A SENSE OF PLACE

Exploring the potentials and possible uses of Location Based Social Network Data for urban and transportation planning in Turku City Centre

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Exploring the potentials and possible uses of Location Based Social Network Data for urban and transportation planning in Turku City Centre

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PREFACE

Social media has become a common feature of our everyday life. For researchers, social media provides large amounts of readily accessible, on-time and qualitatively rich data that can be used to study urban activities and people's interactions. The specific characteristics of different forms of social media, such as Twitter, Instagram and Foursquare, open different avenues for both quantitative and qualitative analysis.

A vast majority of data collected by social networks and crowd-sourced platforms is made available to the public by the users themselves, sometimes more and other times less consciously. This data can be collected and analysed by third-parties, providing a granular and detailed description of social processes through space and time. As we aim to show, it is a valuable data source, even though only a part of the urban population uses social media. Moreover, as the number of users grows, so does the amount, quality and usability of data, thus overcoming the actual lack of representativeness of the sample.

In our research, we are particularly interested in the analytic use of Location Based Social Network data (from here onwards called LBSNd) combined with other data sources used in urban and traffic planning, in this case remote mapping and configurational analysis. This hybrid approach can offer interesting insight into the daily and weekly rhythms of use of space as well as the meanings people attach to particular urban spaces. In such analysis LBSNd works as an invisible treasure of data and meta-data produced directly by the urban population, including visitors. In this explorative study on Turku we will present just a few possible uses of this data.

RESEARCH TASK

Our main research interest is to study how Location Based Social Network data (LBSNd) can be used for the urban and transportation planning. In case of City of Turku, this was done to discuss the current spatio-temporal dynamics in its city centre, indicating potentials for further development, and assessing how a new tram line that may be constructed would change the situation. For instance, whether the new tram line is going to empower active areas or revitalise idle streets. Overall, the tasks were focused on exploring which streets and spaces in Turku's city centre are more likely to attract people today and how the situation might change if a new tram line will be constructed. The study was assigned by the City of Turku and funded from Turku Urban Research Programme.

Location Based Social Network data was considered as primary source due to the current regulations of Finland which do not allow to use mobile users' positioning data to study activity patterns. Yet, it has also other advantages: while mobile positioning data can be used mainly to analyse users mobility patterns and their key locations, LBSNd allows more detailed analysis on human activities, based for example on pictures, texts, location preferences. Such qualitative information can be used to study the character of a place or the reasons why some areas are socially more active than others.

We divided the assignment into the following tasks:

- Using agile methods to mine LBSNd
- Mapping activity patterns
- Studying spatio-temporal patterns using LBSNd
- Using LBSNd analytics to discuss the following questions:
  - > How is the usage of central Turku characterised today?
  - > How could it be developed?
  - > What are the hidden potentials of central Turku (e.g. locations with limited activity but with substantial flow of people within it or in its vicinity) and how could the potentials be used to (re) activate idle zones?
  - > How would the planned tram line change the dynamics of central Turku?

The report we present will provide a set of key findings and ideas for possible developments. However, the materials should be considered as a tool for further analysis and development. Therefore the content is presented in a rather short and simple form and structured so that it would be easy to consult during the policy making process. We believe that the results will offer many inspiring details for people who know Turku well and can think of potentials for many particular locations.

Previous research

The project was carried out in an academic environment, following methods and techniques based on published research, but also offering ground for developing and testing new ideas. Prior to defining methods for tackling the tasks, we carried out a brief literature review while conducting actual tests with a relatively small sample of social network data. Jointly the studies indicate a wide range of possibilities and methods for using LBSNd to observe user behaviour, activity and mobility patterns, individually or in relation to each other. In our literature review the initial selection included approximately 80 studies from which 25 papers were selected based on their relevance and accuracy of methodological description. Although the specific focus of the researches varied, the techniques and methods to study spatio-temporal patterns were quite similar. In Appendix 1 to this report, we present detailed information on seven (7) papers that were the most distinctive as well as the most influential ones to our research.

Most of the previous studies were carried out in major cities like New York, San Francisco or Tokyo in areas of high population density, and were based on data collected either from Foursquare or Twitter (detailed description will follow further on page 10). Foursquare has mostly been used to study activity patterns. Meanwhile, Twitter's data has been often used to study mobility patterns as well as the semantic analysis of Tweets.

Location Based Social Network Data

Based on the brief literature review we concluded that Twitter and Foursquare probably represent the most significant data sources for studying activity and spatio-temporal patterns in Turku. Although these social mediums are widely and intensively used by millions of users worldwide, Buzzadors studies (2014) reveal that in Finland only one (1) percent of Internet users visiting Foursquare and five (5) percent Twitter on daily basis. Due to the low numbers of users and other technical limitations, we decided to include Instagram, which is used by 15 percent of Internet users in Finland. As neither Twitter nor Foursquare allow collecting historic data, we could start gathering "tweets" and "check-ins" starting from the beginning of the project, limiting the size of the data to the period of two months; Instagram, on the other hand, allows downloading data for a period of one calendar year or even longer. We proceeded by setting up a Raspberry PI to mine the data from Twitter and Foursquare API for the longest possible period (which was altogether two months) and to download data for one year from Instagram. Hereby we present a brief review of collected data.

Long term data mining tasks are mostly carried out using dedicated servers in order to have a constant and stable data flow while having a backup service securing the data. For this project using a Raspberry PI instead of the servers has proven to be an agile, stable and cost-efficient method. We used two devices downloading data in parallel and in different locations to avoid potential problems.

