-care, community, and social intercourse – and Necessary – related to workplaces, mobility, education, basic nutrition and healthcare – as two major spatial categories following Gehl's studies (2011).

Taking into account necessary and optional activities it is observable that necessary activities tend to be distributed in extensive areas, while optional activities tend to be concentrated in hotspots or along main shopping streets. Furthermore, there is a mismatch in the distribution of optional-necessary activities points towards the risk of functional segregation. A mix of optional and necessary activities is a good indicator for a vibrant surrounding.

Oslo

- Optional activities are concentrated in the city center and along the main corridors (cartwheel structure). The corridors are highly marked by the linear distribution of activities along them.
- In contrast, necessary activities tend to distribute in areas like industrial and logistic parks that appear as clusters of necessary activities as well as activities in the port.
- The city center hub has a good mix of optional and necessary activities. Filipstad has a low concentration of both, but the location is at a walkable distance from the city center.
- The location of Ski Station has more optional than necessary activities.
- The location of Alnabru has more necessary than optional activities.

Hamburg

- Similar to Oslo, necessary activities are distributed in areas while optional activities are concentrated in the intersection of main streets for each neighborhood, which highlights neighborhood centers in a polycentric system.
- The hub location of Holstenstraße has a higher number of optional than necessary activities. This distribution can be related to the fact that the hub is located next to the St. Pauli district, where leisure and social activities can be found.
- Schnackenburgallee has a higher concentration of necessary activities due to its commercial and industrial environment.
- For the other four hub locations, the distribution is relatively homogeneous.

Gothenburg

- Similar to the other two cases, necessary activities are distributed around areas while optional activities are concentrated in hotspots. In Gothenburg optional activities are concentrated in the city center and along the main streets, all of them along the southern border of the river. The necessary activities are concentrated towards the south of the city center, along the E6 highway and Johanneberg and Änggården university areas.
- The hub in Nordstan has a high density of both optional and necessary activities.
- The hub in Lindholmen has a higher concentration of necessary activities.
- The hub in Jaegerdorf has a low concentration of both optional and necessary activities.

Figure 7: Distribution of optional acticities (1 of 3)
Source: Authors

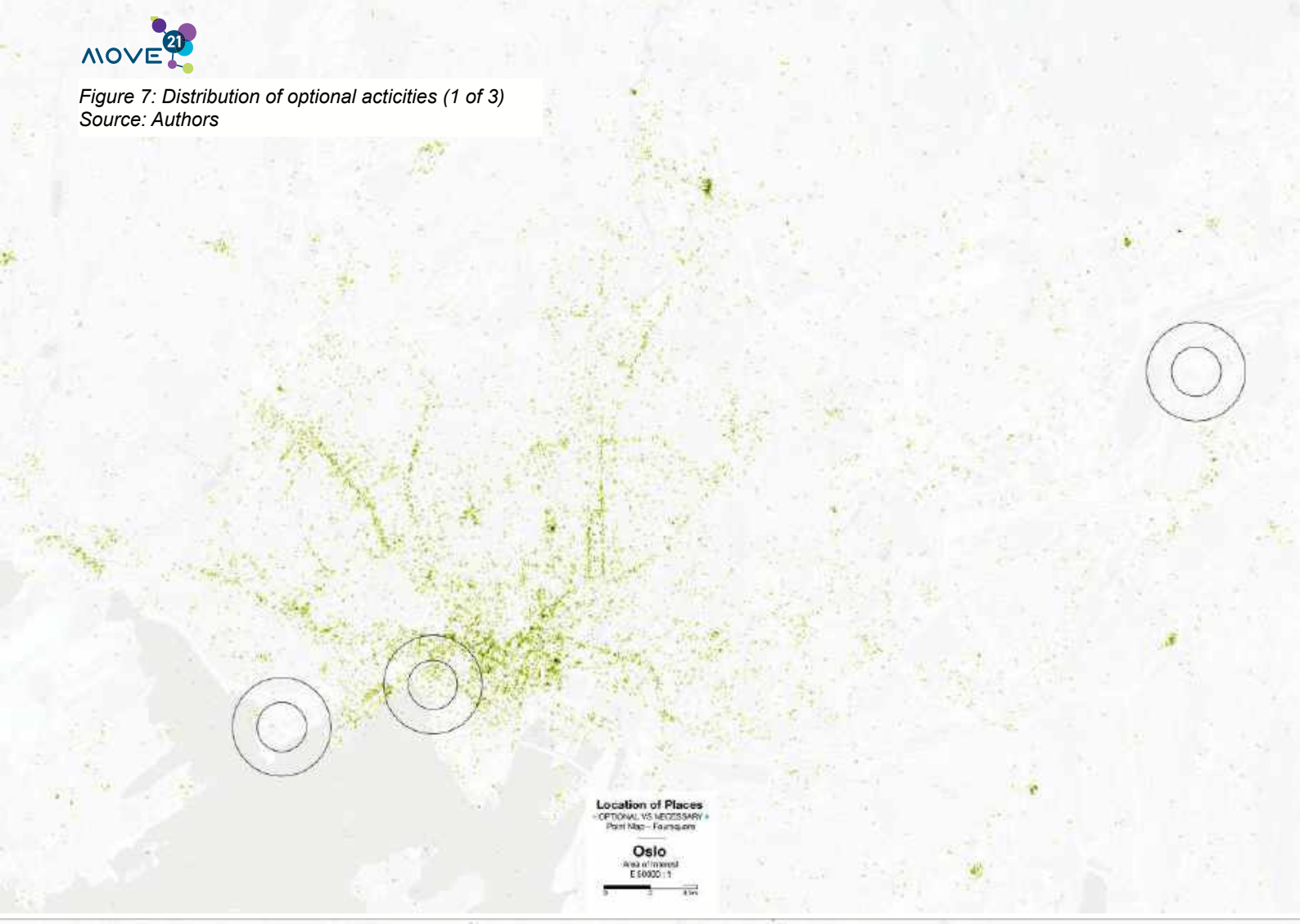
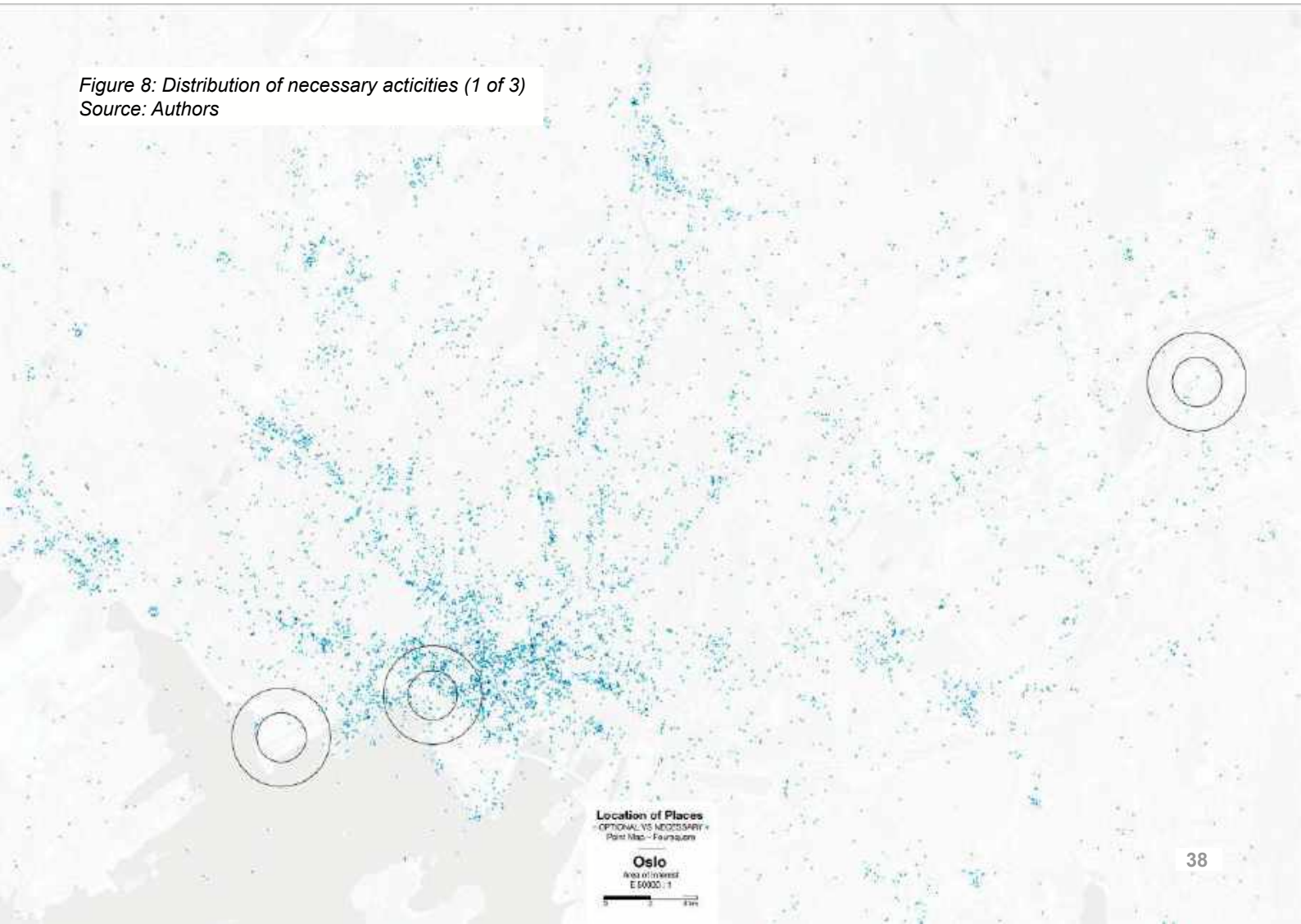


Figure 8: Distribution of necessary acticities (1 of 3)
Source: Authors



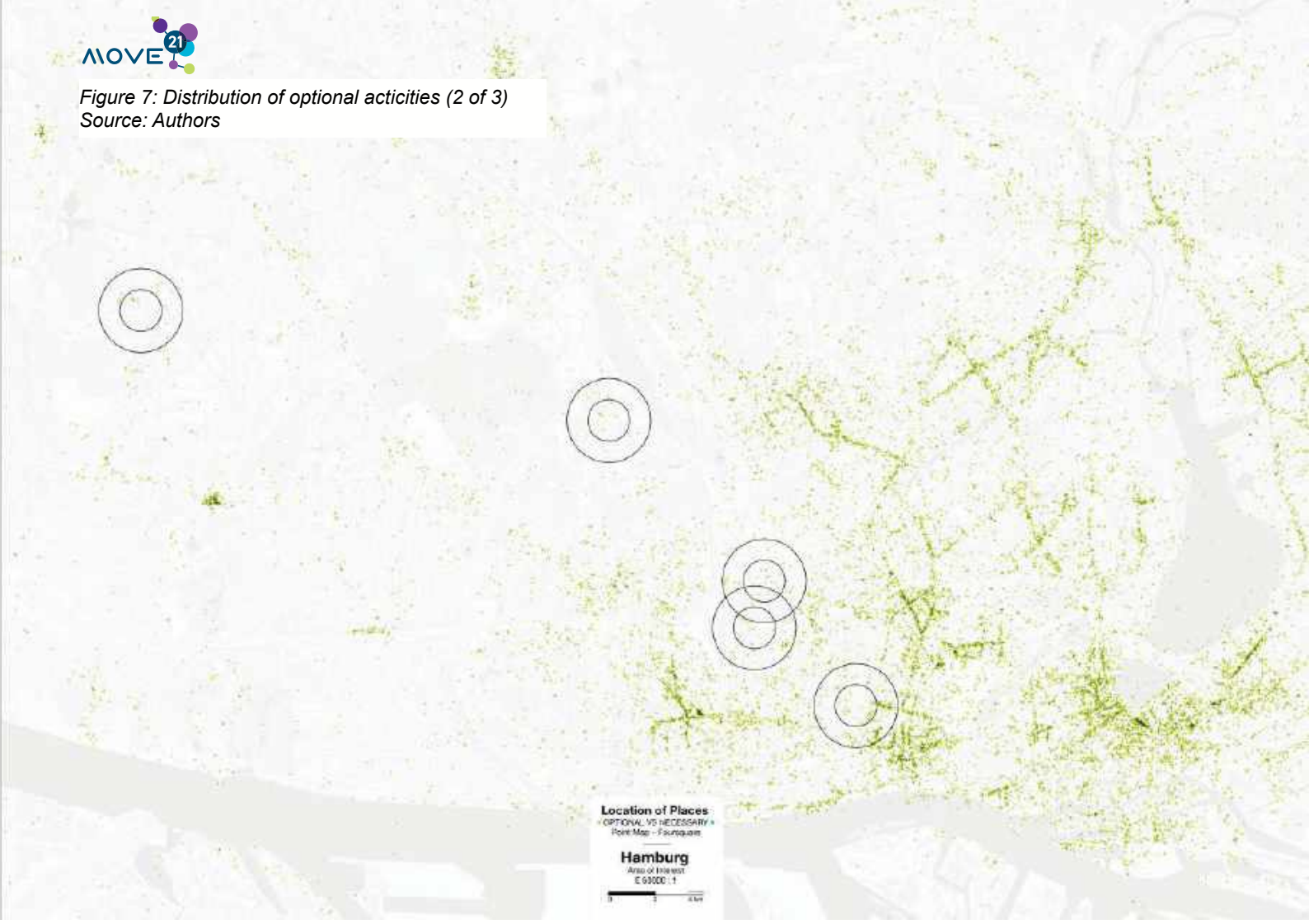


Figure 7: Distribution of optional acticities (2 of 3)
Source: Authors

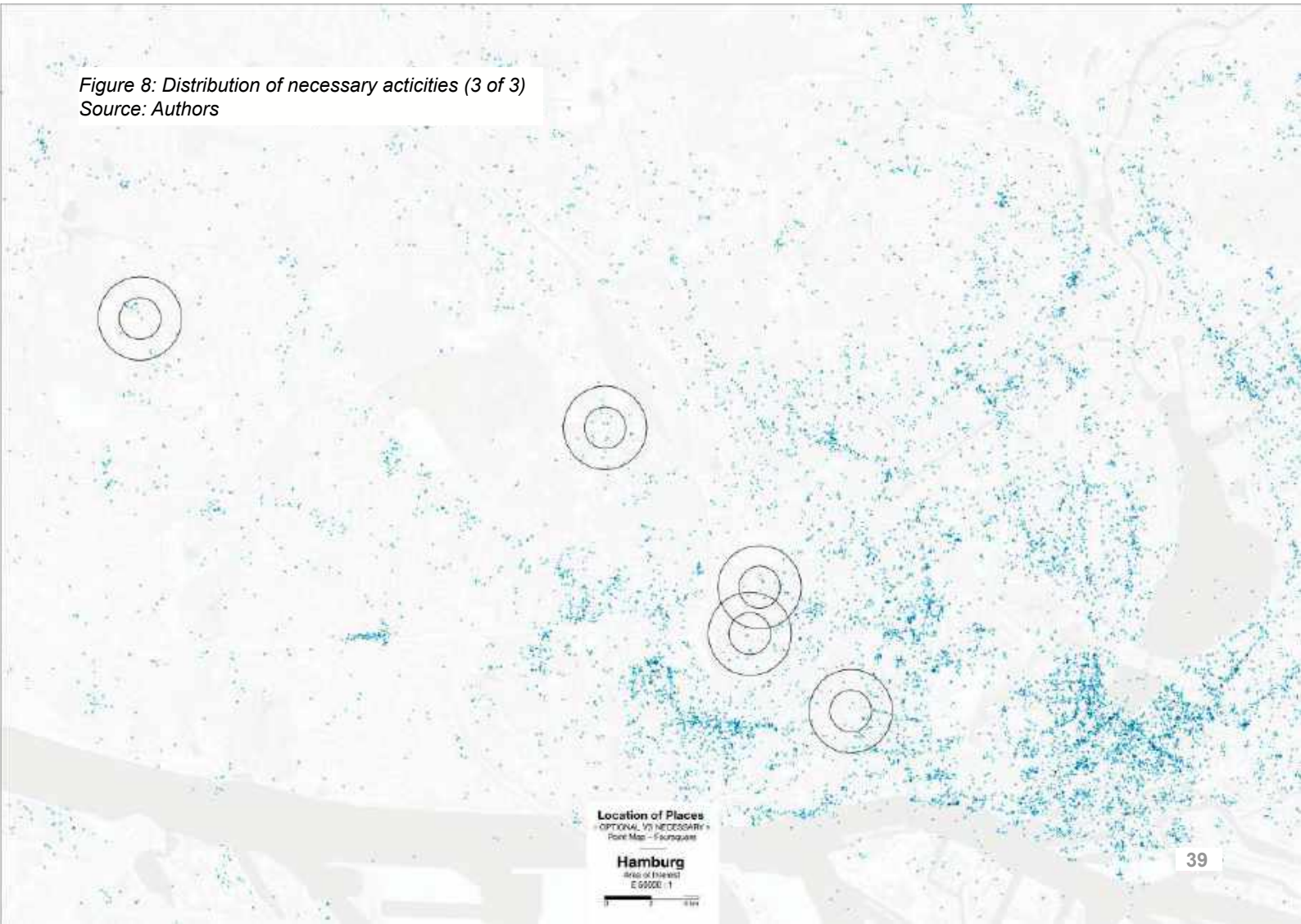


Figure 8: Distribution of necessary acticities (3 of 3)
Source: Authors

Figure 7: Distribution of optional acticities (3 of 3)
Source: Authors

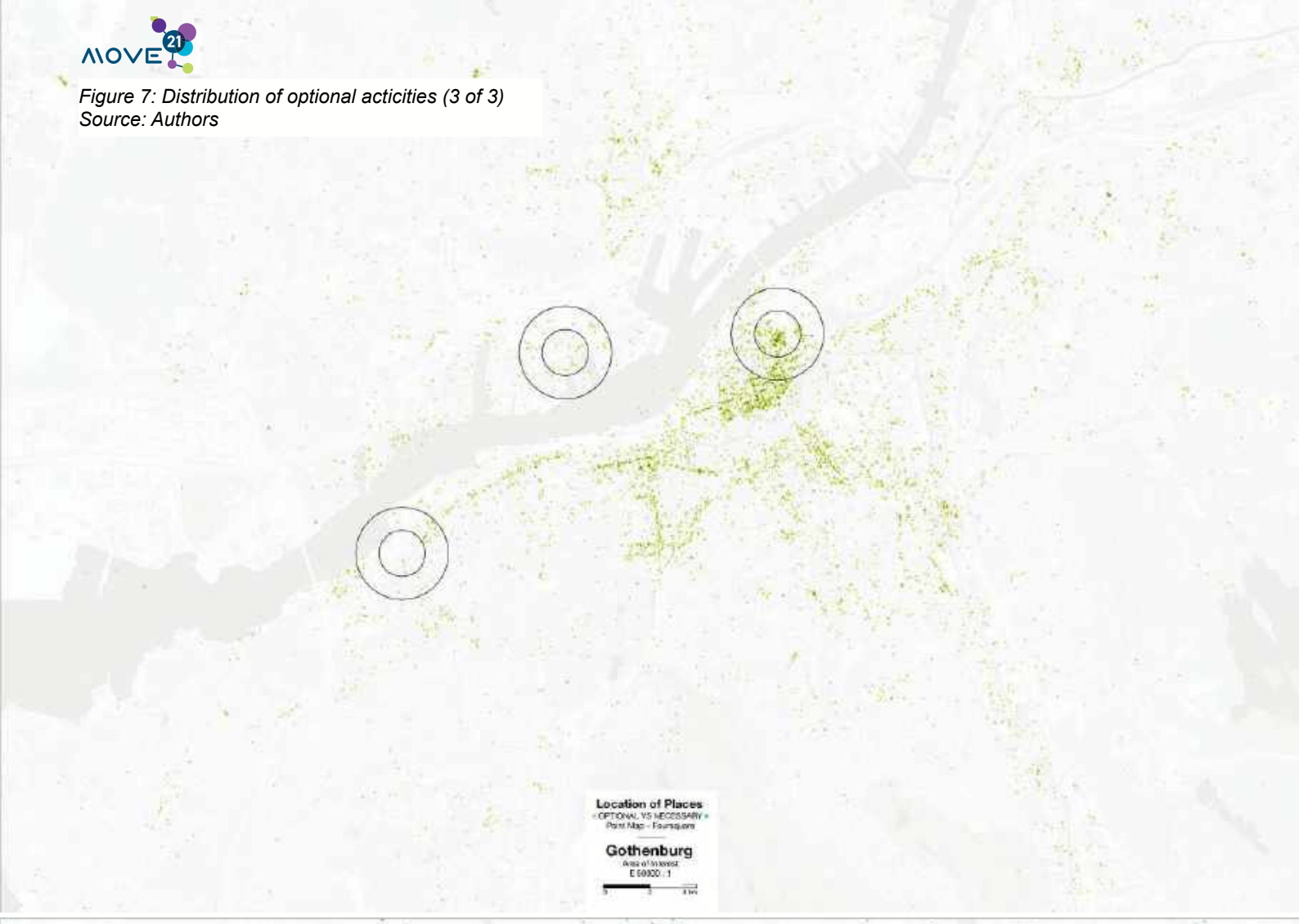
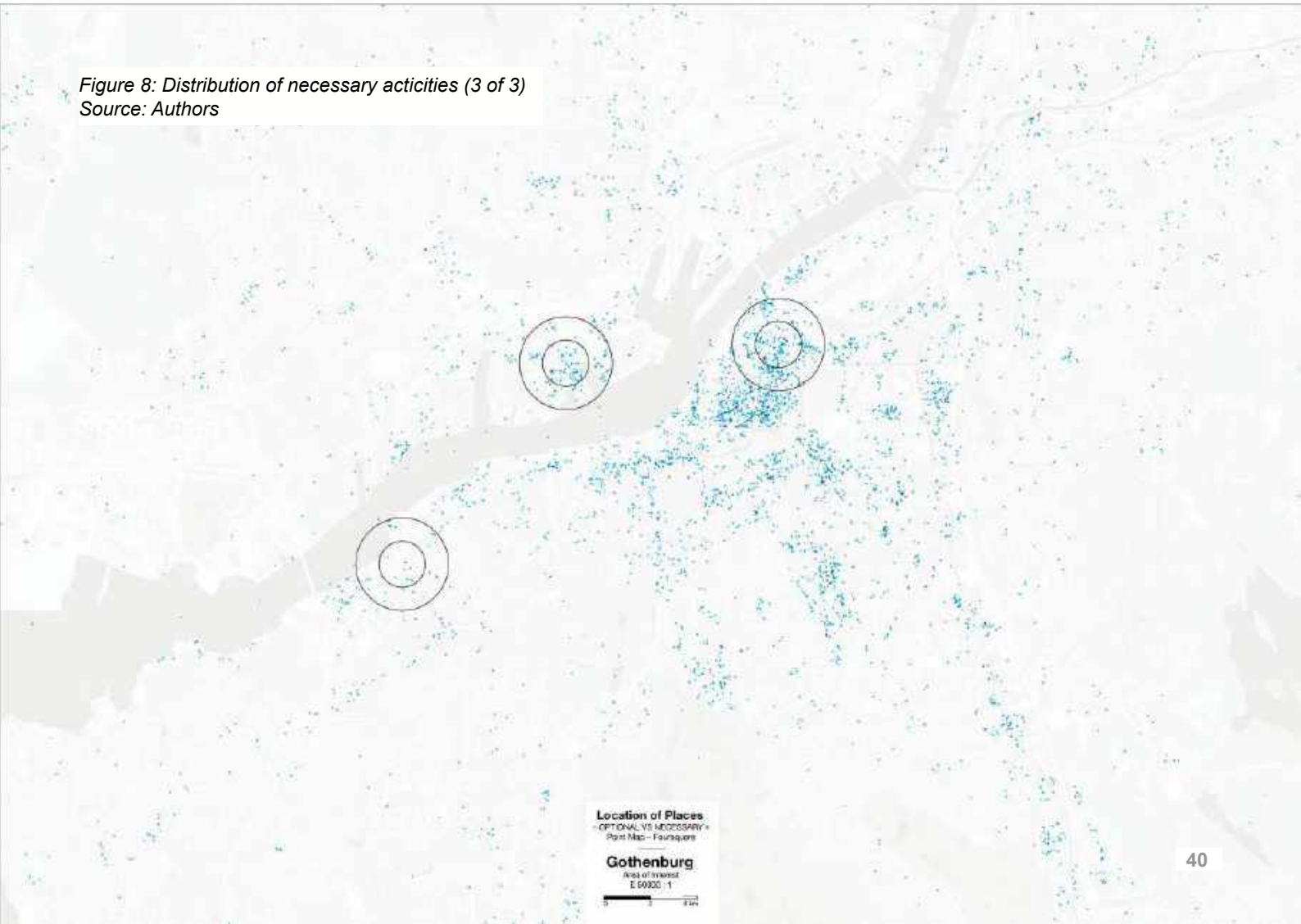


Figure 8: Distribution of necessary acticities (3 of 3)
Source: Authors



5.3.3 Distribution of activities by type

Optional places tend to be visited by a higher number of different persons than necessary places, which are generally linked to routine activities (e.g. take the subway, go to work, go to school) and therefore, the same users perform visits repeatedly. Consequently, a high mix of functions in one area would contribute to keeping the area active constantly throughout the day, avoiding congestion derived from usage peaks (Figures 9 to 12).

Oslo

- The city center presents a high diversity of activities of all kinds.
- Consumption activities are concentrated in the city center and the western part of Bogstadveien, Bygdøy allé, and Markveien. Shopping malls also present a high concentration of consumption activities, among which we find the area around the hub at Ski Station.
- Mobility-related services are mainly related to the central station in the city center, and the ferry stops at the port.
- Leisure and social activities are concentrated in the central area distributing gradually towards the north (between Gamle Aker and Rodeløkka). Social activities also gather around Grønland. The nightlife activities cluster around Hausmannskvartalene.
- The hubs in the city center and Filipstad are connected to a high diversity of activities.
- The hub in Alnabru is more connected to workplaces.
- The hub in Ski Station is connected to consumption and leisure activities at the shopping center, and presents an extensive residential surroundings that characterize a commuter city.

Hamburg

- There is a strong mismatch in the placement of different functions, pointing towards a distinct functional nature of each area.
- Consumption activities are located around the Altona train station, with particular emphasis along the streets and close to the intersections of Ottenser Hauptstraße - Bahrenfelder Str.
- Leisure and social activities are distributed around the area of Reeperbahn. Social activities can also be found southwest of the Altona station.
- The workplaces are mainly clustered around the center of the Ottensen area in the west, and the Hamburg Messe in the east.
- The hub location in Osdorfer Born has a low density of all kinds of activities.
- The hub in Holstenstrasse is very close to social and leisure activities related to the nightlife area at the west. It is also at a semi-walkable distance (800m) to consumption clusters at the northeast (Schanzenstraße) and the west (Ottenser Hauptstraße)
- The hubs in Schnackenburg Allee and Neue Mitte Altona present a low density but a reasonable mix of functions, as well as relative closeness (600m) to the workplace cluster in Ottensen and consumption activities towards the west.

Gothenburg

- Consumption activities are located in the city center and along the axis Första Långgatan–Norra Allégatan–Parkgatan.
- Strong educational clusters are around the two main universities and the Lindholmen hub area.
- Leisure and social activities are in the city center and towards the south of the area of Lorensberg. Social activities are also in the Masthuggets district and towards Olivedal. Nightlife areas are grouped in clusters along Andra Långgatan, and the area between Lorensberg and Vasastaden.
- Workplaces are mainly in the city center and Lindholmen.
- Mobility activities cluster around the central station.
- The hub in Nordstan has a high density and diversity of activities.
- The hub in Lindholmen is connected to education and workplaces, it is potentially an innovation and start-up environment.
- The hub in Jaegedorf has a low density of all activities with a slight turn toward the category of leisure-related activities in the north and south following the river border.