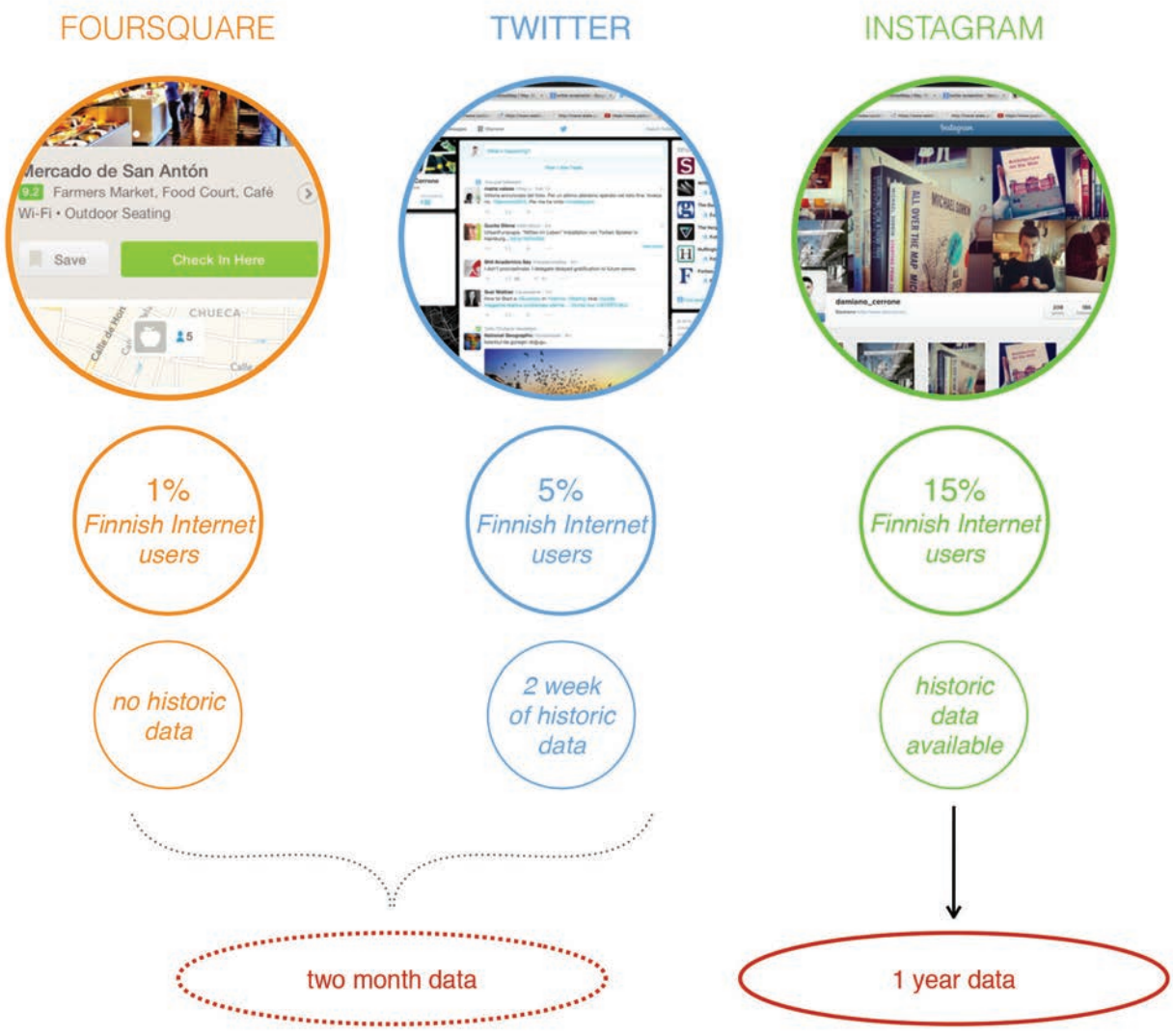


Figure 1. Usage of social media in Finland

Figure 2. Tweets density map

Founded in 2006, this social network has 284 million monthly active users worldwide, compressing their ideas into short 140-character text messages – more than 500 million messages are generated daily. Led by the idea of "telling your story", Twitter encourages people to share thoughts, inspiring images, links to other sources, and stimulates interactions between users. Twitter can be accessed through its web interface, mobile APPs or SMS. Users can choose to share their location and their tweets. All the tweets that contain geographic information are called "geolocated tweets" and their accuracy depends on the precision of the user's mobile phone hardware. It is possible to obtain geolocated tweets using the Twitter API and map them as crumbs left by users to study spatio-temporal patterns and mobility patterns (for frequent users). Moreover, it is possible to gain an overview of locations visited by users on a daily basis, follow their routines and draw up a potential sequence of the places one user may visit.

In addition, content analysis of tweets can provide an insight into the reasons why certain users prefer certain locations, or a possibility to study the moods and sentiments that motivate users to write tweets and the topics they refer to. More and more often Twitter is being used as a tool to inform (weather conditions – hurricane alerts) and gather people in critical situations (coordinating demonstrations), while companies are often creating Twitter accounts to promote their products and to give visibility to their events.

Collecting data

Twitter allows collecting data in real time or for a period of past two weeks. At first we collected the short historic data and then set up a program to collect all the geolocated tweets from the Twitter API every second hour as they were generated by the users.

Dataset

Period: 18 Nov 2014 --> 5 Jan 2015
Users: 362
Geolocated tweets: 2 519
Top 5 frequent users: user_1 = 352 tweets / user_2 = 168 / user_3 = 145 / user_4 = 64 / user_5 = 61

Short conclusions

In Turku we have found only 362 users who shared at least one geo-located tweet. Considering that out of this number only few of them are frequent users, we could not use this dataset to study spatio-temporal patterns or mobility patterns – except for the few active users. Furthermore, these very few frequent users are dramatically more active than all the other users, making it unfeasible to get any general overview of users location choice.

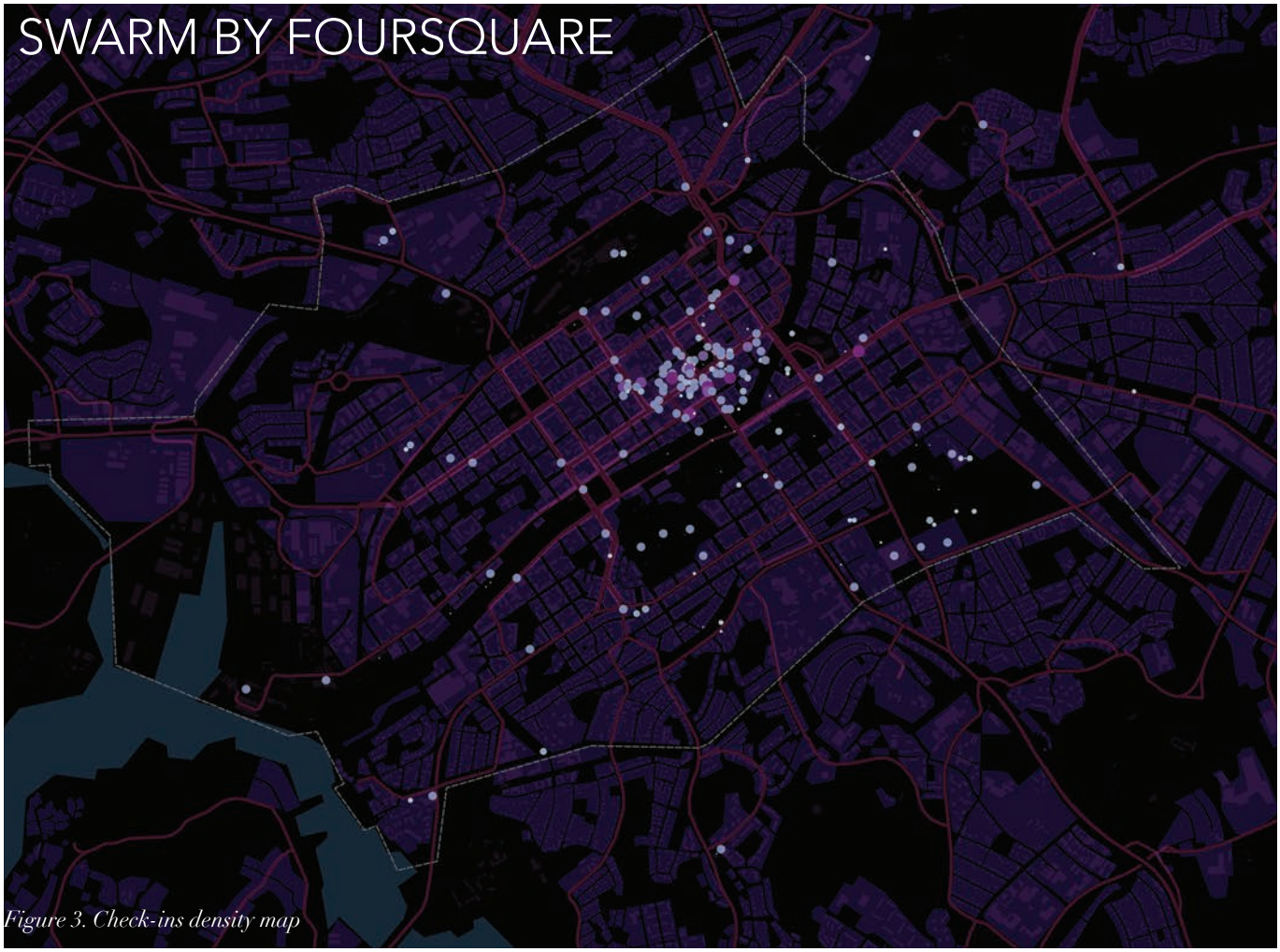


Figure 3. Check-ins density map

Foursquare is a mobile application that enables finding places or venues according to users' preferences. In addition, users can use the mobile APP to check-in at the venues they visit, rate them and write short reviews. In 2014 a new side-app called Swarm was launched dedicated only to checking-in, while Foursquare was maintained for all the other functions. In this study we gathered the locations of users' check-ins generated by Swarm.

Collecting data

In order to collect data from the Foursquare API, we selected all the venues in Turku and then requested the total amount of check-ins for each venue hourly. The total amount of check-ins per venue can be used to find the most popular places in town, and for studying spatio-temporal patterns, we could calculate the number of check-ins hourly or daily. Finally it is also possible to extract the venue category in order to study activity patterns. However, not all the venues and services – such as bars, shops or supermarkets - are registered in Swarm by Foursquare.

Dataset

Period: 2 Nov 2014 --> 5 Jan 2015
Users logs: 2 519
Venues: 505

Short conclusions

Compared to the size of the city, the dataset of Swarm by Foursquare does not contain enough venues to make it significant for studying activity patterns in Turku. If our study was extended to regional or national scale, then it would be possible to observe wider spatio-temporal patterns. At the same time these few venues present in the dataset are all concentrated in the eastern side of the centre, around Kauppatori and the Hansa Emporium (a shopping centre). It does not reveal new information but it supports the idea of a city centre which is still hosting the most attractive venues and hangouts of Turku.

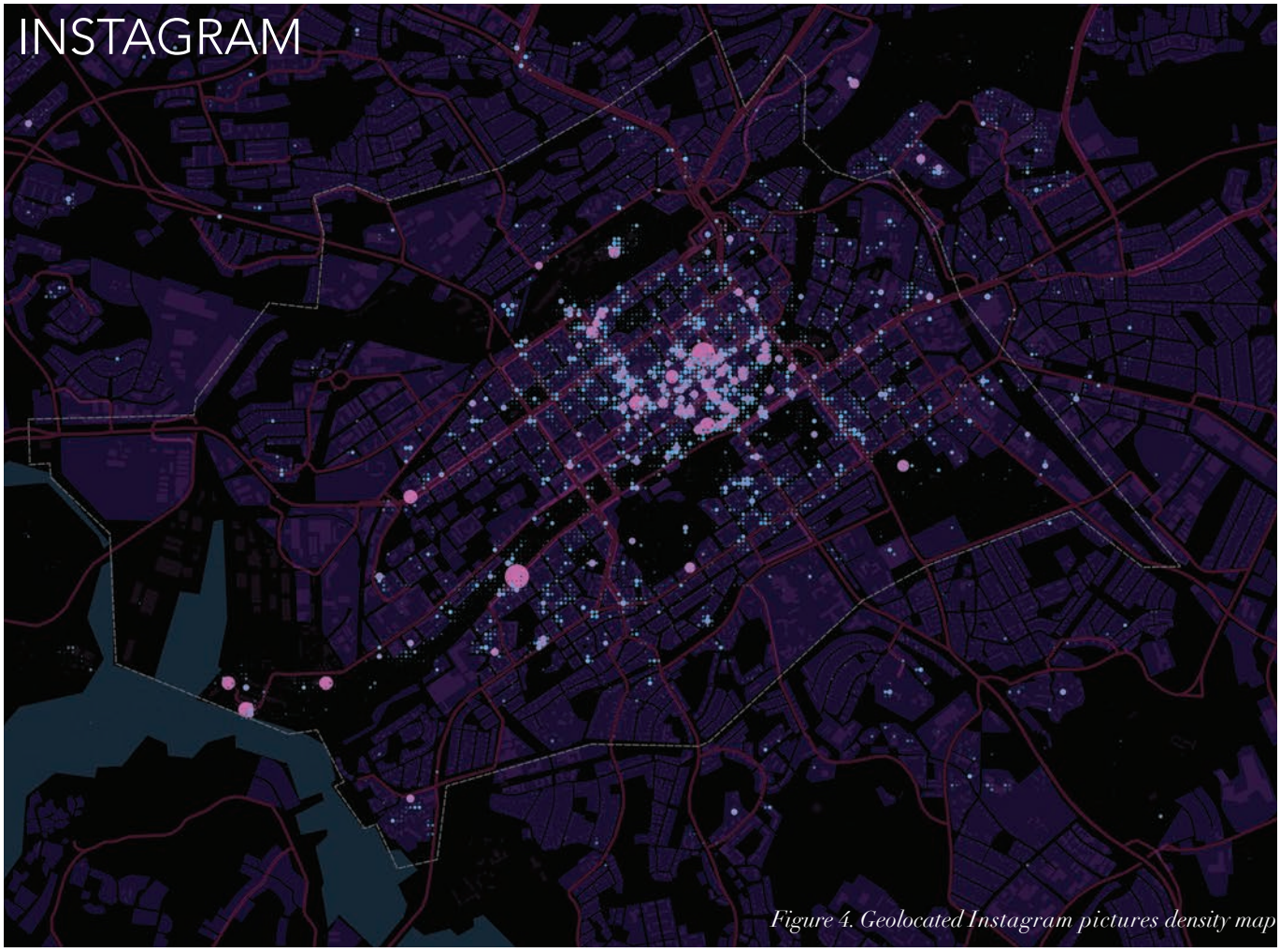


Figure 4. Geolocated Instagram pictures density map

Instagram APP allows users to post and share important moments by shooting and posting photos or videos on their account. About 150 million active users post 60 million photos per day worldwide and they can also be shared on other networking services such as Twitter, Facebook or Tumblr. Although Instagram is more widely used than Twitter and Foursquare, conclusions on the possible usage of Instagram in studies stay rather moderate. Researchers have focussed on studying user types, analysing the semantics of the text users add to their pictures, and carrying out visual analysis of pictures content.

Collecting data

We collected data from the Instagram API by selecting all the geolocated Instagram pictures taken in Turku from November 1, 2013 to November 1, 2014. To overcome data scraping limitations we set up a Python script running on a Raspberry PI querying the Instagram API at shorter intervals, as the number of pictures possible to collect at a time is limited.

Data parsing

Instagram and Twitter data suffers from what apparently is a users location's coordinates rounding problem. If we displayed all the locations of Instagram pictures on a map, a considerable amount of them appear to be aligned on a regular grid. In 2014 Eric Fischer observed this phenomenon on thousands of geolocated Tweets apparently aligned along a grid too. Fisher concluded that this fuzzed data was produced by iPhone devices avoiding displaying the exact location of the device. He solved the problem by eliminating all the points that have at least one coordinate in common. The results of this work might give a visually appealing map as it eliminates all the points apparently aligned but on the other hand the dataset will lose all the valid points that have one coordinate in common by coincidence. To solve the rounding problem while keeping all other points with one common coordinate, we parsed the data by eliminating all these points that were aligned along the grid. Our parser could have also eliminated valid points but the probability of this is much smaller compared to the method used by Eric Fischer.