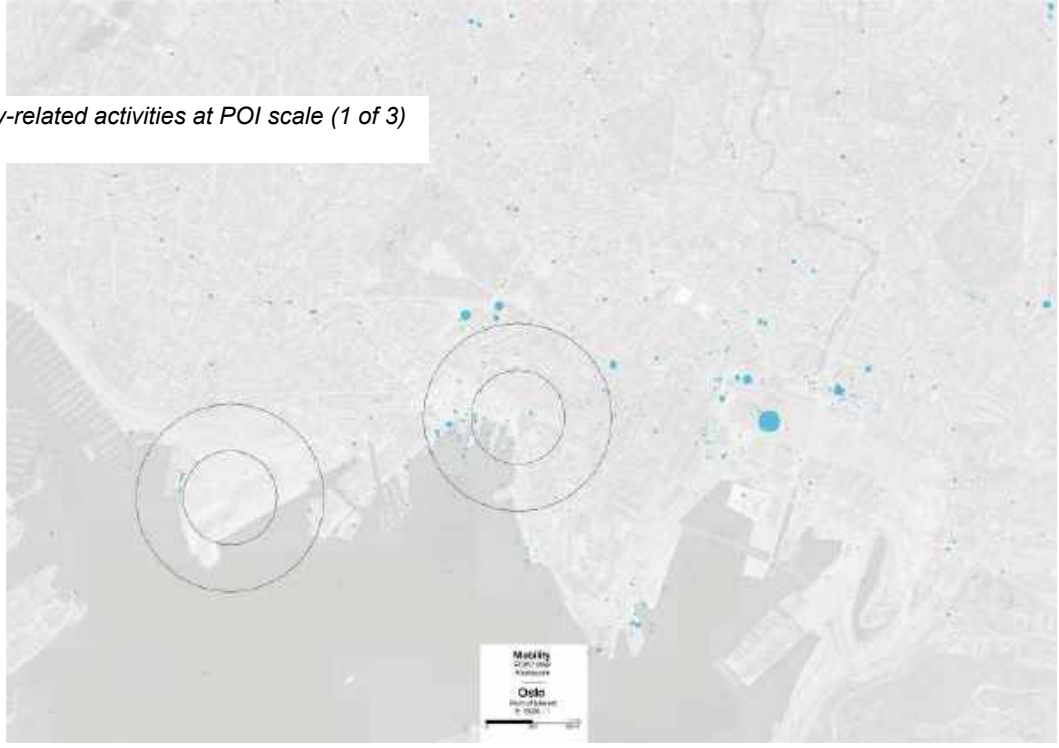


Figure 9: Mobility-related activities at POI scale (1 of 3)
Source: Authors

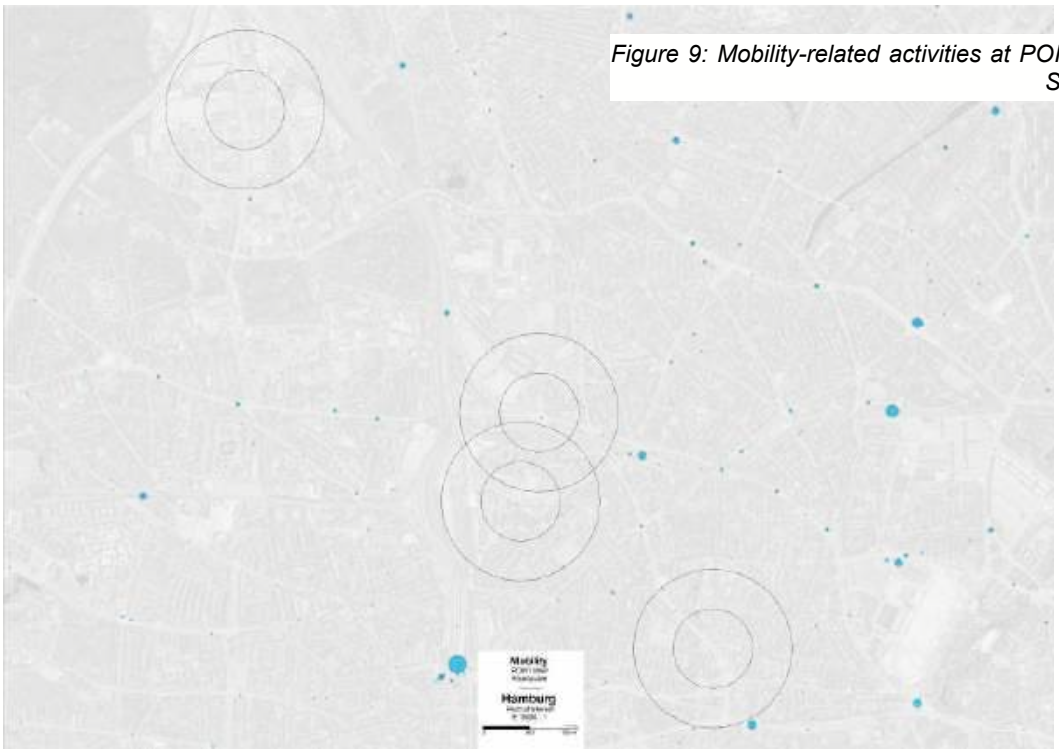


Figure 9: Mobility-related activities at POI scale (2 of 3)
Source: Authors

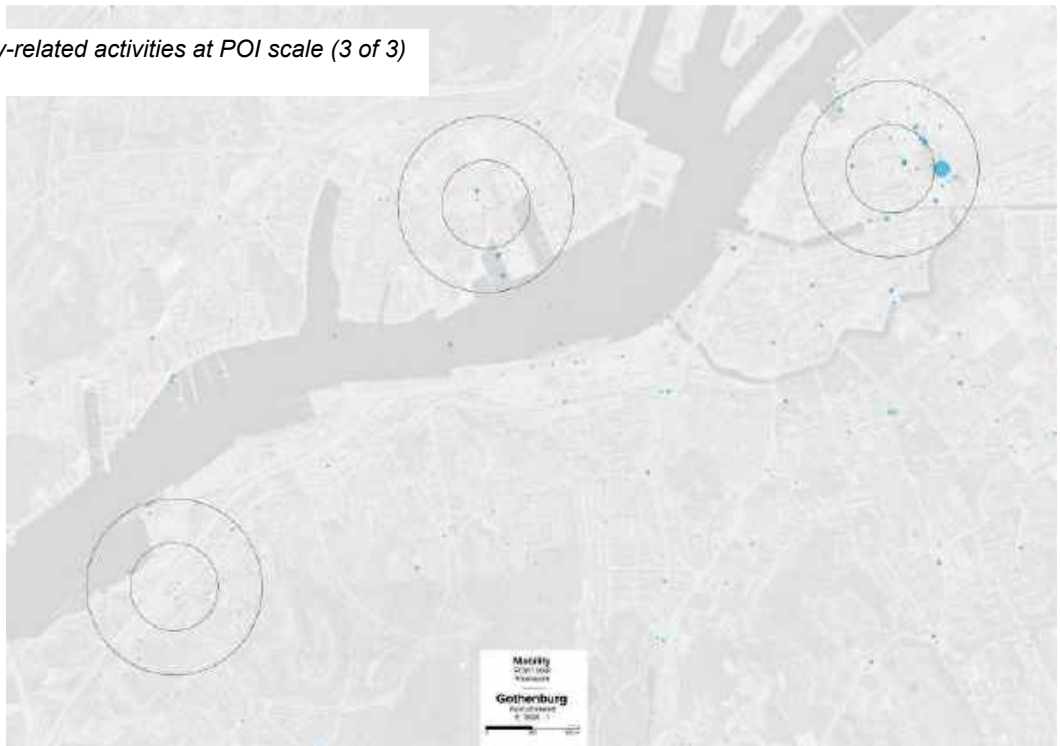


Figure 9: Mobility-related activities at POI scale (3 of 3)
Source: Authors

Figure 10: Consumption activities at POI scale (1 of 6)
Source: Authors

Figure 10: Consumption activities at POI scale (2 of 6)
Source: Authors

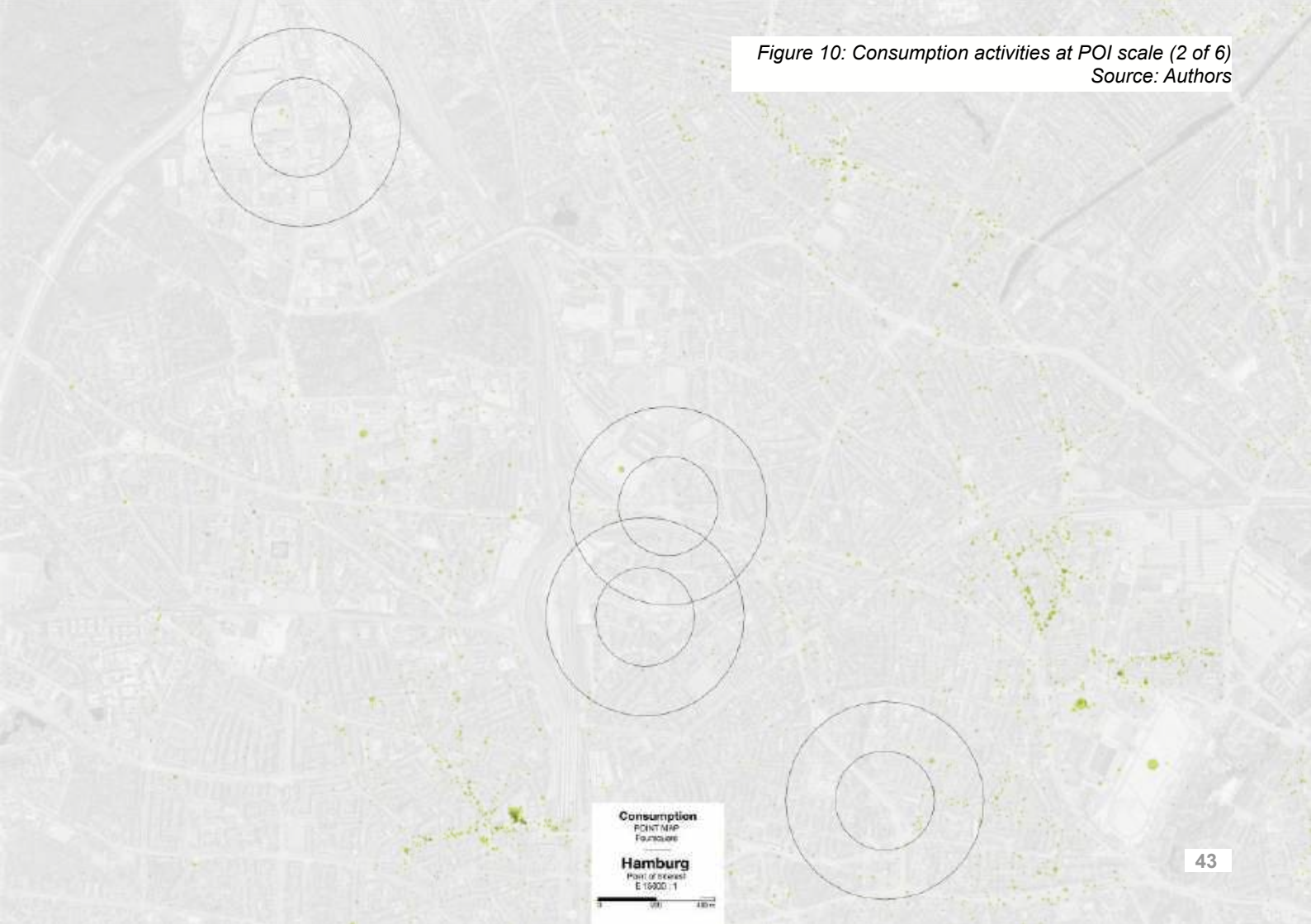


Figure 10: Consumption activities at POI scale (3 of 6)
Source: Authors

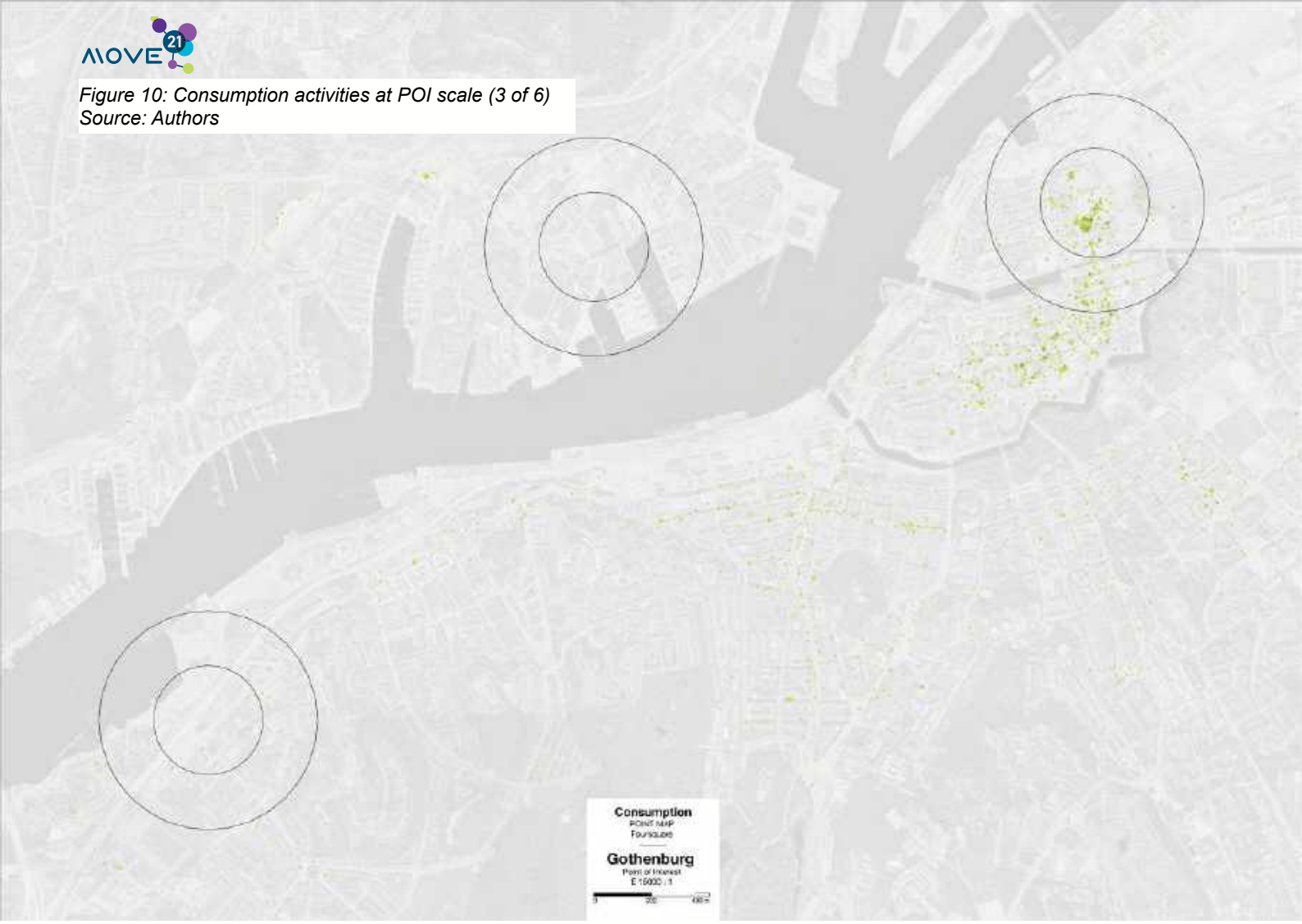


Figure 10: Consumption activities at POI scale (4 of 6)
Source: Authors

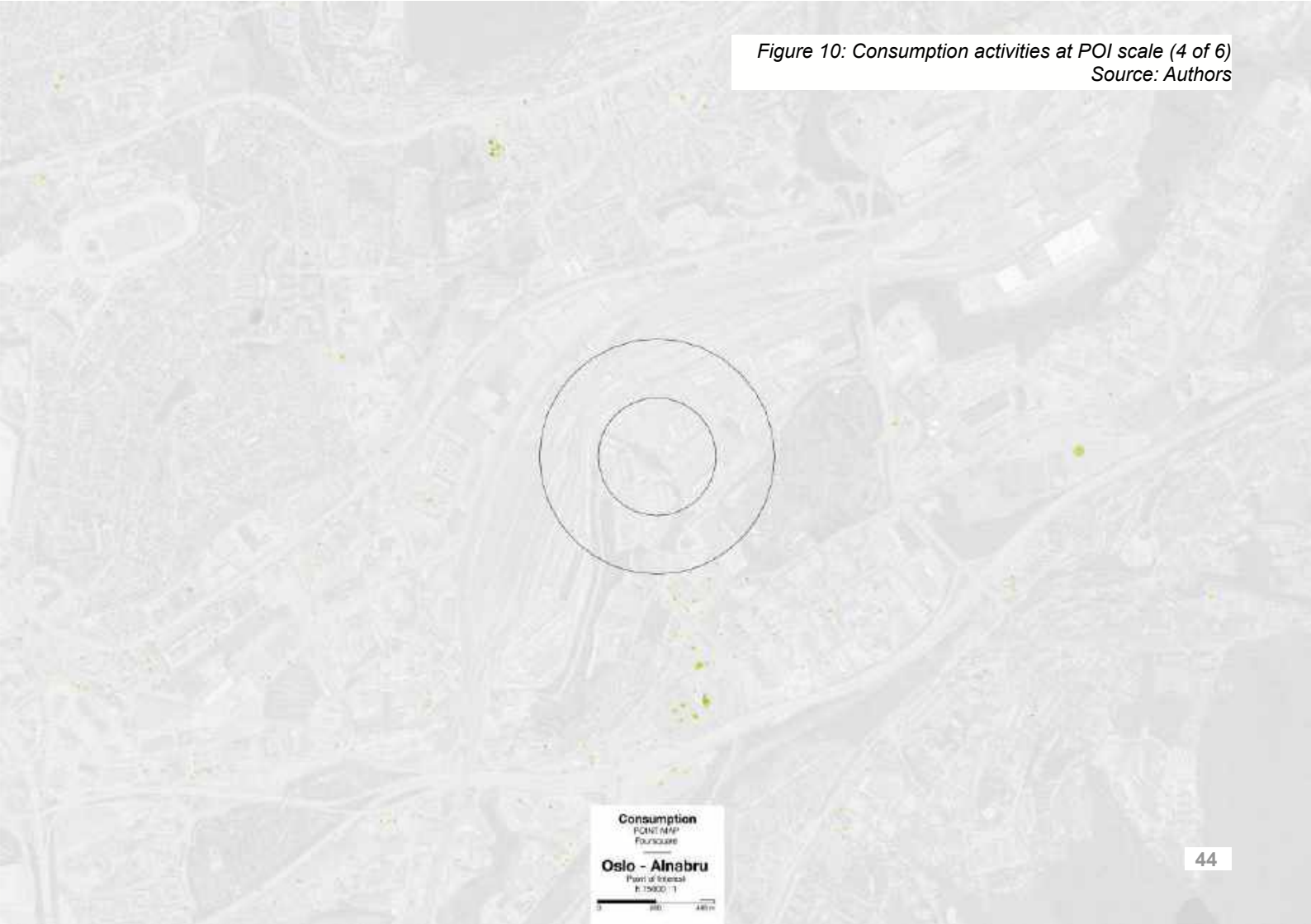


Figure 10: Consumption activities at POI scale (5 of 6)
Source: Authors

Figure 10: Consumption activities at POI scale (6 of 6)
Source: Authors

Figure 11: Workplaces and offices at POI scale (1 of 6)
Source: Authors

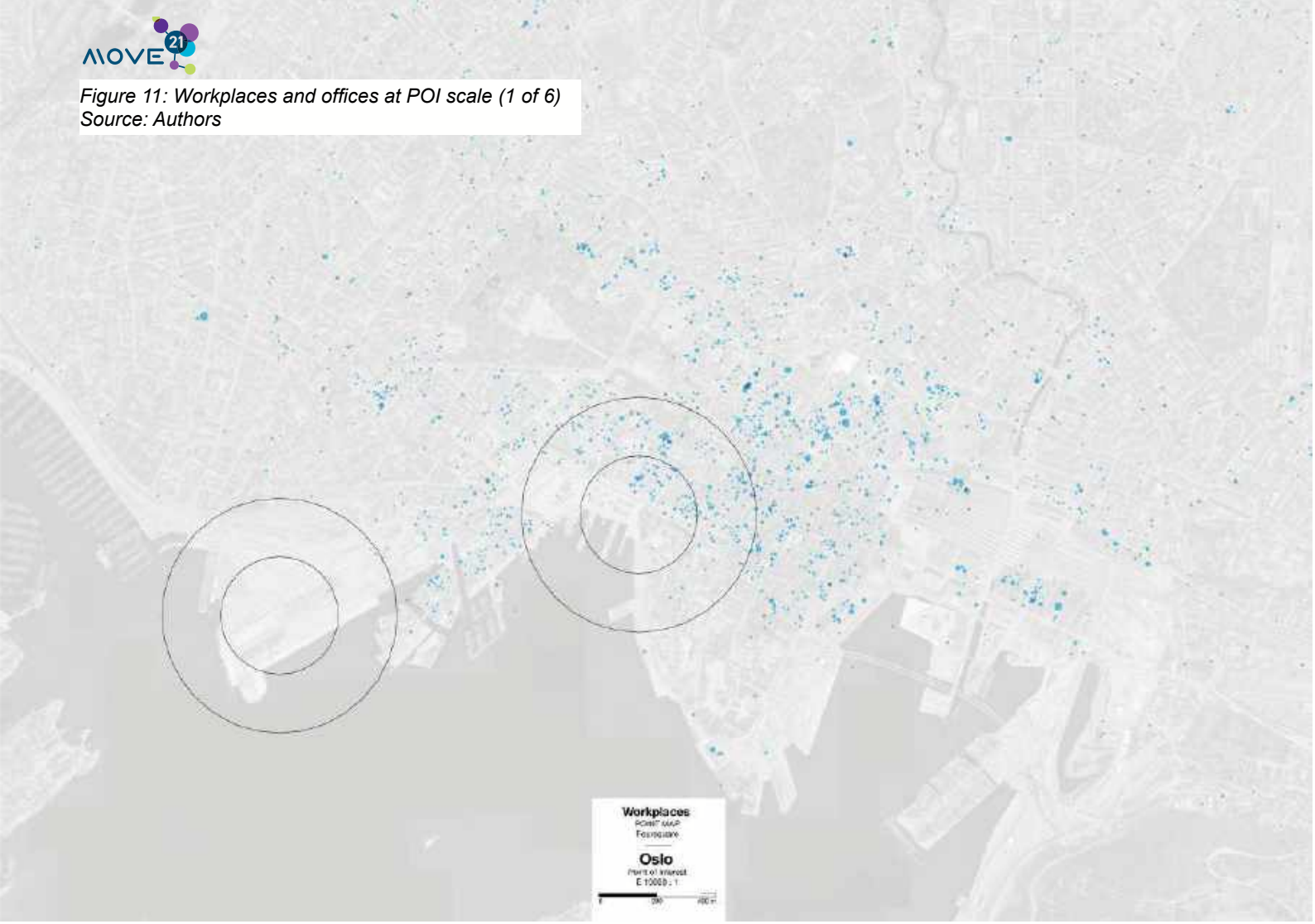


Figure 11: Workplaces and offices at POI scale (2 of 6)
Source: Authors

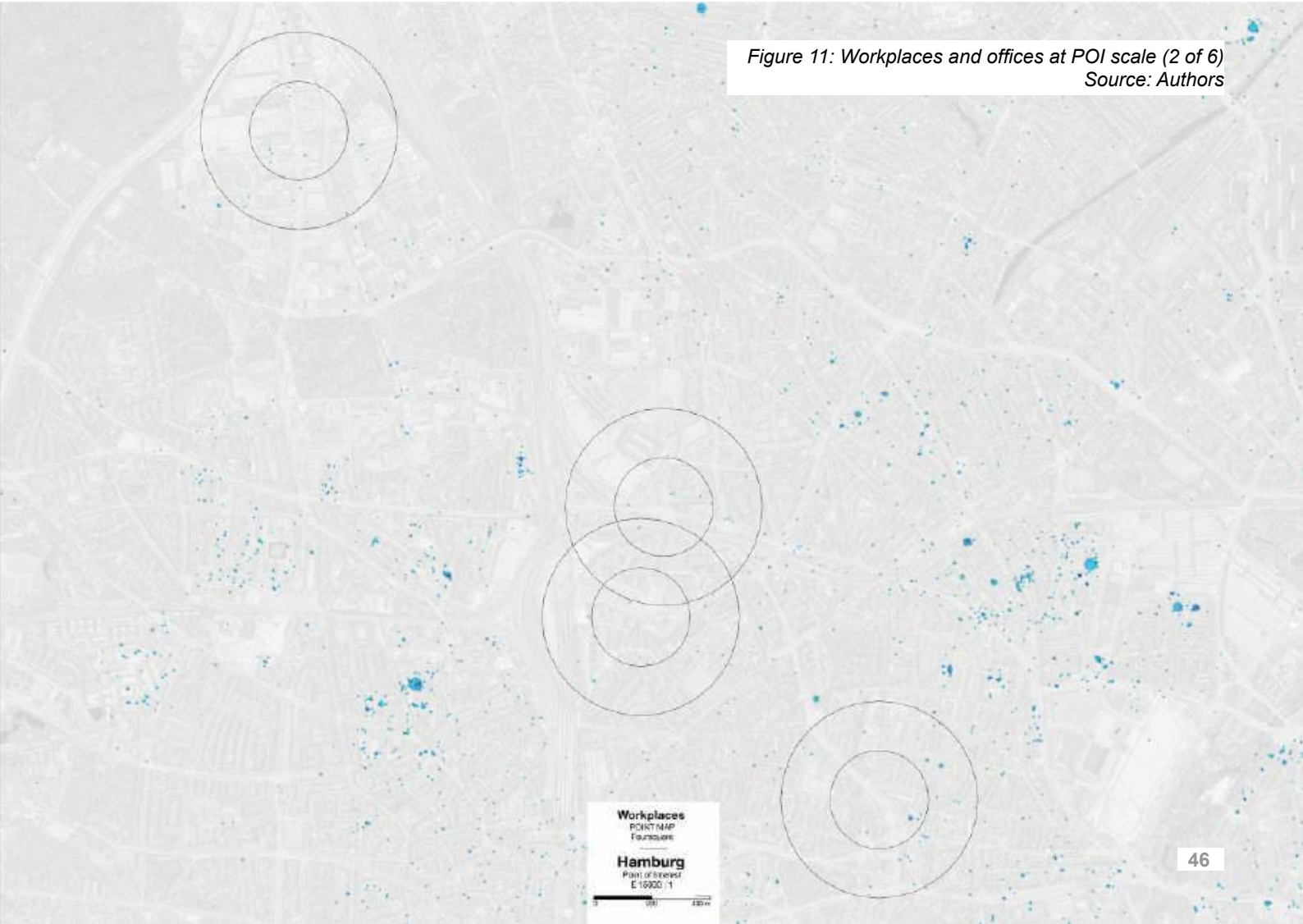


Figure 11: Workplaces and offices at POI scale (3 of 6)
Source: Authors

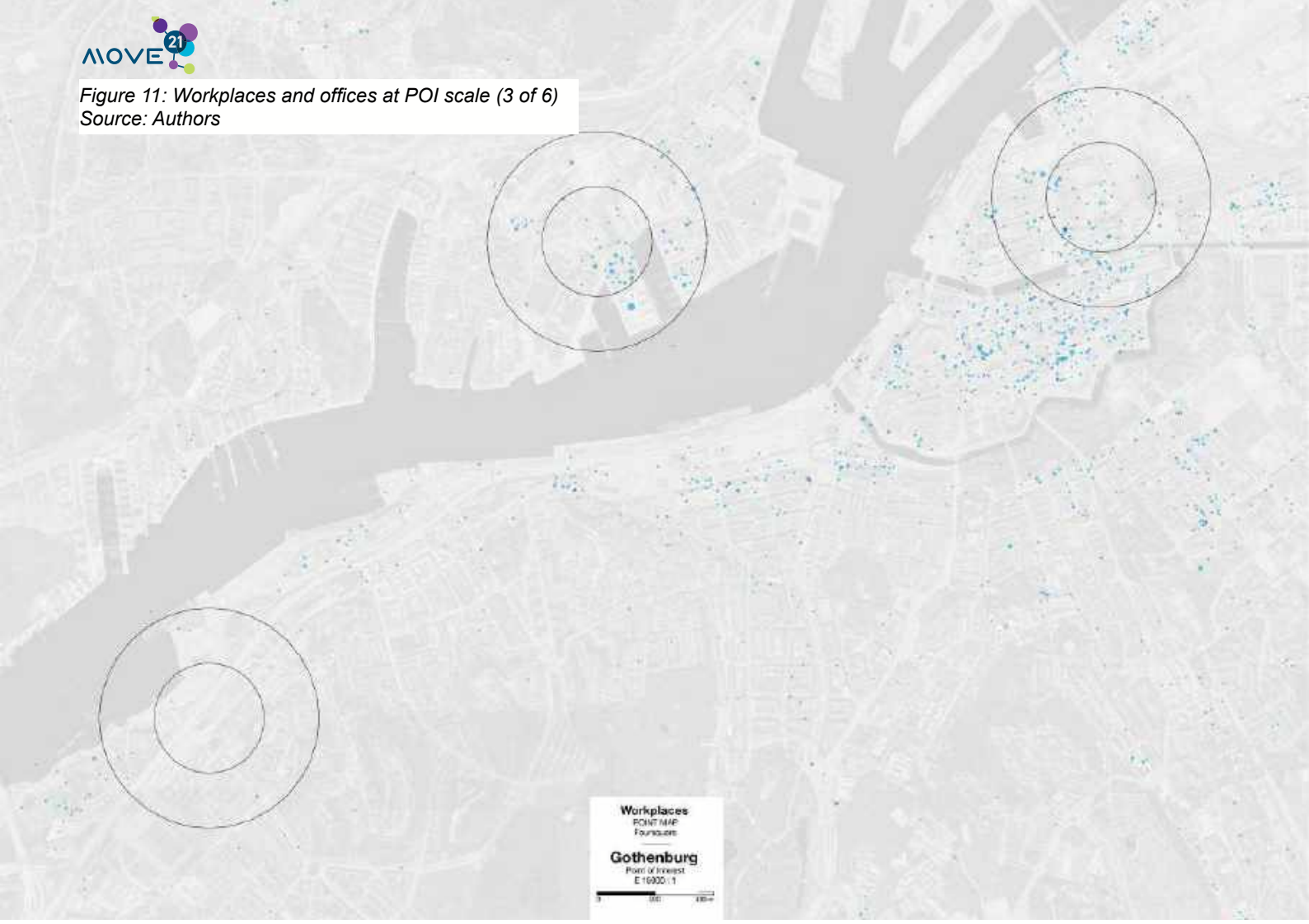


Figure 11: Workplaces and offices at POI scale (4 of 6)
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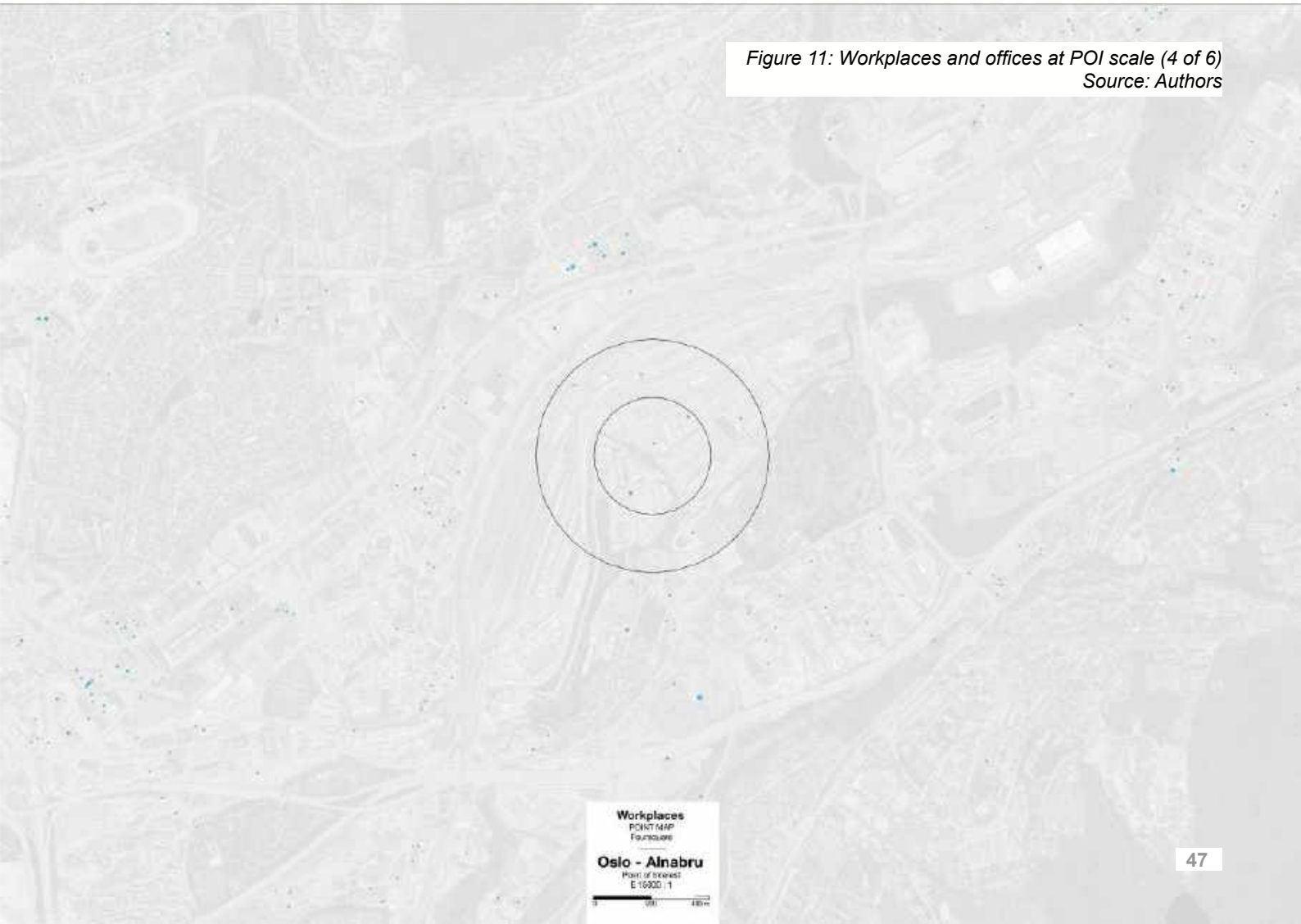