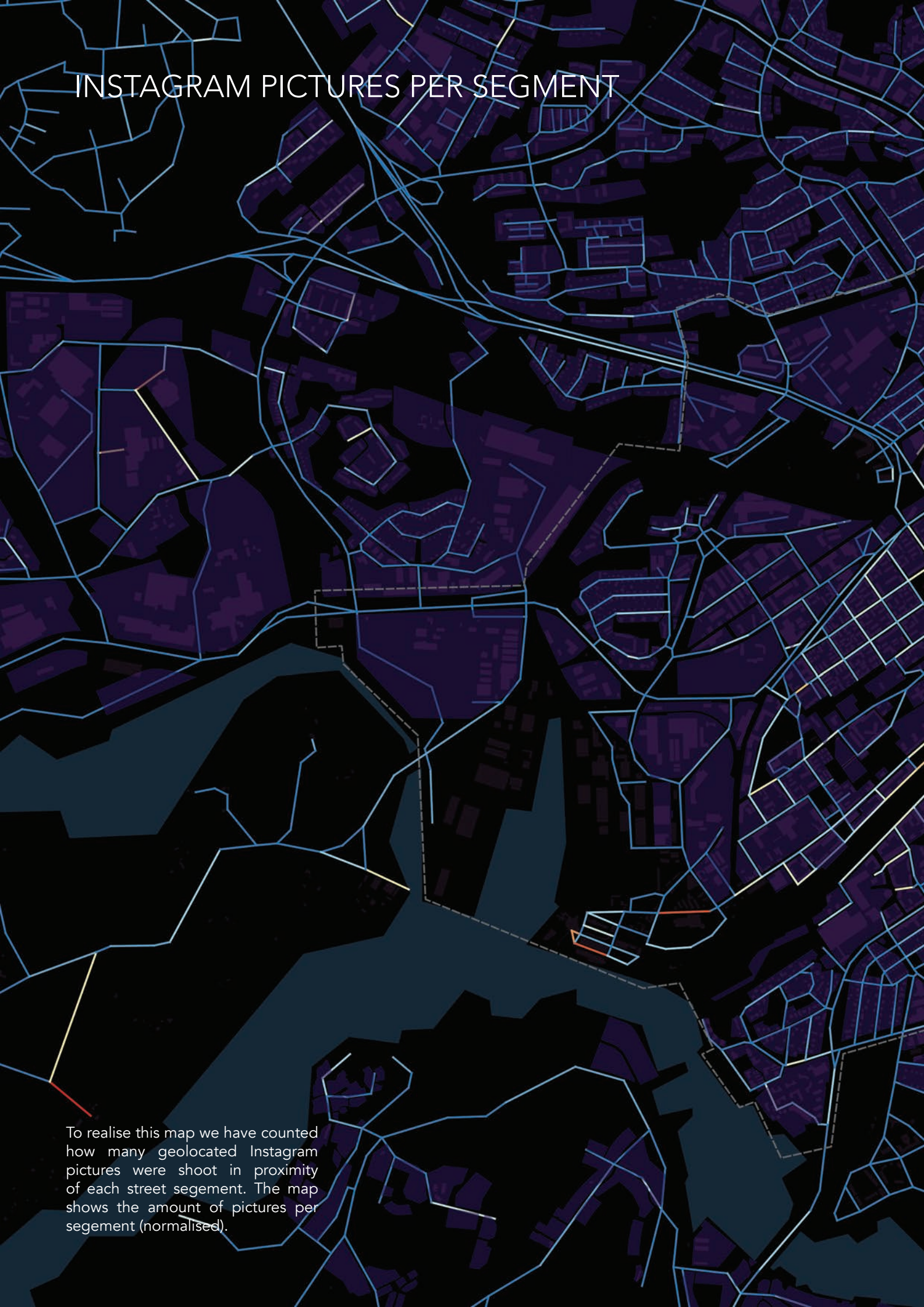
Dataset

Period: 1 year
Users logs: (o)155 251 / (p)149 624
Users: (o)18 808 / (p)18 624

Top 5 frequent users (p): user_1 = 1173 public geolocated pictures / user_2 = 491/ user_3 = 562 / user_4 = 678 / user_5 = 694.

o = original dataset
p = parsed dataset

INSTAGRAM PICTURES PER SEGMENT



To realise this map we have counted how many geolocated Instagram pictures were shoot in proximity of each street segement. The map shows the amount of pictures per segement (normalised).

Figure 5. Geolocated Instagram pictures density per street segment

Short conclusions

Compared to previous studies, we had some obstacles to overcome in analysing Turku. Firstly, the data produced in two months by Twitter and Foursquare users was not big enough to study spatio-temporal patterns. Eventually we found that only a very small number of users were sharing geolocated Tweets in Turku and the venues registered in Foursquare were few when compared to the size of the city. Overall these two applications did not have enough frequent users to carry out statistically significant analysis.

Secondly, Instagram data is the only dataset we have collected that is suitable to study spatio-temporal patterns, as it contains an extensive number of users and allows to use data collected during one year. At the same time this dataset represents only the portion of people's lives, which inspires them to take pictures. This can be seen as an advantage as photographs are pretty much related to space, time and the way people interact with the city and with each other.

Developing data sources for LBSNd analysis

Due to the cumulative character of the social media data, a long-term research strategy would be beneficial. What a city could do immediately is establishing a unit or a project dedicated to collecting and monitoring the Location Based Social Network data (LBSNd). In this project we have used Instagram, Twitter and Foursquare as data sources, but in principle it could be possible to retrieve data also from other social networks such as Facebook, to study location choice and density of people by collecting events locations and the number of participants; LinkedIn, to study professional networks and the labor market; VeriSign, to study location choice and density of people based on users transactions; as well as many other smartphone applications or service providers not classified as LBSN but constantly collecting location based user data. For example apps for taxi or car-sharing services (Uber, Taxify), sport trackers (Endomondo, Runtastic), trip planners (TripAdvisor, TripIT), public transportation APIs, accommodation reservation services (Airbnb, HotelTonight), and event ticketing apps (Eventbrite). The problem is, of course, that most of the above do not provide public access to their databases. Nonetheless, it might be possible to establish cooperation programs to grant the access. Furthermore, it is important to evaluate whether the specific apps or services have enough users in the particular city to provide a sufficient data sample.

A city could also consider monitoring the content of social activity revealed by applications, possibly in combination with a "digital dashboard program" – such as CityBeat (http://demo.thecitybeat.org). In addition to collecting data into a database, a digital dashboard could be used by scientists to study emerging phenomena in real time. It could also give an appealing outlook of the city's activity and improve its image.

Limitation and biases

The analyses based on LBSNd have to deal with and be aware of the limitations and biases with regard to the data. Most importantly, assumed active users of online social networks are likely to represent younger and more technology aware social groups as well as higher rather than lower income groups. However, the use of social media has already spread considerably in all age groups and studies prognose increasing use of the Internet, smartphones and online social media among all social groups, including the elderly and those with lower incomes. Nevertheless in the current situation we cannot say that it would represent generic tendencies.

Another concern is the activity level of users. Even if the sample is representative, some individual users can be extremely active and thus skew the understanding of the overall pattern. It should also be mentioned that not all the user accounts belong to private individuals but also to corporate bodies such as companies who use social networks to reach their favored target groups.

This list is not complete and mentions only the most common concerns found relevant to this study. Those interested in further information can refer to several studies taking notice of the limitations of using LBSN (among others Leetaru et al. 2013).