Figure 11: Workplaces and offices at POI scale (5 of 6)
Source: Authors

Figure 11: Workplaces and offices at POI scale (6 of 6)
Source: Authors

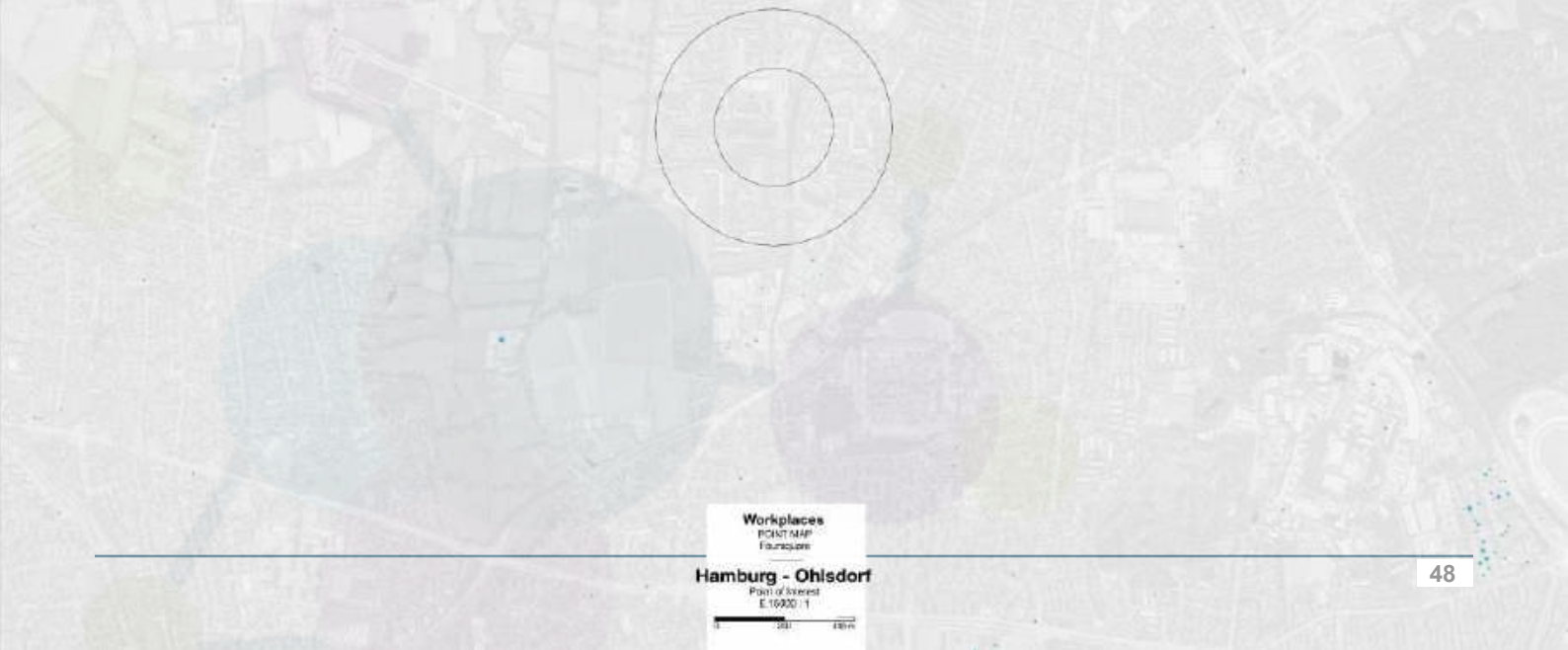


Figure 12: Social and Third Places at POI scale (1 of 6)
Source: Author

Figure 12: Social and Third Places at POI scale (2 of 6)
Source: Authors

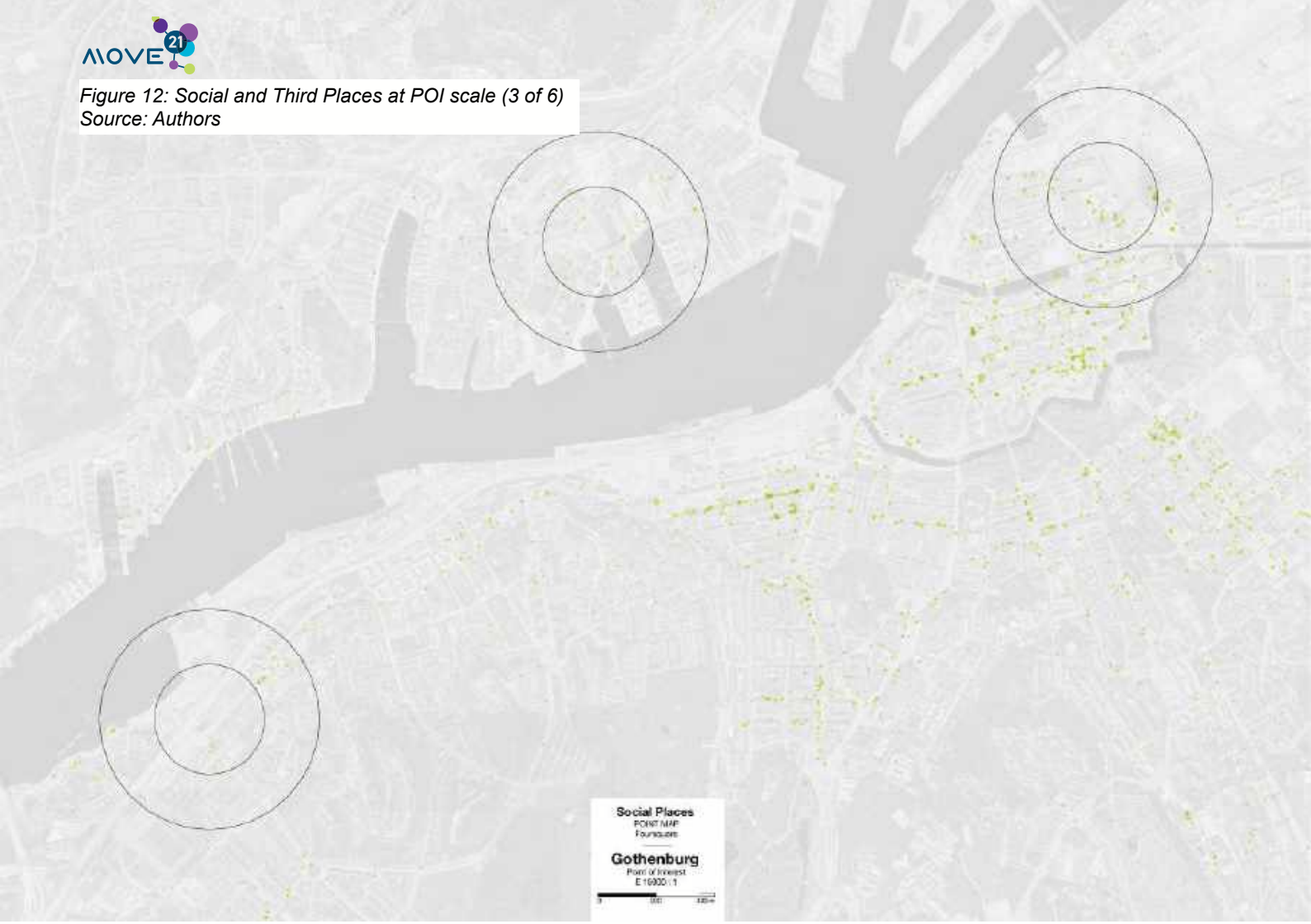


Figure 12: Social and Third Places at POI scale (3 of 6)
Source: Authors

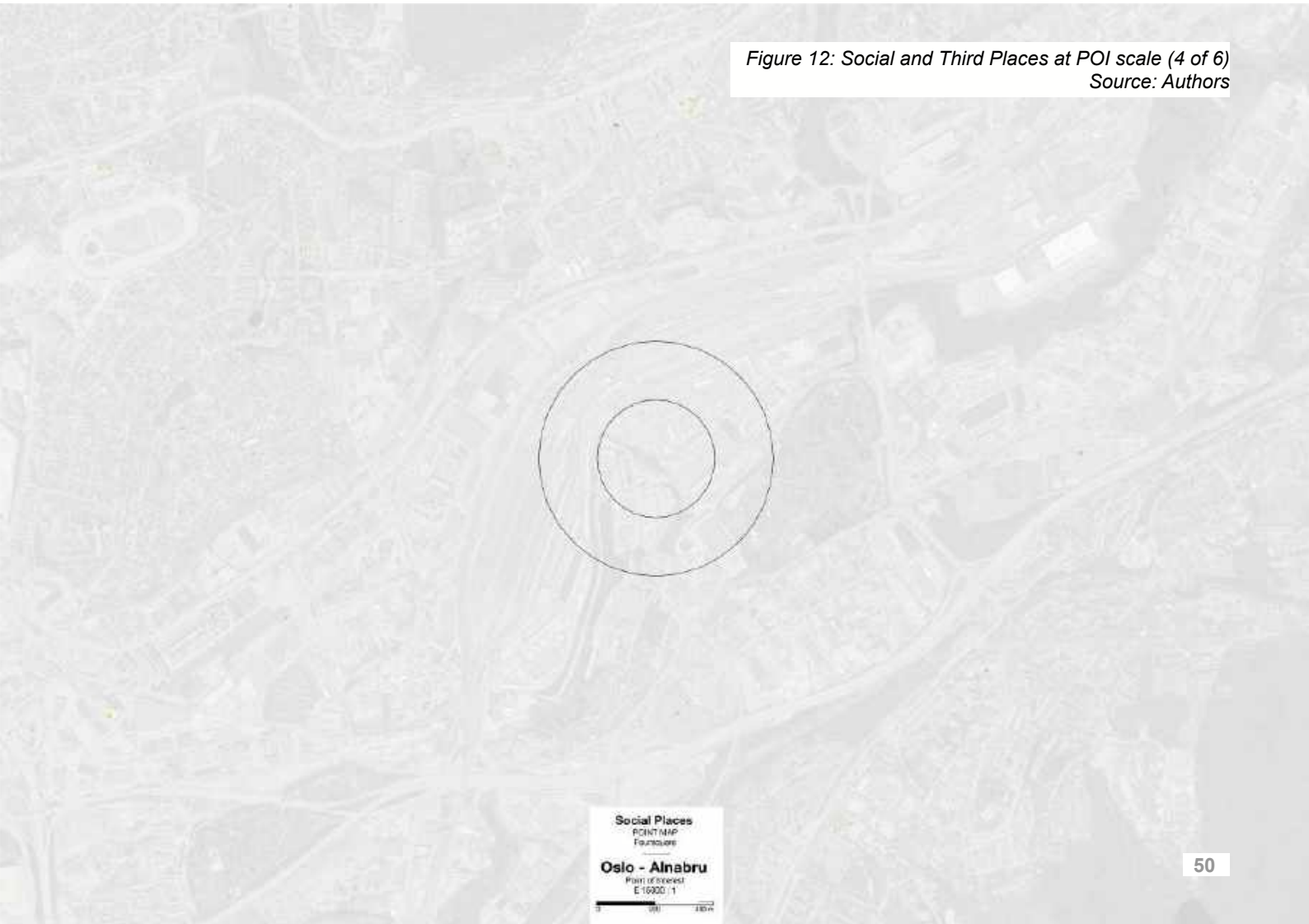


Figure 12: Social and Third Places at POI scale (4 of 6)
Source: Authors

Figure 12: Social and Third Places at POI scale (5 of 6)
Source: Author

Figure 12: Social and Third Places at POI scale (6 of 6)
Source: Authors

5.4 Socioeconomic Relevance

5.4.1 Clusters of popularity

Carpio-Pinedo and López Baeza (2021) implemented an automatic cluster calculation on Foursquare metadata to measure what they defined as 'impact of a venue of the socio-economic fabric' meaning that a higher impact of a place for the city would mean higher relevance, popularity, and likability for the place to be considered a landmark. One of the key values in their analysis is the number of 'check-ins' defined as the number of times that the place has been visited, and the visit has been intentionally posted on the social network Foursquare – and/or Swarm. Deliberate broadcasting of locations is understood as a potential manifestation of the contribution of the place to the generation of an individual's urban identity. The results of this metric can be found in Figure 13.

In general, it is observable that the popularity and density of places (5.3.1) are not distributed equally. Large mobility knots like airports and train stations concentrate a high number of visits in a single location and are therefore outstanding in all three cities. In the three cities, the most visited areas highlight the city center more strongly than the distribution of density (city center plus axes or poly-center).

Oslo

- The most popular areas are the city center (including Aker Brygge) and the area towards the north around Olaf Ryes Plass.
- The hub near the city center is within one of the most popular areas. Filipstad is in an area with a low number of visits but is walkable from the city center.
- Ski Station and Alnabru have a low number of visits.

Hamburg

- The most popular area is Hamburg city center, with secondary-level cluster Sternschanze and Altona/ Ottensen.
- Holstenstrasse, Neue Mitte, and Hartkorstrasse are near secondary-level popularity clusters, but with a low number of visits at a short distance.
- The locations of Osdorfer Born and Schnackenburg Allee have a low number of visits.

Gothenburg

- The main popular areas are in the city center and towards the southeast along Lorensberg and the northern part of Masthuggets district.
- The hub in Nordstan is in the most popular area.
- The location of Lindholmen is moderately popular.
- Jaegerdorf has a low number of visits.

Figure 13: Density of visits at AOI scale (1 of 3)
Source: Author

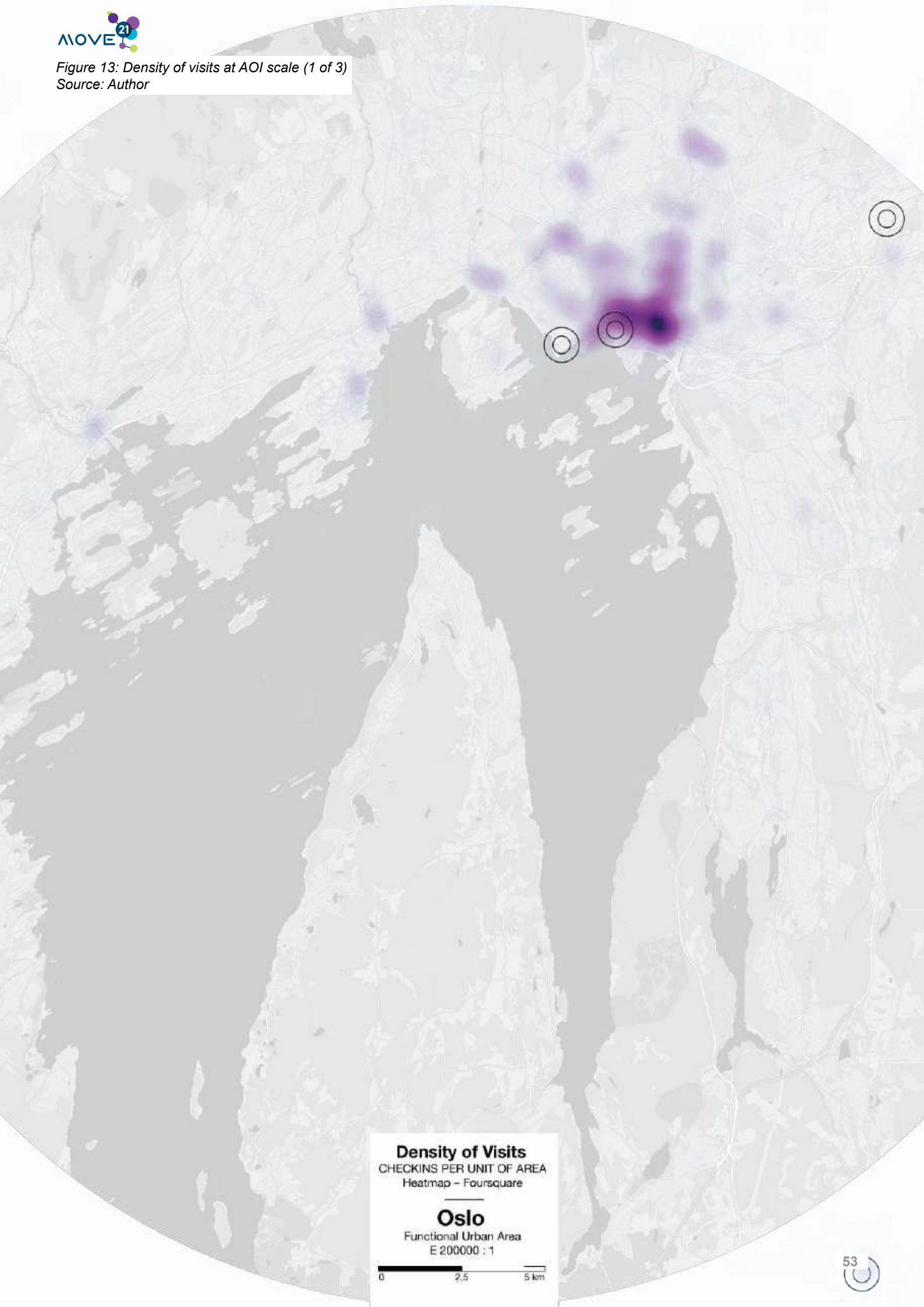


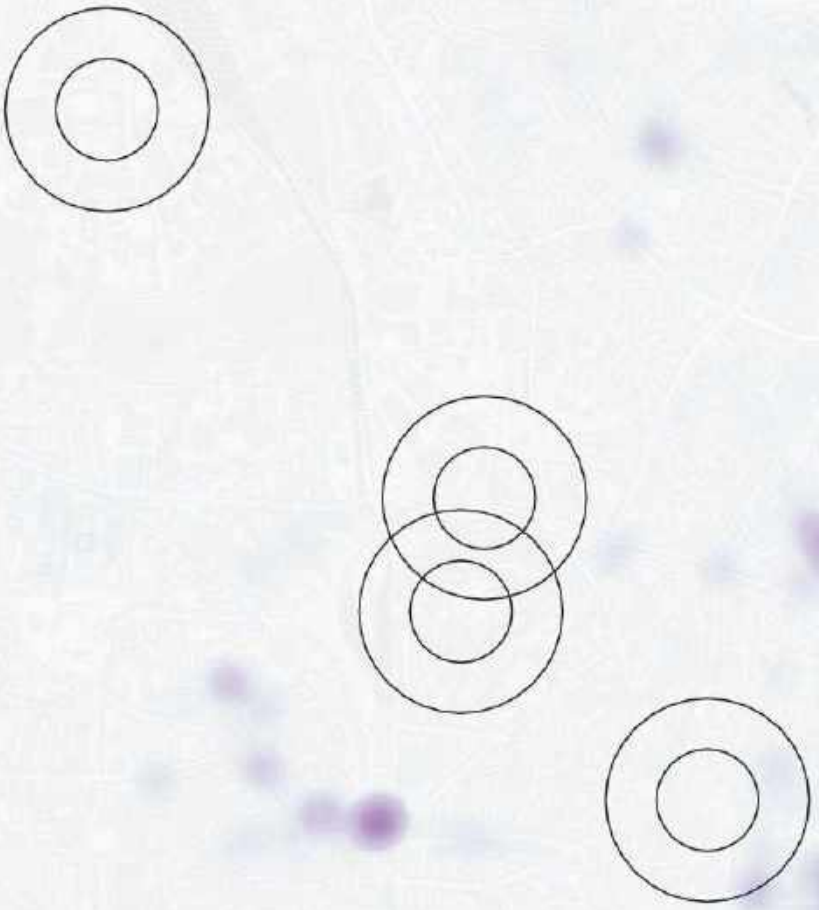
Figure 13: Density of visits at AOI scale (2 of 3)
Source: Author

Density of Visits
CHECKINS PER UNIT OF AREA
Heatmap – Foursquare

Gothenburg
Area of Interest
E 50000 : 1

0 2 4 km

Figure 13: Density of visits at AOI scale (3 of 3)
Source: Author



5.4.2 The popularity of optional and necessary activities

After plotting every venue by the number of aggregated check-ins (intentionally registered visits) received in time (X-axis, Figure 14) and the number of different users visiting every place (Y-axis, Figure 14) – it can be observed how the point dispersion gradient points toward a higher relevance in fewer venues potentially perceived as landmarks, and lower numbers in a higher number of places. With the dataset utilized, five clusters are detected being Cluster 1 the one with the highest impact further from the X, Y origin (e.g., one would travel from anywhere in the city to visit them, one would acknowledge their existence) and Cluster 5 the one with lower relevance at an urban scale closer to the X, Y origin (e.g., small stores and services frequented by people in the surrounding streets).

Distinct trend lines can be calculated for optional and necessary activities showing the correlation between the overall number of visits and the number of different visitors. These tendencies constitute two distinct trend lines – Optional places tend to be visited by a higher amount of different persons and linked to exceptional practices such as leisure or tourism (closer to Y-axis). In contrast, Necessary places are generally linked to routine activities such as working, commuting, or studying (closer to the X-axis).

- The distribution of the overall number of places is very similar in the three cities, as well as the number of visits per category and per place on average overall (bar charts below graphs, Figure 14).
- However, Oslo and Gothenburg follow a very similar trend, while Hamburg follows a different one. This is due to the difference in the “overall number of visits” and the “different visitors” going to these places. Hamburg presents a lower variety of visitors (proportionally to the overall number of visits) in comparison to Oslo and Gothenburg. This means that the activities in Hamburg tend to be closer to the routine, as there are the same people performing the same activities over time. Oslo and Gothenburg, in contrast, present a higher variety of different people (Figure 14)
- In the three cities, consumption, leisure and social activities stand out in the number of places and number of times visited, followed by workplaces (in the number of places) and mobility (in the number of visits, due to the airports, ports, and central stations).

Oslo

- Alnabru´s most visited type of place is the workplace.
- Filipstad is known for its port-related facilities.
- The ski station has the highest number of visitors at the Train Station and the shopping mall.
- The city center (ZEZ) has a good mix and density of all categories.

Hamburg

- The main attractions in Hartkortstrasse are the open public spaces.
- The popular activities of Holstenstrasse are influenced by its proximity to the nightlife area of bars and clubs.
- Kaltenkirchener Platz has a mild mix of several activities of the social and leisure type.
- Osdorfer Born and Schakenburgallee present a low number of activities, being a shopping mall and a fitness center the highlight of the areas, respectively.

Gothenburg

- Jaegedorf has a low number of activities, being open spaces the highlight.
- Lindholmen’s most visited type of place is the workplace, followed by hotels.
- Nordstan has a good mix and density of all categories.