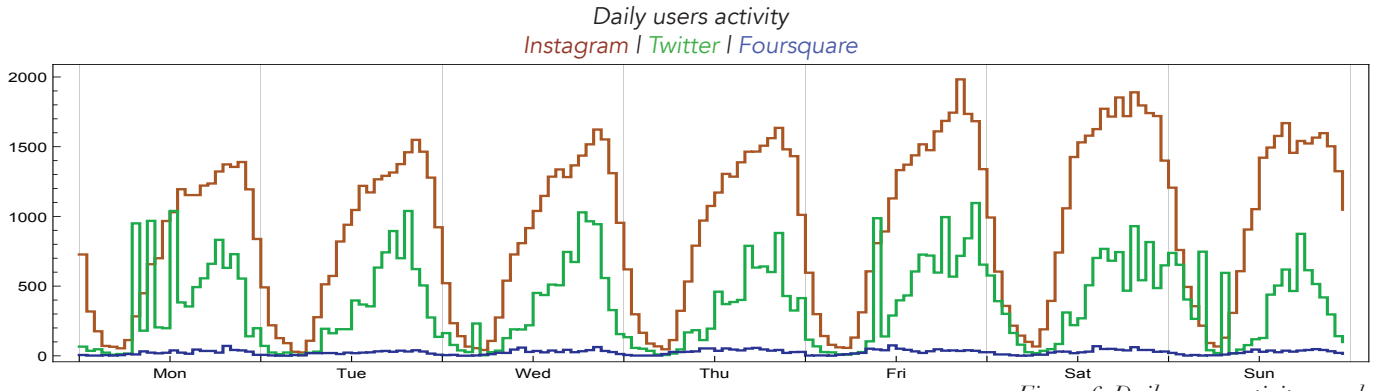


Figure 6. Daily users activity graph

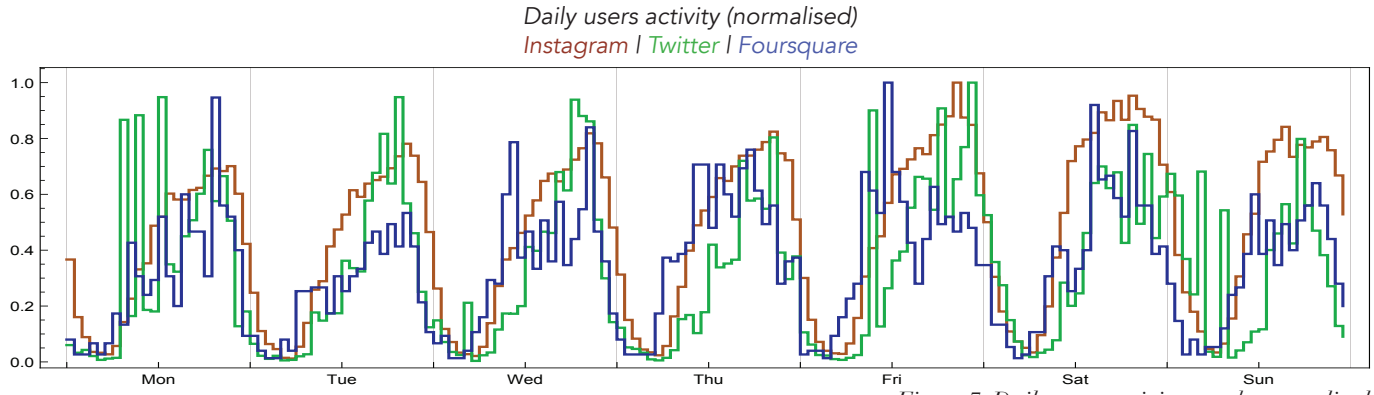


Figure 7. Daily users activity graph, normalised

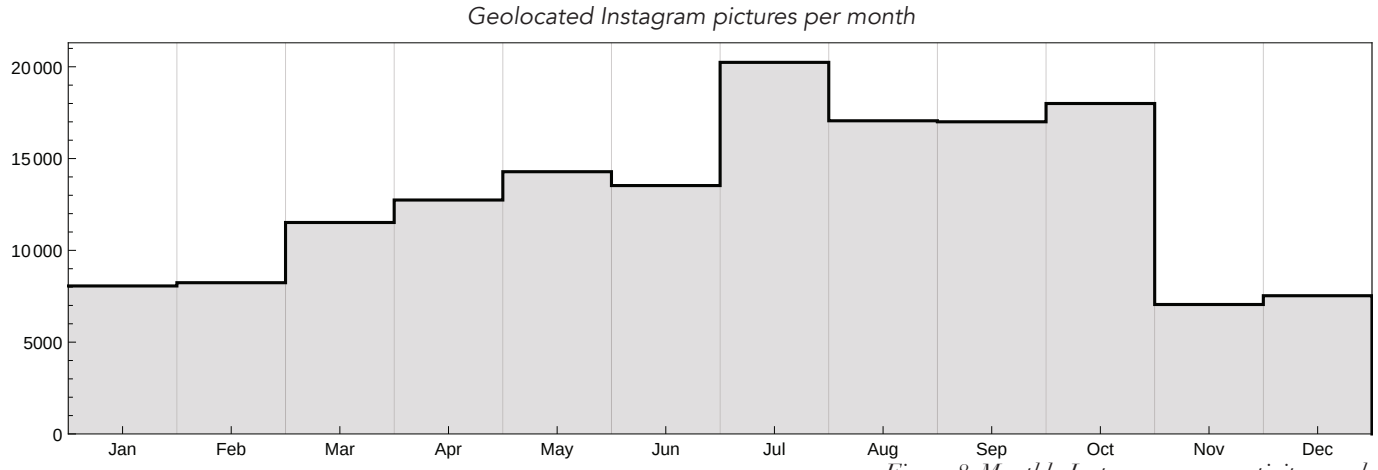


Figure 8. Monthly Instagram users activity graph

Workplan

To overcome the difficulties found with Twitter and Foursquare, we needed to use a method to study activity patterns in central Turku without using these datasets but combining data from different open sources. To achieve this aim we used multivariate and multi-temporal datasets to reveal the active and idle spots in central Turku, visualised on what we call gravity maps. For this purpose we needed to gather and produce data describing the locations people are most likely to visit, what are the places that foster interactions and where people are most likely to pass by. More specifically we needed to organise or produce the following datasets:

Spatio-temporal patterns

(users location choice)

Instagram data is used for mapping user location choice.

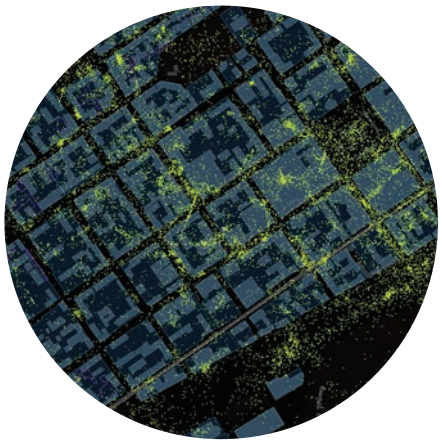


Figure 9. Geolocated Instagram pictures

Activity patterns

(places that foster interactions)

Activity patterns are studied by mapping all the uses that are likely to attract certain kind of human activities at the ground level. In addition, the study focuses on the interaction between different uses during specified periods of time.

Figure 10. Activity map

Accessibility

(where people are most likely to pass by)

A dataset with all possible sources is created to describe and assess accessibility in Turku to study where people are most likely to pass by. Perceived and spatial accessibility is analysed using Space Syntax analysis, and car traffic and light traffic data provided by the City of Turku is included together with the OpenStreetMap users' GPS traces and Turku's public transportation network.

Figure 11. GPS traces

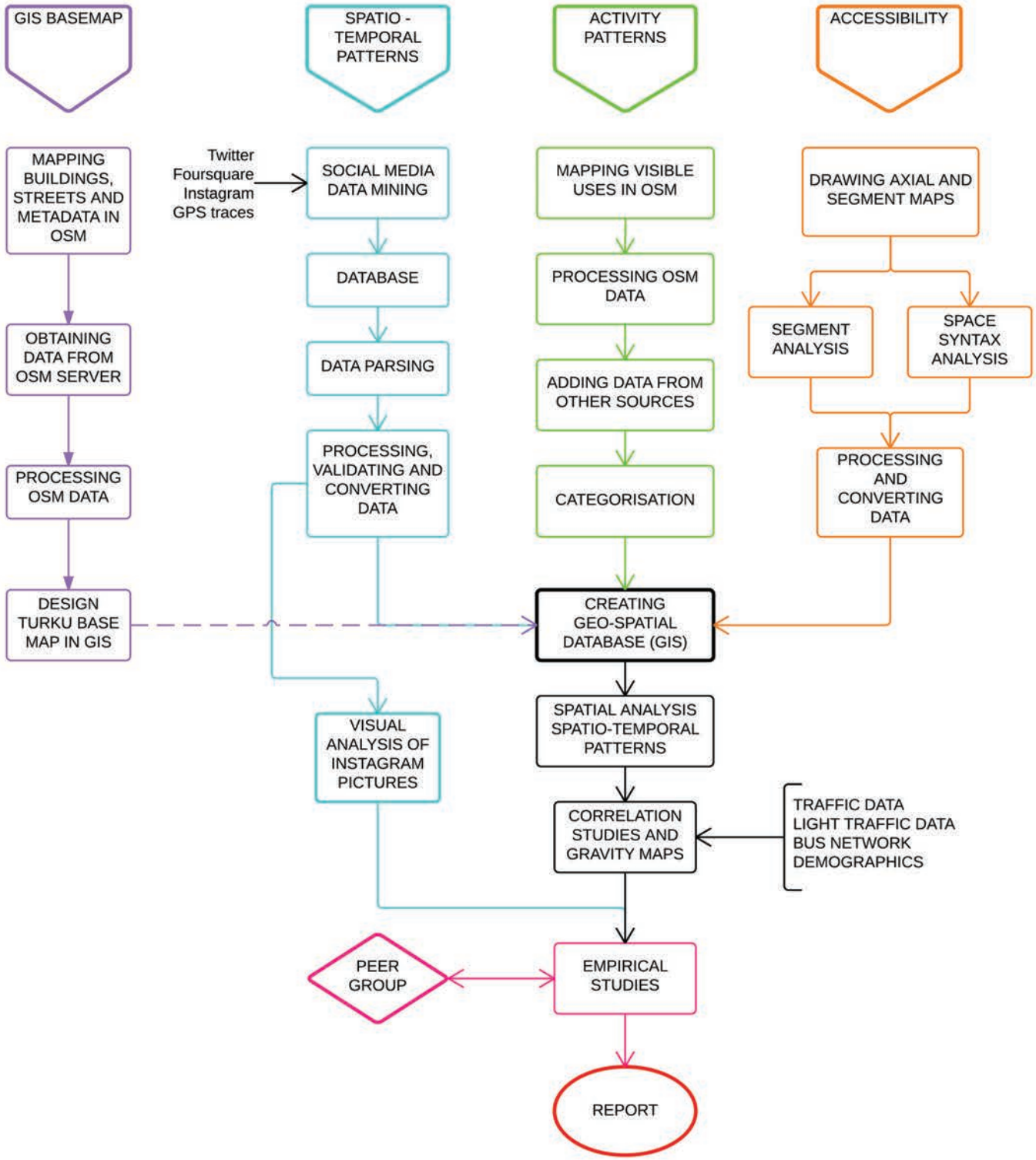


Figure 12. Work plan

SPATIO-TEMPORAL PATTERNS

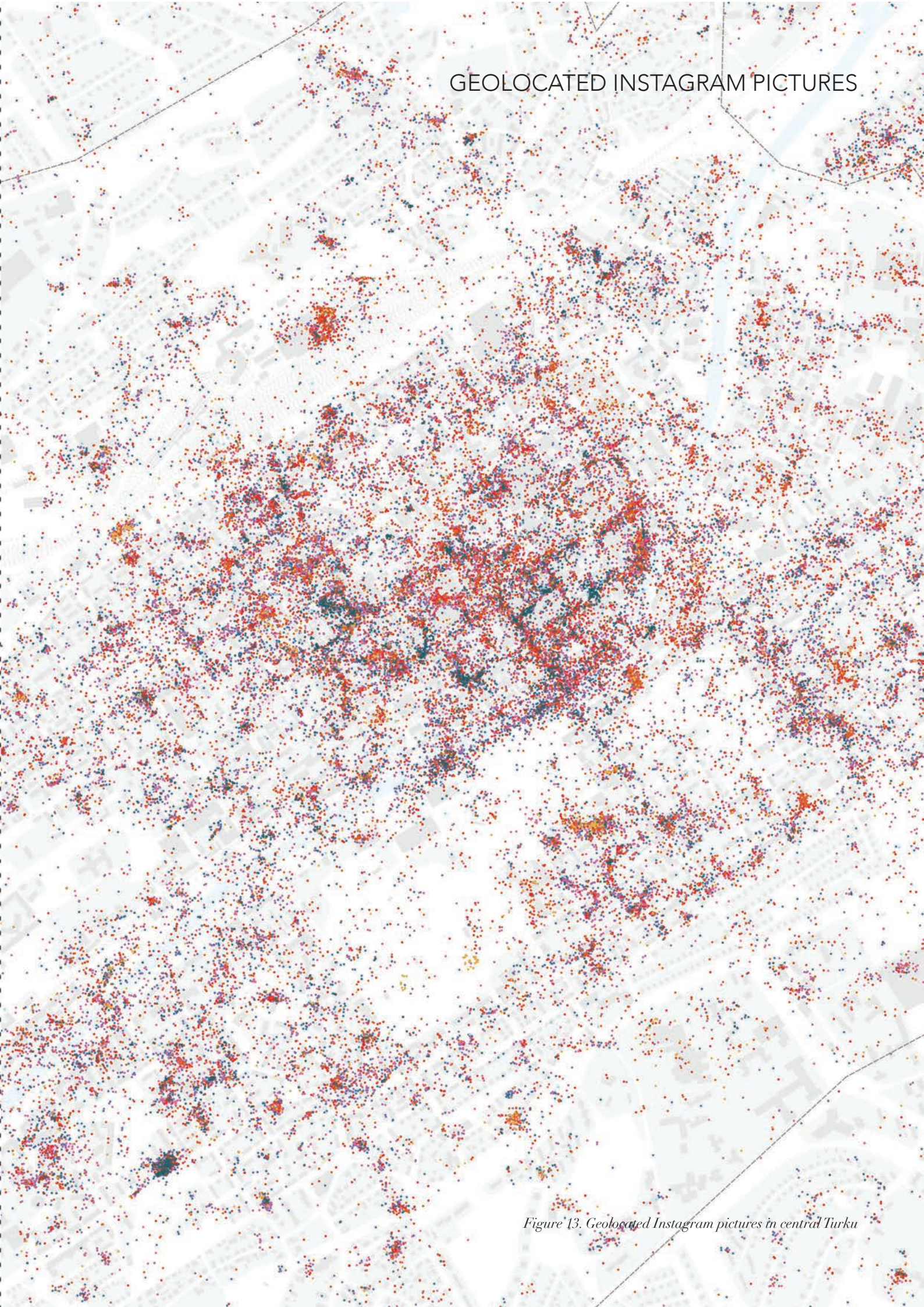
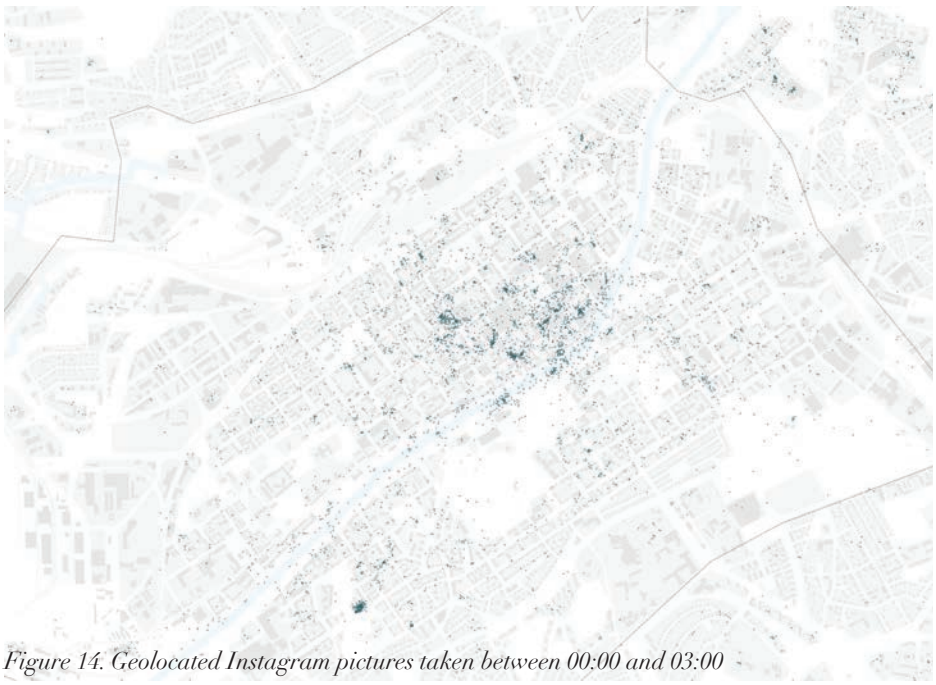


Figure 13. Geolocated Instagram pictures in central Turku

The information we collected from Instagram offers a general and quantifiable understanding of the events that gather people in certain areas of urban space, as well of the interests, habits and attitudes of the local population – the very pulse of the city. Looking at the sheer volume of online activity on social networks, most of which takes place on-the-go, one can see the city breathing – as the end of the workday gives way to leisure activities, which eventually taper off as more and more people go to bed, only to start all over again the following morning. As an increasing number of people attach "tags" to their social-media posts, individual tags offer even more information.