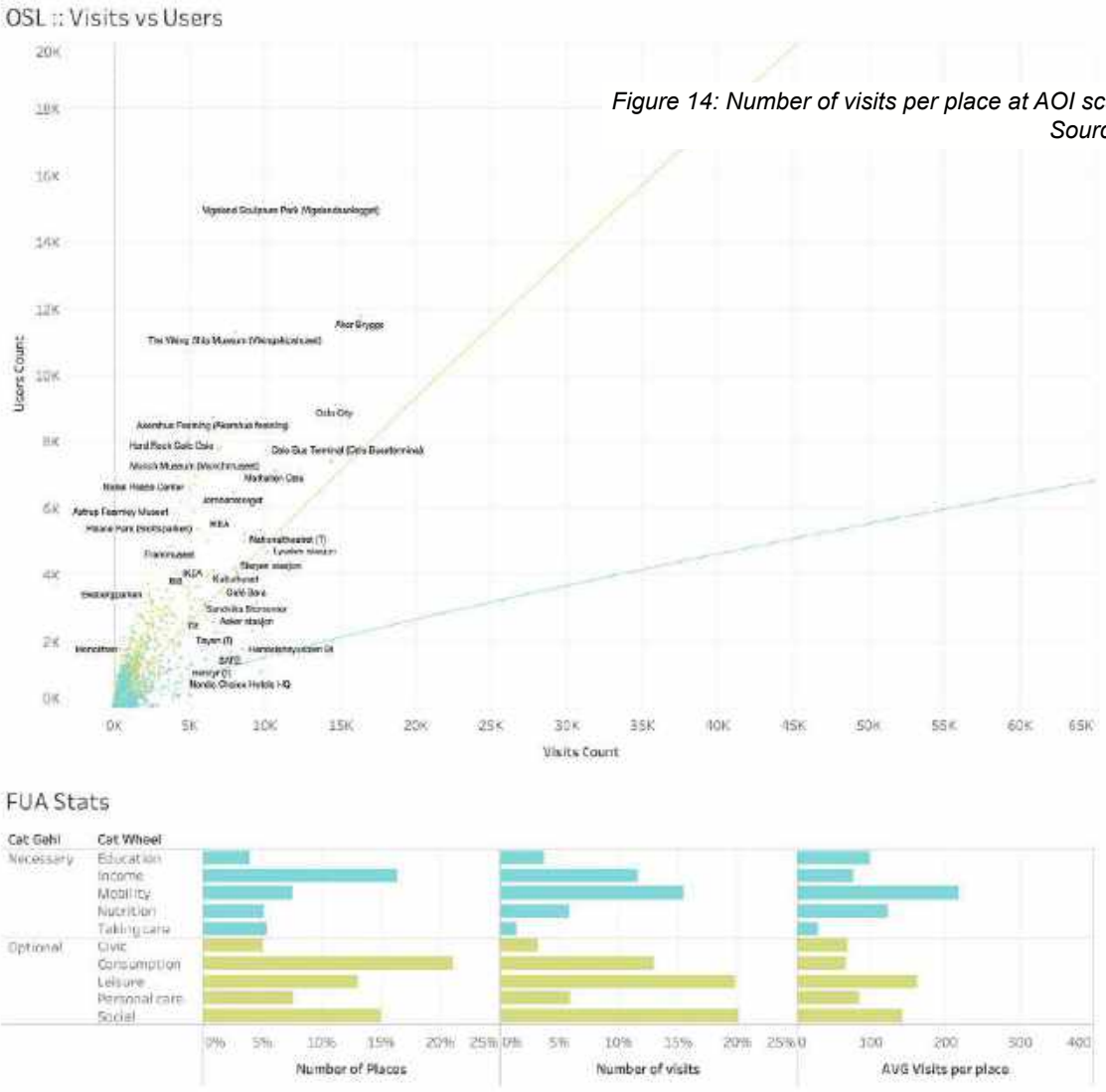


Figure 14: Number of visits per place at AOI scale (1 of 3)
Source: Authors

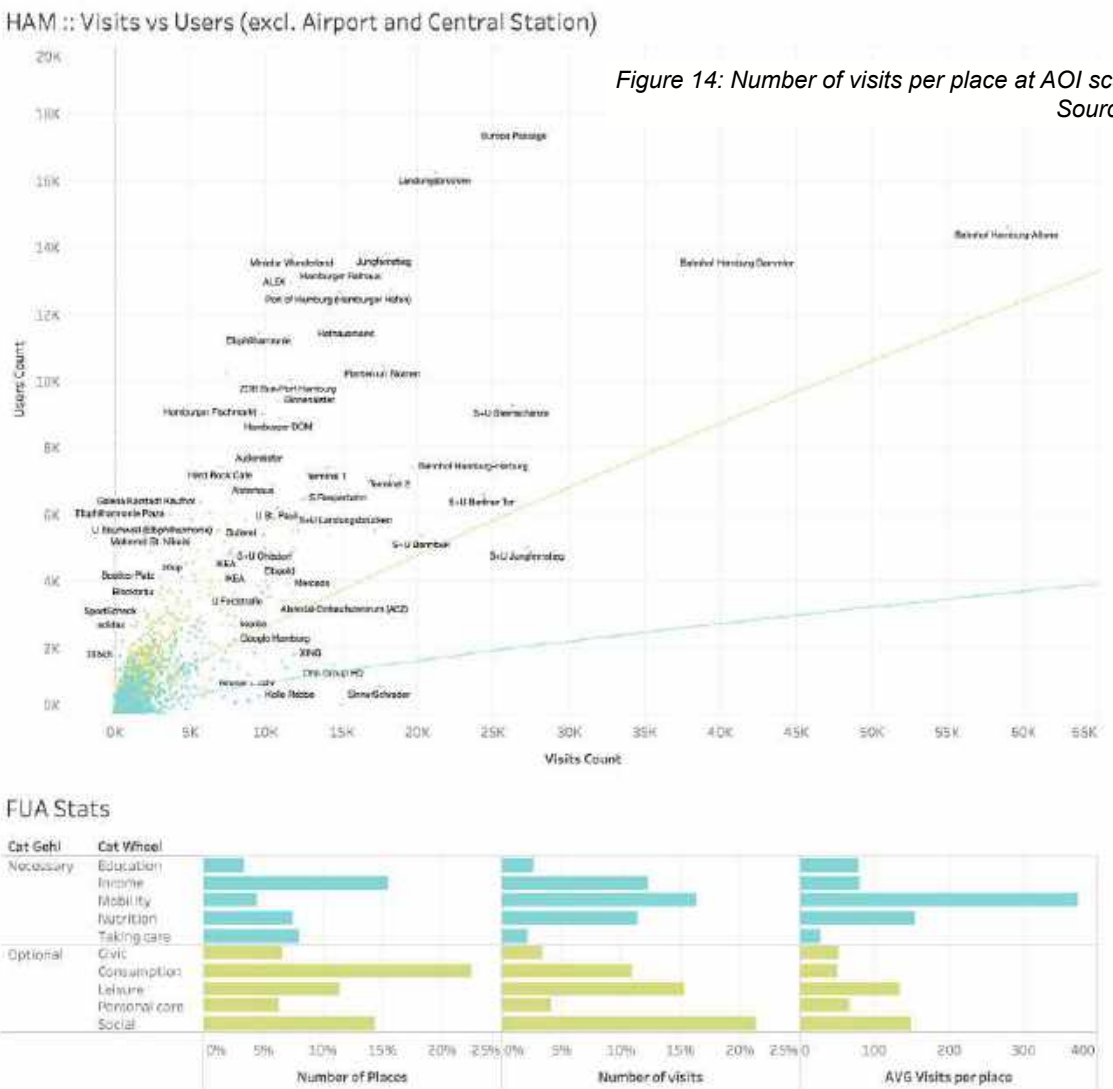


Figure 14: Number of visits per place at AOI scale (2 of 3)
Source: Authors

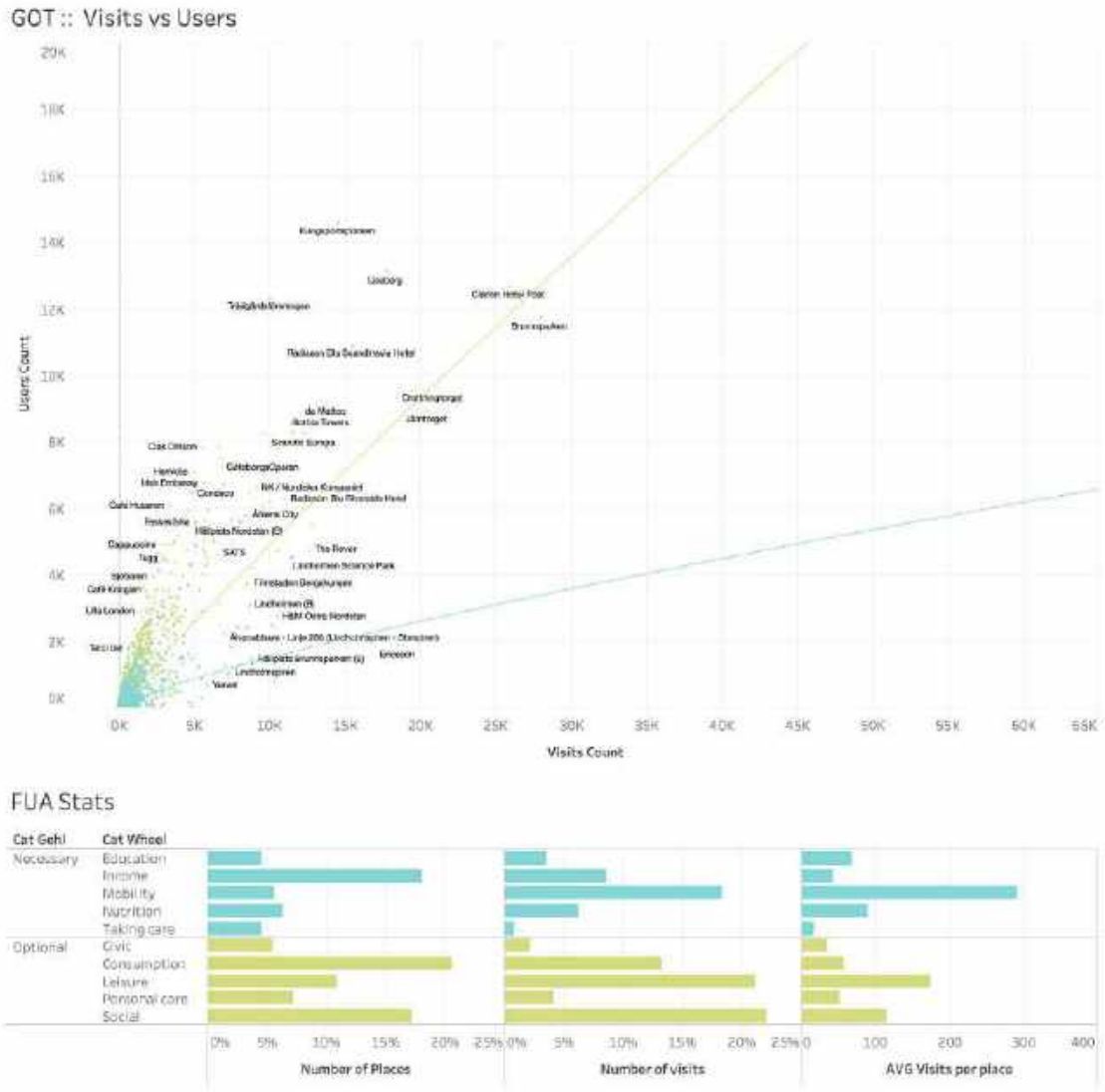


Figure 14: Number of visits per place at AOI scale (3 of 3)
Source: Authors

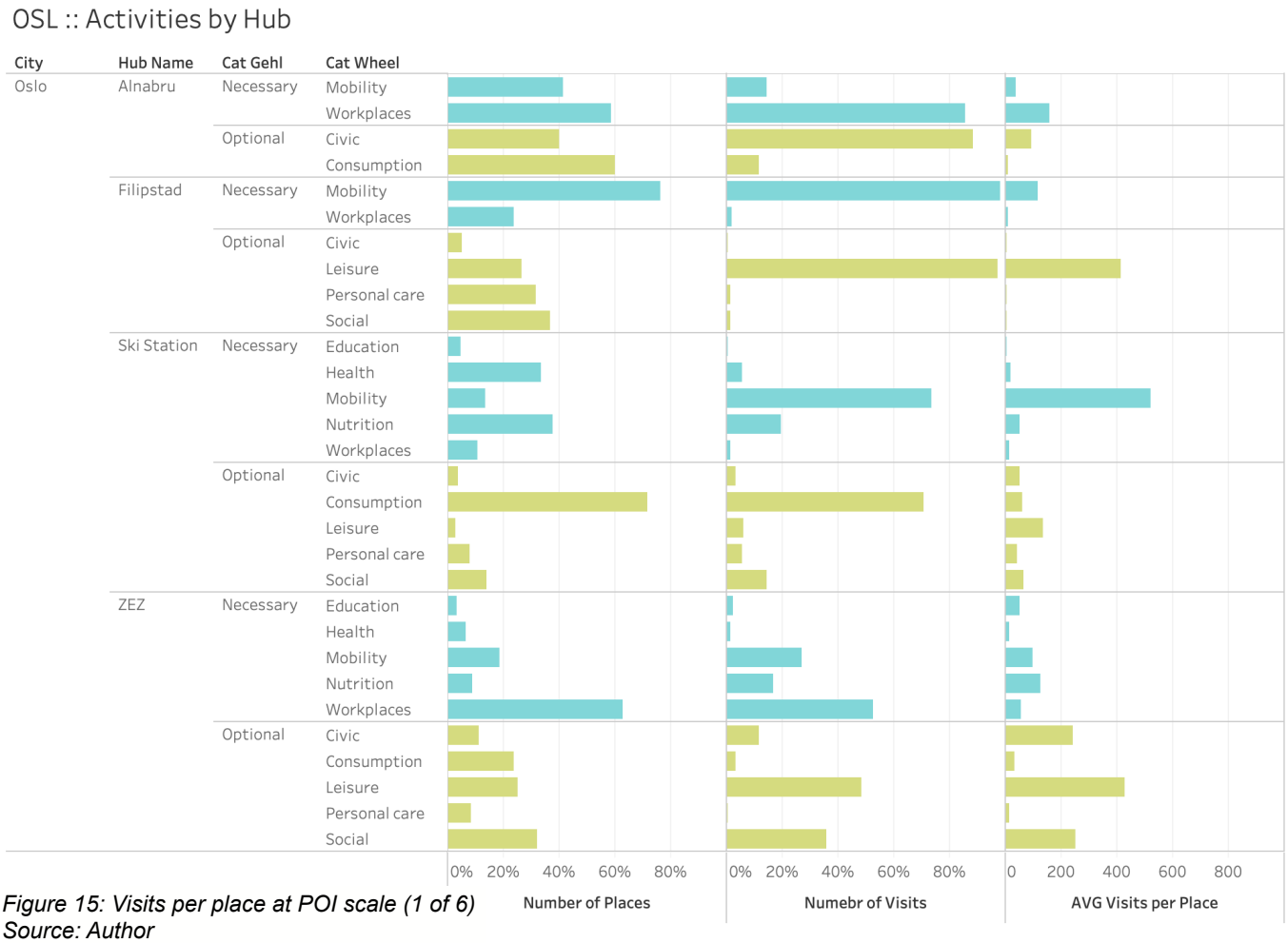


Figure 15: Visits per place at POI scale (1 of 6)
Source: Author

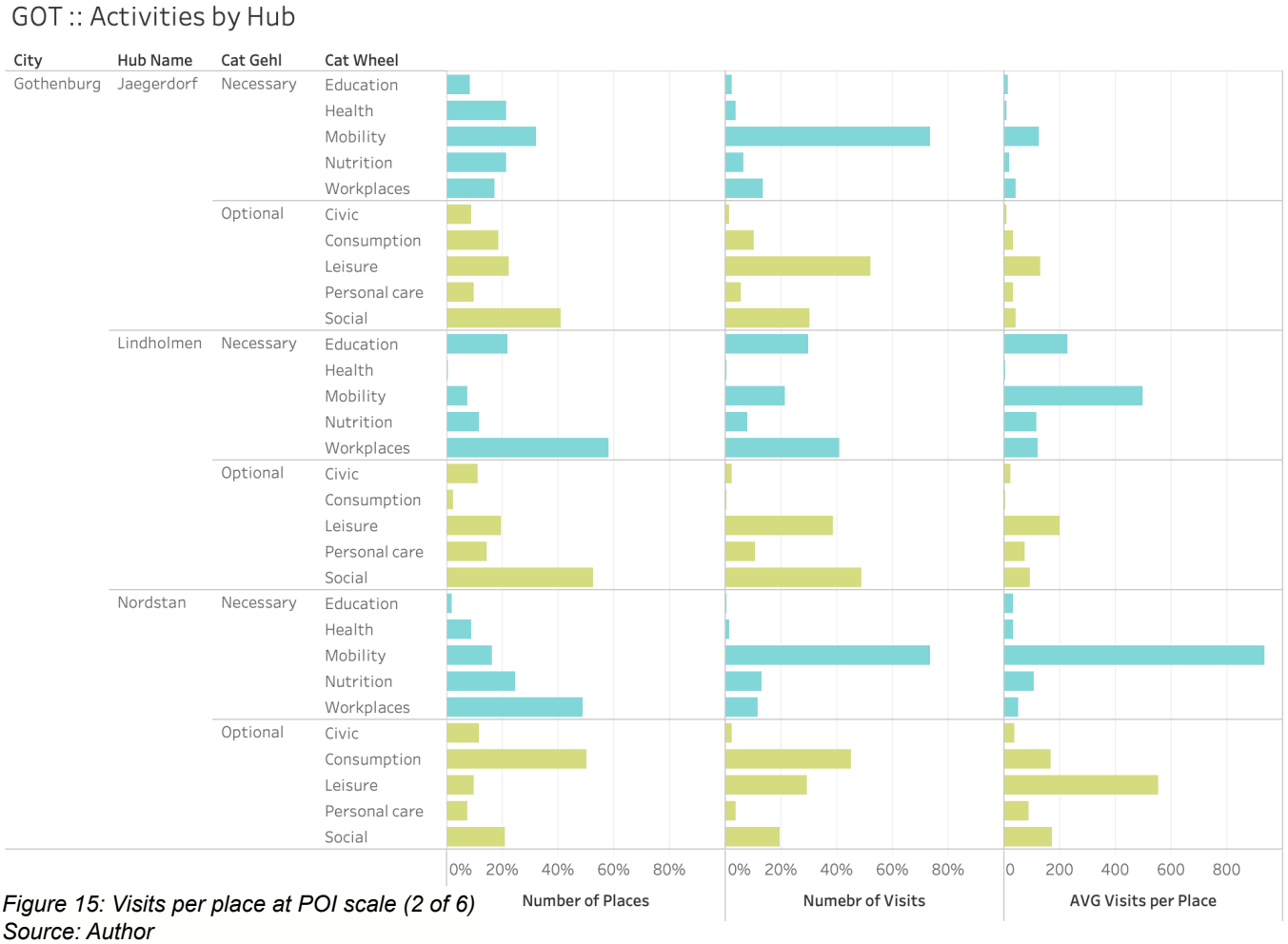


Figure 15: Visits per place at POI scale (2 of 6)
Source: Author

HAM :: Activities by Hub

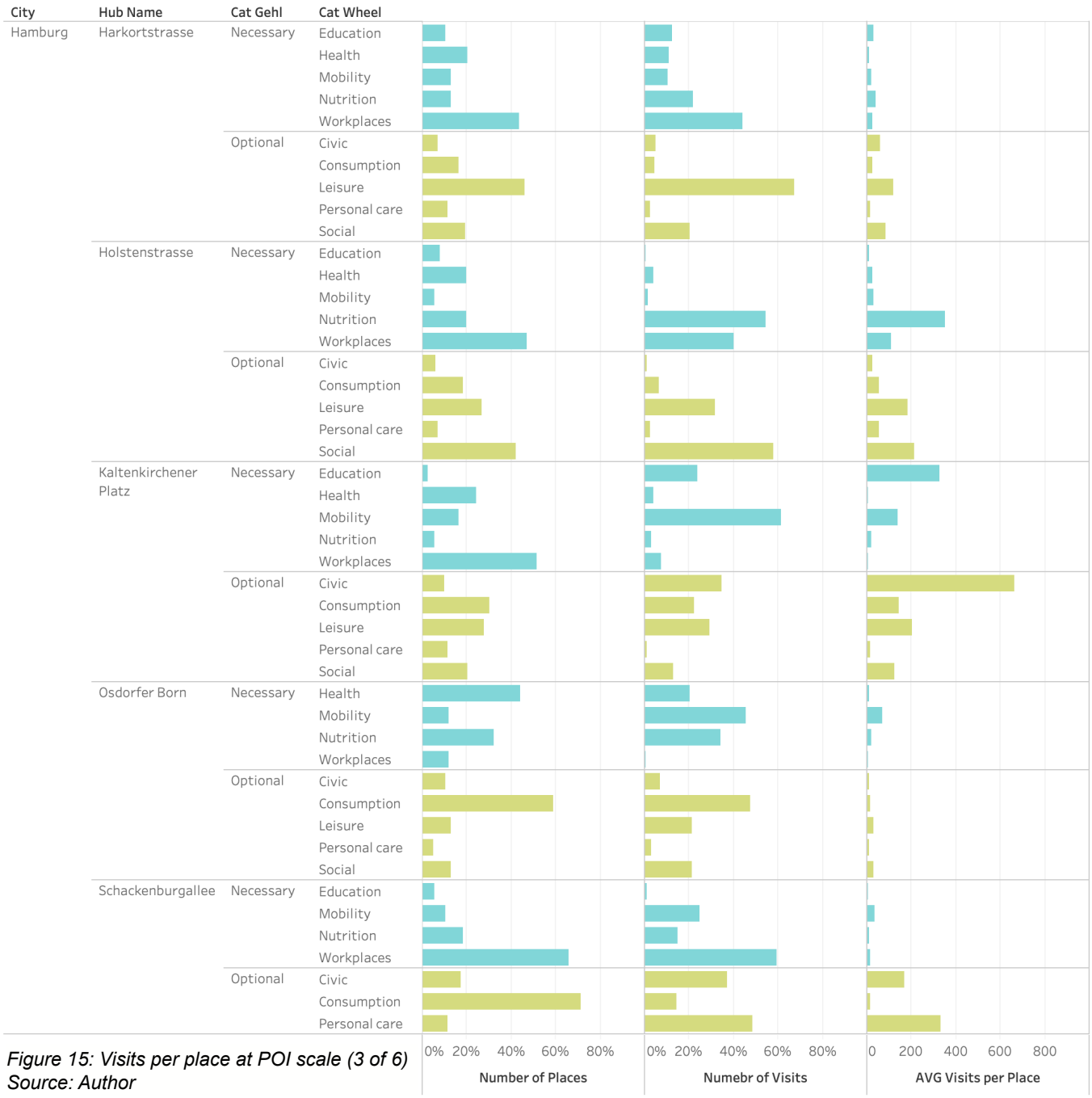


Figure 15: Visits per place at POI scale (3 of 6)
Source: Author

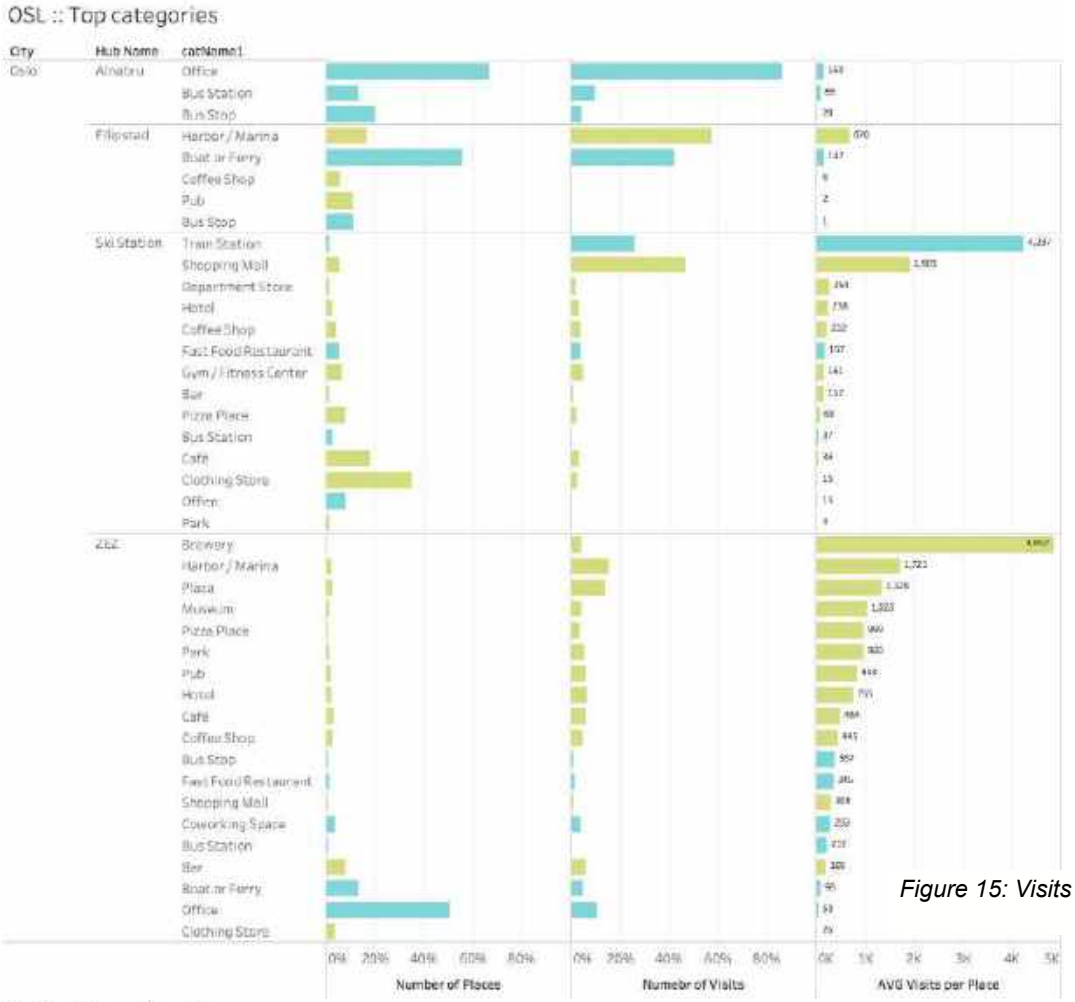


Figure 15: Visits per place at POI scale (4 of 6)
Source: Author

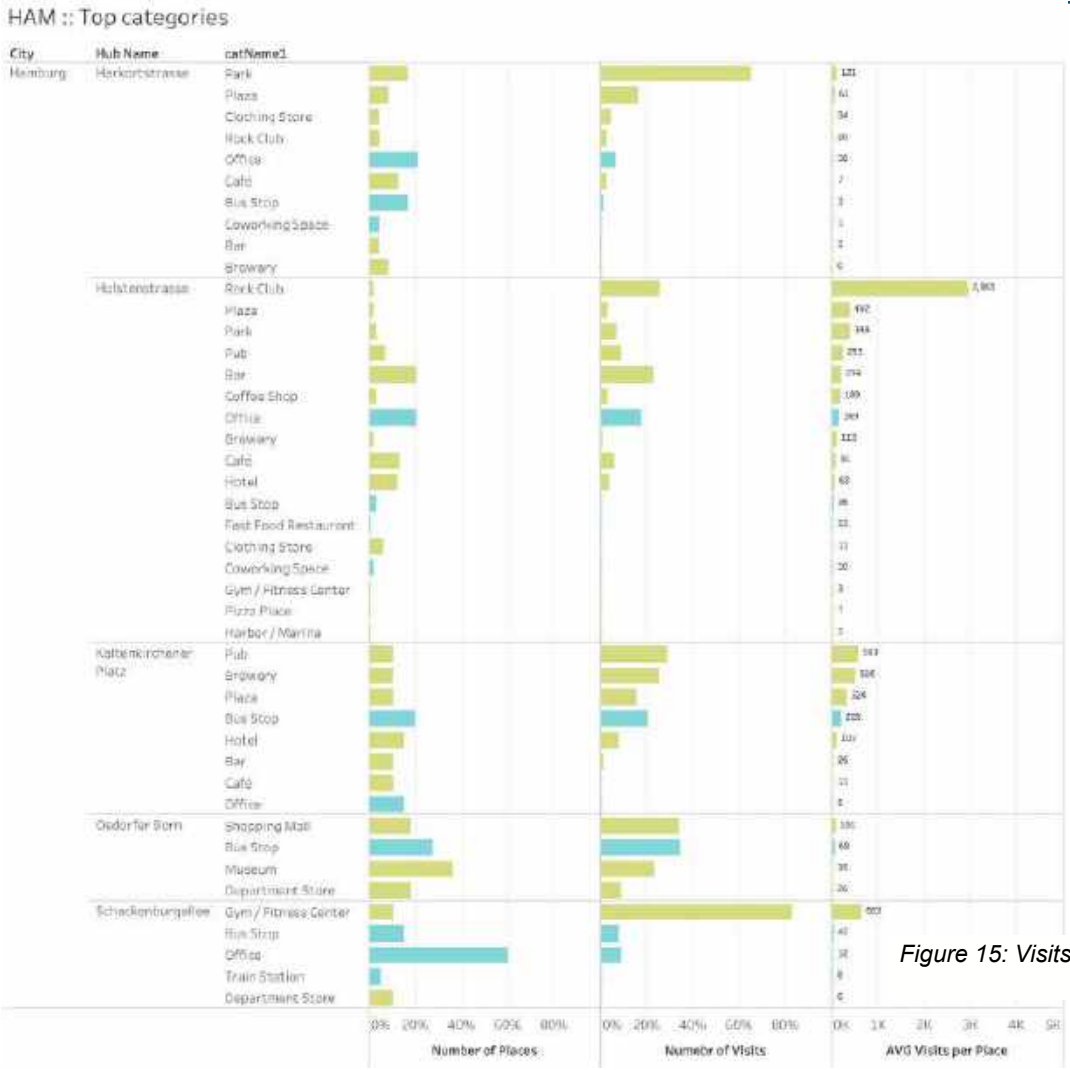


Figure 15: Visits per place at POI scale (5 of 6)
Source: Author

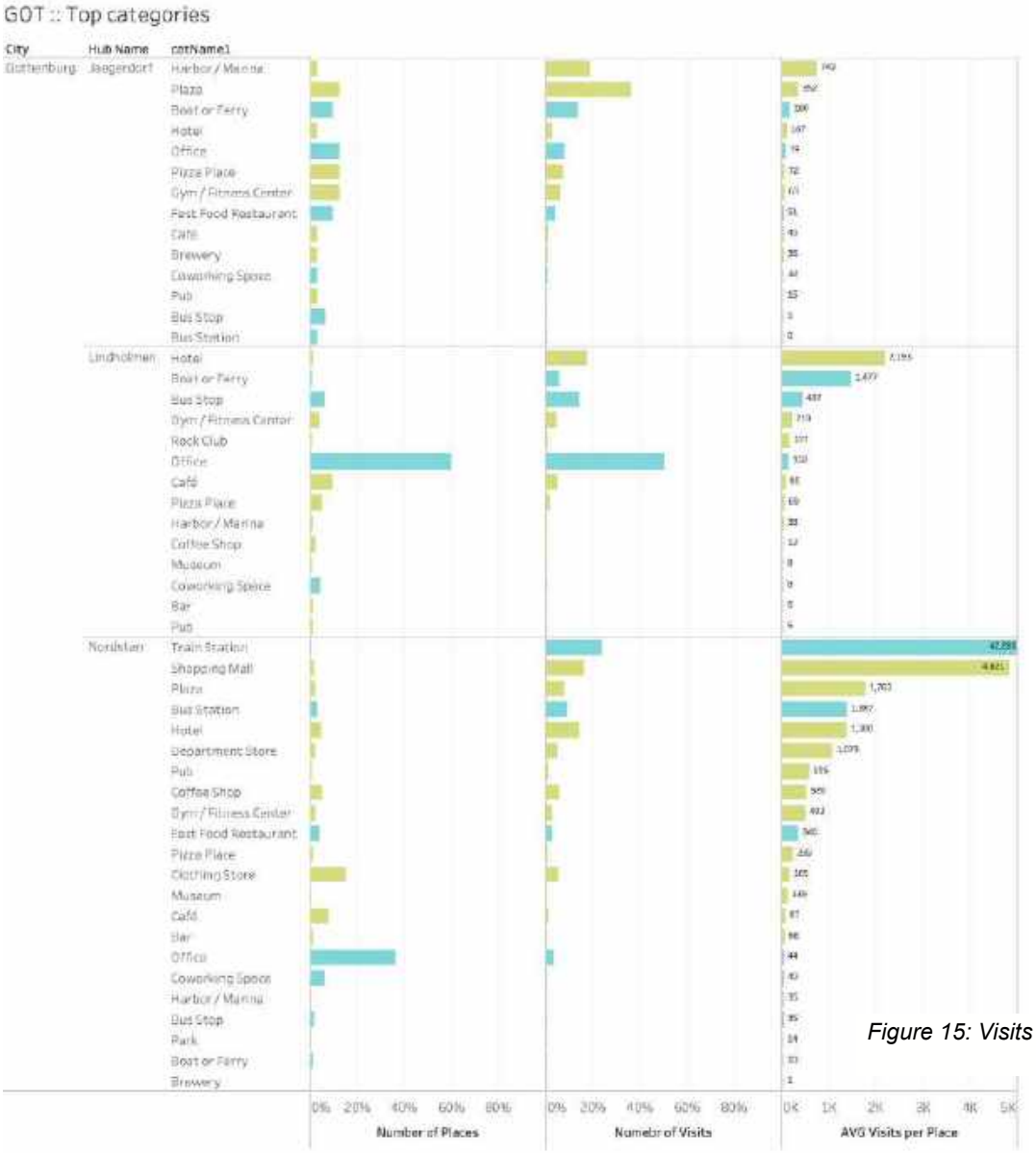


Figure 15: Visits per place at POI scale (6 of 6)
Source: Author

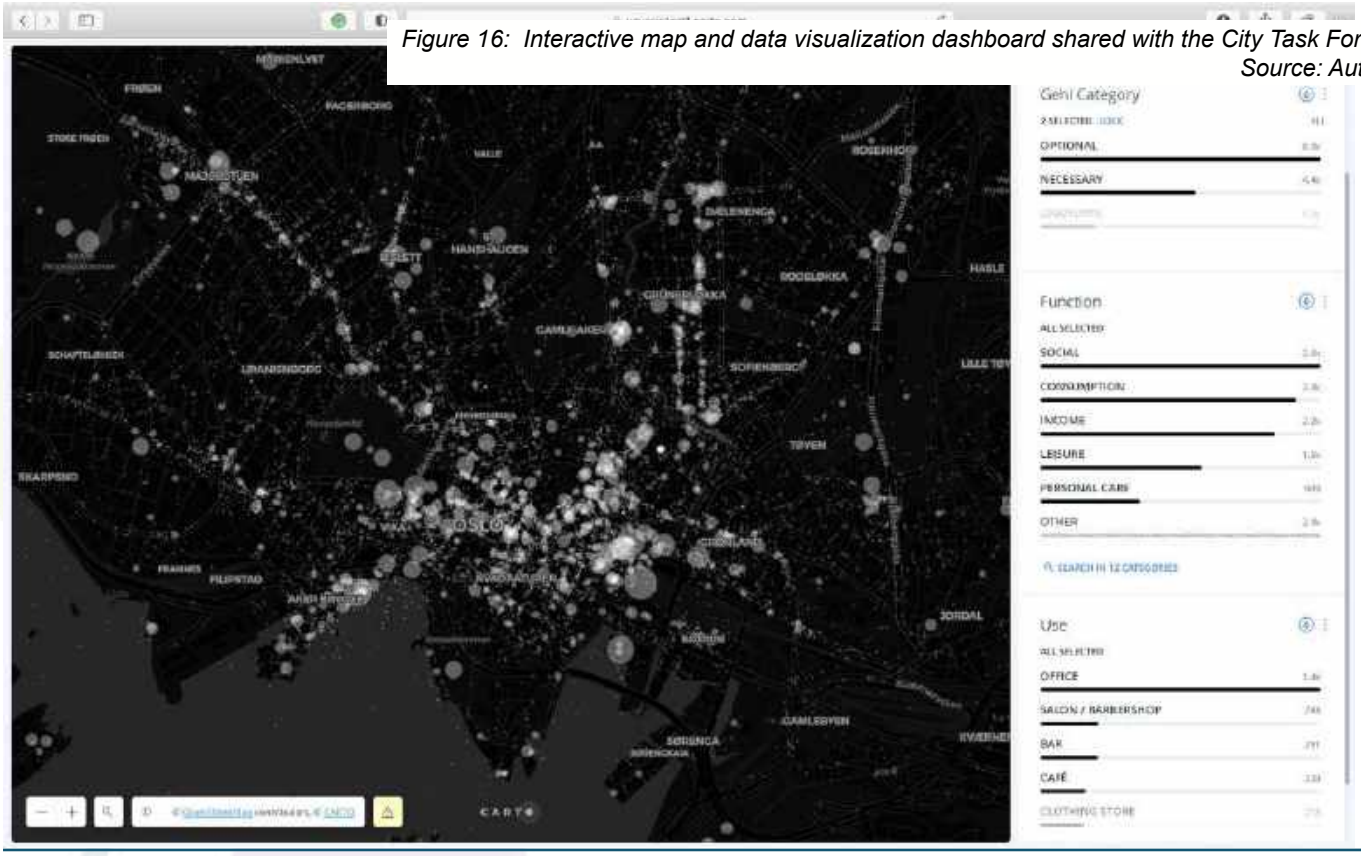


Figure 16: Interactive map and data visualization dashboard shared with the City Task Forces
Source: Author

6 Discussion and conclusion

This work aims to be exploratory research combining different data sources to analyze and extract valuable insights about the performance of small-scale public open urban spaces from a socio-spatial perspective. Our methodology provides a wider city-scale narrative needed to comprehend the results on a local neighborhood scale. It also shows some consistent patterns when observing different data sources pointing towards the validation of the method. The aim of this deliverable is to offer a comprehensive approach that triggers conversations and observations. Specifically, about the case, the results depict some socio-spatial characteristics of the hub candidate locations relevant for consideration in further studies, analysis, and eventually spatial proposals.

This chapter contains a case summary of the analysis of the three cities as well as initial recommendations what functions and activities the potential hubs could include in future. Furthermore, limitations with regard to data collection are also discussed.

6.1 Non-technical data access

Access to interactive maps is possible via the following links. The sharing of these maps aims at enabling further exploration of the datasets on the side of decision-makers, and also the general public. An “embed” code is also available for the integration of the interactive map and dashboards into any website.

6.1.1 Oslo

Link

https://usuariotest1.carto.com/builder/5d3b7223-3403-4cf4-b503-b8d9f2c117f4/embed

Embed

<iframe width=”100%” height=”520” frameborder=”0” src=”https://usuariotest1.carto.com/builder/5d3b7223-3403-4cf4-b503-b8d9f2c117f4/embed” allowfullscreen webkitallowfullscreen mozallowfullscreen oallowfullscreen msallowfullscreen></iframe>

QR Code

6.1.2 Hamburg

Link

https://usuariotest1.carto.com/builder/f1ad5cb4-241e-4089-8374-ffdfe37aedde/embed

Embed

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QR Code

6.1.3 Gothenburg

Link

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QR Code

6.2 Case Summaries

Oslo

- There is a noticeable division of urban types between the inner and the outer part of the ring (Kirkeveien–Finnmarkgata). The inner part of the ring presents higher density of activities and building forms with larger buildings and closed building blocks. Streets in the inner part of the ring are smaller, shorter, and closer to a grid pattern, which along with the above-listed characteristics results in a potentially highly walkable and pedestrian-friendly area similar to traditional European urban types. The index of walkability is higher in this area, showing an extensive and continuous walkable city center.
- These characteristics gradually shift to a disperse, low-density, organic model, closer to sprawl fabric, at the outer part of the ring. This fabric is characterized by single-family housing in an open block structure with an organic street pattern with multiple turns and a low number of intersections that result in a non-pedestrian-friendly atmosphere, along with the low density of amenities and services. The main activities are located in shopping malls that potentially encourage motorized traffic.
- Connecting the inner and the outer parts of the ring, popular areas gather along main streets that connect the city center to city-scale landmarks at the intersection of these axes with the ring (Storo, Colosseum, Skøyen, BI Handelshøyskolen Campus, Vigeland Park) following a cartwheel structure. These streets also show a higher level of urban integration. Particularly, the E18 highway extends from the city center towards both sides of the Oslo-Viken bay (Sandvika and Ski) being the main artery at a functional urban area scale.

Hamburg

- The inverse correlation between spatial network relevance and socio-economic relevance poses the paradox of people choosing to visit places which gather people, regardless of the pure spatial configuration of those. The results represent a mismatch between the presence of places and the number of visits registered, compared to the relevance of these places within the spatial street network –both at an urban and a local scale. We could infer that while the spatial configuration of the street network favors the relevance of places near complex intersections, longer streets, or areas of recent development –theoretically gathering higher pedestrian flow and thus activeness and socio-economic relevance – our approach shows the opposite; activeness is concentrated in areas with lower network measurement results, which are potentially linked to historical values, pedestrian-scale design with smaller streets, and places of socio-economic attraction (such as landmarks, neighborhood centers, and main commercial axes).
- Even though balanced in general amounts, a mismatch is produced in the spatial distribution of optional and necessary activities deriving in functional segregation of places. The core area is polycentric. Neighborhood centers emerge in the intersection of axes that gather optional activities along them, and necessary activities tend to cluster around transport hubs.