00:00 > 03:00



Monday: 1170
Tuesday: 800
Wednesday: 869
Thursday: 1025
Friday: 987
Saturday: 1851
Sunday: 2328

Figure 14. Geolocated Instagram pictures taken between 00:00 and 03:00

Monday: 184
Tuesday: 141
Wednesday: 157
Thursday: 196
Friday: 187
Saturday: 437
Sunday: 615

Figure 15. Geolocated Instagram pictures taken between 03:00 and 06:00

03:00 > 06:00

Mapping spatio-temporal patterns

In order to visualise spatio-temporal patterns using Instagram data, we have designed a series of maps showing all the geolocated Instagram pictures divided by time frames of 3 hours. Each geolocated Instagram picture is represented with one point on the maps, while colours are used to identify the time frame. These maps can be used to observe people's location density, revealing the active and idle urban spaces depending on the day and the time frame. In addition, for each map we indicate the number of pictures taken during the time frame of each day to have a more detailed overview of users' temporal patterns.

06:00 > 09:00

Monday: 813
Tuesday: 873
Wednesday: 891
Thursday: 934
Friday: 1022
Saturday: 637
Sunday: 491

Figure 16. Geolocated Instagram pictures taken between 06:00 and 09:00

Monday: 2253
Tuesday: 2259
Wednesday: 2362
Thursday: 2712
Friday: 2715
Saturday: 3133
Sunday: 2476

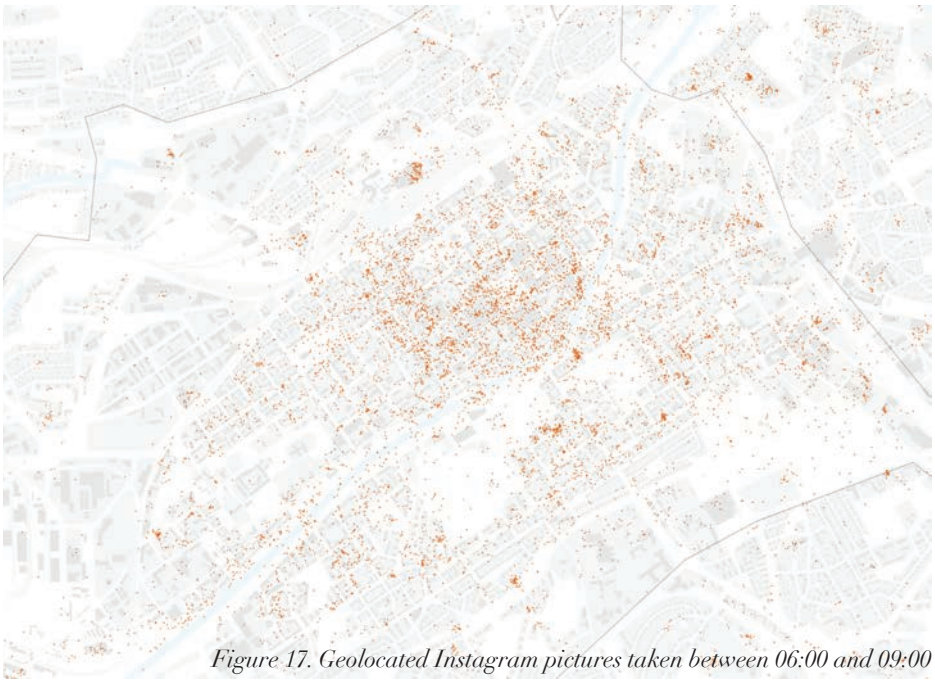
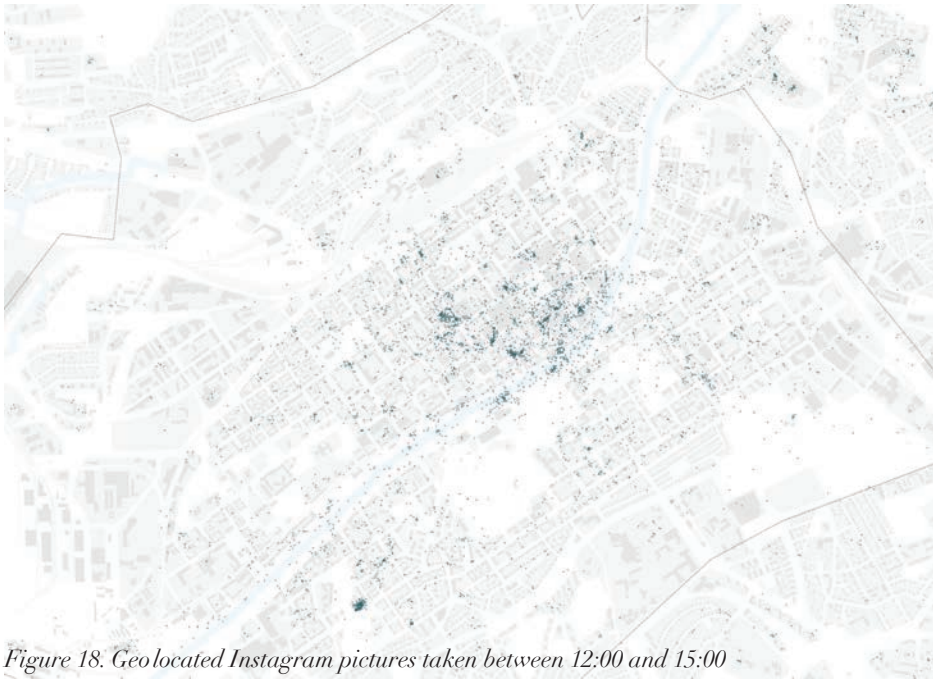


Figure 17. Geolocated Instagram pictures taken between 06:00 and 09:00

09:00 > 12:00

12:00 > 15:00



Monday: 3275
Tuesday: 3299
Wednesday: 3368
Thursday: 3299
Friday: 3987
Saturday: 4555
Sunday: 4359

Figure 18. Geolocated Instagram pictures taken between 12:00 and 15:00

Monday: 3503
Tuesday: 3724
Wednesday: 3825
Thursday: 4153
Friday: 4473
Saturday: 5165
Sunday: 4520

Figure 19. Geolocated Instagram pictures taken between 15:00 and 18:00

15:00 > 18:00

18:00 > 21:00

Monday: 3887
Tuesday: 4226
Wednesday: 4410
Thursday: 4551
Friday: 5223
Saturday: 5215
Sunday: 4543

Figure 20. Geolocated Instagram pictures taken between 18:00 and 21:00

Monday: 3302
Tuesday: 3536
Wednesday: 3649
Thursday: 3757
Friday: 4572
Saturday: 4644
Sunday: 3738

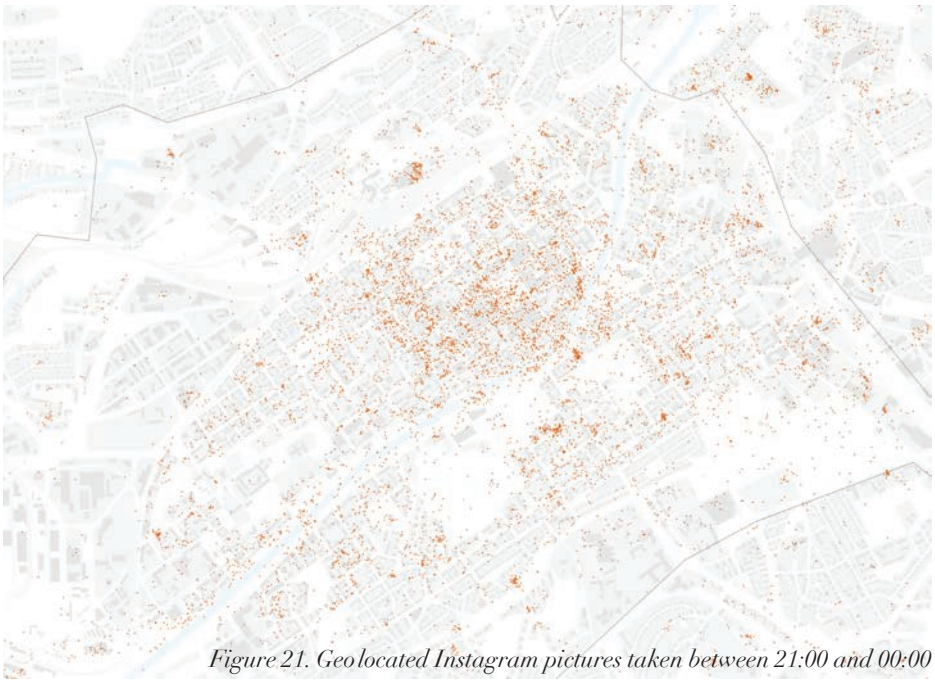


Figure 21. Geolocated Instagram pictures taken between 21:00 and 00:00

21:00 > 00:00

Hastags

Instagram users can add text to their pictures and use this feature to embed hashtags, links to other users or emoticons. Third parties are allowed to obtain this text and the comments left by other users on each single picture. Researchers can analyse the semantics to learn about trending topics or study references to other users to reveal users' friends network.