- Low building density with open multi-family blocks in organic street patterns with multiple turns and a low number of intersections results in a low walkability index, and multiple small walkable units disconnected from each other.

Gothenburg

- Similarly to Oslo, Gothenburg has a dense city center where the majority of activities and services are concentrated in the areas of multi-family buildings, closed building blocks, and grid street patterns. There is a highly integrated mix of optional and necessary activities, which along with the street network characteristics create a pedestrian-friendly and walkable environment. Density is considerably lower in the areas of residential districts (single-family housing and multi-family open blocks) where amenities and services have a lower density.
- There is an observable division north and south of the river. The presence of port-related activities along the river and hard infrastructure (railways and highways with high urban integration) along the river borders strengthens this division, with the southern border considerably denser and more diverse than the northern border, which presents a lower density and stronger division of functions.
- Noticeable clusters of isolated single functions (necessary activities) with urban-scale impact appear in low-density areas (Volvo, Lucky Hops, Lindholmen Innovation, Östra Sjukhuset Hospital), and commercial-leisure functions (optional activities) in the main axes connect these areas with the city center (Bäckebol Köpcentrum, Allum, IKEA-Bauhaus) following a radial structure. These main streets also present a high level of urban integration.

6.3 What to put in a mobility hub: Recommendations

This deliverable considers hubs as a potential host to activities from the perspective of mobility, transport, logistics and social uses. Regarding the last category, some general guidelines to recommend types of activities, functions and services are described in the following section.

When the results of the metrics calculated in this contribution are put together, it is possible to distinguish four different types of environments surrounding the hub candidate locations. This classification is presented in Figure 17 and it is the result of performing a cluster calculation using the quantitative variables presented in the section 5, measured within a radius of 400 meters from every hub candidate location. In this context, it is possible to establish four distinct environment types.

Figure 17: Summary of all metrics. Source: Authors

Type 1: Those hubs located in places with a critical mass of urban vitality are within city centers and areas that cluster high levels of all types of activities, and high levels of walkability. Consequently, the potential social use connected to the hubs should consider the use of the existing customer base and pedestrian volumes, as well as the existence of places of origin and destination of trips. Hubs in these locations could consider their use within a multi-purpose mobility scheme.

Type 2: Those hubs located in areas with a low density of services and activity are also less walkable and less connected to the rest of the city. Potential uses of a hub could provide these areas with services that are missing, in the direction of social justice and equal access to basic services. This process would intend to create a new flow of pedestrians towards the use of this one service in the area driven by necessity and potentially activate inactive public spaces with single-purpose trips. The result of implementing hubs with social activities in these areas is expected to be more noticeable than in dense, well-functioning popular areas.

Type 3: Those hubs located in industrial areas with a defined functional clustering could provide these areas with services that are complementary to the ones existing. A critical customer base could be used, and the multi-purpose mobility scheme could also be applied. It is likely that the comfort at pedestrian level tends to be low due to the size of the buildings and built infrastructure, therefore other transport modes should also be considered.

Type 4: Those hubs located in areas that constitute “walkable units”, and are well connected to the rest of the city or to a main street. With the exception of the shopping mall at Ski, these areas also present a low level of vitality. It’s performance as “walkable units” could favor multipurpose trips in synergy with the activities found in them, aiming for a catalytic effect attracting additional functions and services.

6.4 Limitations and further development

6.4.1 Limitations

These analytics are conditioned by the bias associated with data generation and acquisition. Data about popularity and activity was collected from Foursquare and therefore might not fully represent some tendencies, considering that not every individual is connected to the network through a smartphone. Similarly, data collected from OpenStreetMap was generated and reviewed by the users of the platform, sometimes relying on their own judgement for data type classification. However, using the same data sources across cities and scales makes it easier to understand tendencies and patterns from a broader perspective as well as compare indicators through the same lens.

6.4.2 Next steps: Pedestrian simulation and walkability analytics

At a later stage, a prediction of impact will be carried out using the data presented in this contribution, to simulate the pedestrian flow of people walking through the areas around the candidate locations presented in the living labs. The data gathered from the pedestrian flow simulations will be used to assess the decision-making procedures on the living labs, regarding the types of activities and the locations and their relation to the potential to produce urban vitality at the pedestrian level, consequently affecting the perceived quality and comfort levels of public space.

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