Hashtags are words, unspaced phrases or numbers prefixed by the hash character (#). People generally used these to identify a place (#turku), to express feelings (#happiness), to annotate a topic (#kissmyturku), to locate the picture in time (#sunday), to relate to an event (#ruisrock), to describe an activity (#shopping) and so on. Instagram users can add hashtags to their pictures manually or by using Instagram companion apps (such as Instatag) to help generating hashtags. For the time limits of this project we will give a short demonstration of using hashtags to map spatial and temporal patterns of selected topics. Below we present a set of graph showing the temporal pattern of hashtags that we found significant for mapping activities and emotions but we also used them for validation purposes. For instance we observed the frequency of hashtags such as #night or #morning during night time and in the morning respectively. Possible picks of #night during lunch time would have alerted us on possible invalid data or unexpected social phenomena.

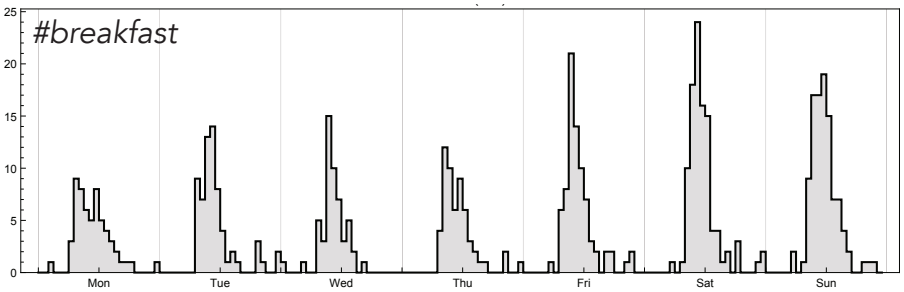


Figure 22. Daily use of "breakfast" hashtag in Instagram

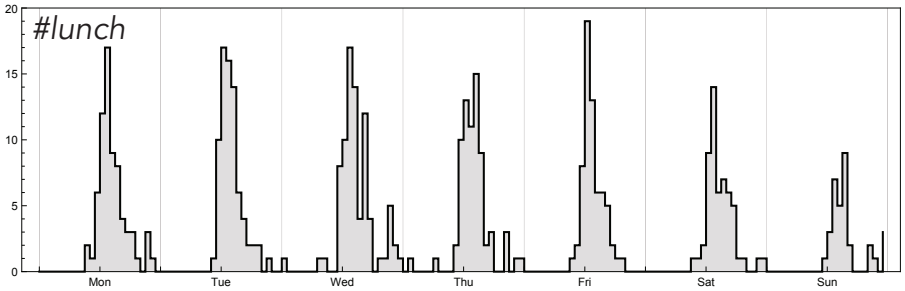


Figure 23. Daily use of "lunch" hashtag in Instagram

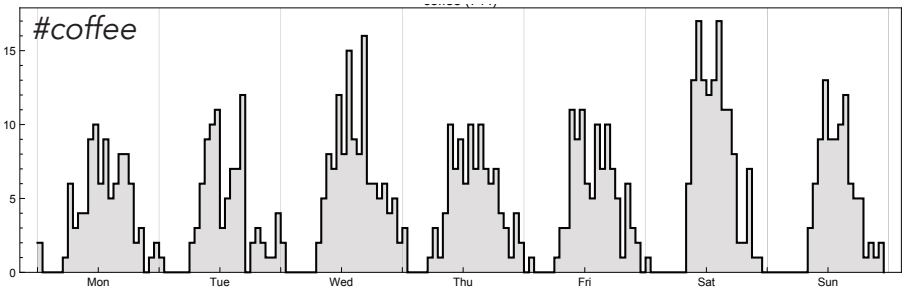


Figure 24. Daily use of "coffee" hashtag in Instagram

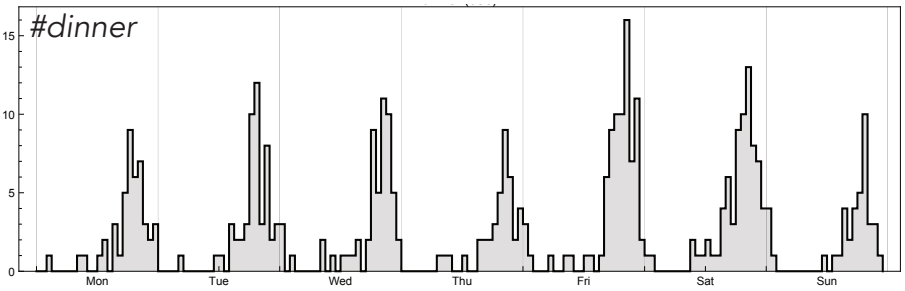


Figure 25. Daily use of "dinner" hashtag in Instagram

EMOTIONS

Positive emotion | Negative emotion tags

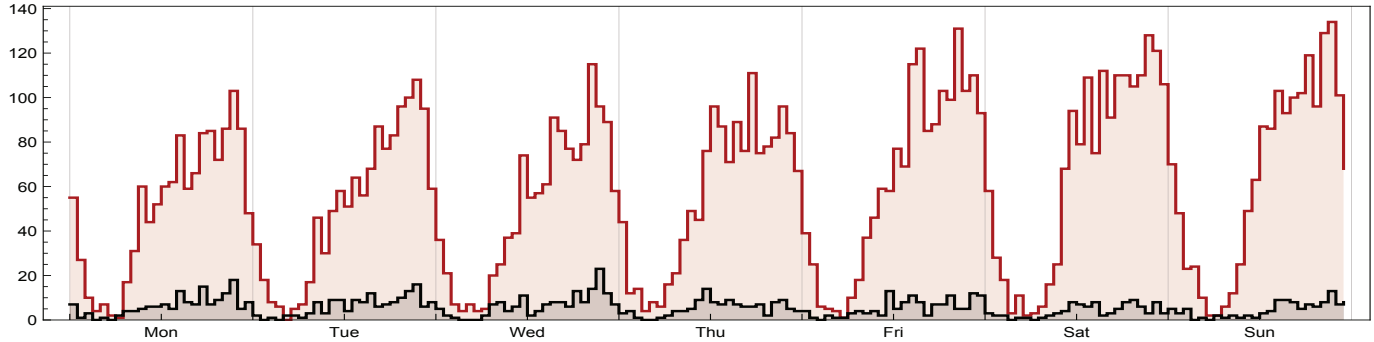


Figure 26. Daily use of "positive" and "negative" emotions related hashtag in Instagram

Emotions

Here we plot two sets of hashtags, one populated with positive sentiments (e.g. #happy, #goodtimes, #smile) and a second one with negative sentiments (e.g. #sad, #bored, #tired). The graph shows that the frequency of the hashtags from each set follow the same temporal dynamics of the general usage of Instagram (see page 17). It is interesting to highlight that the frequency of positive sentiments is about 4 times higher than the negative ones. This suggests that taking pictures with Instagram is an action mostly related with having a good time, and people are perhaps more likely to share exciting and good moments of their lives.

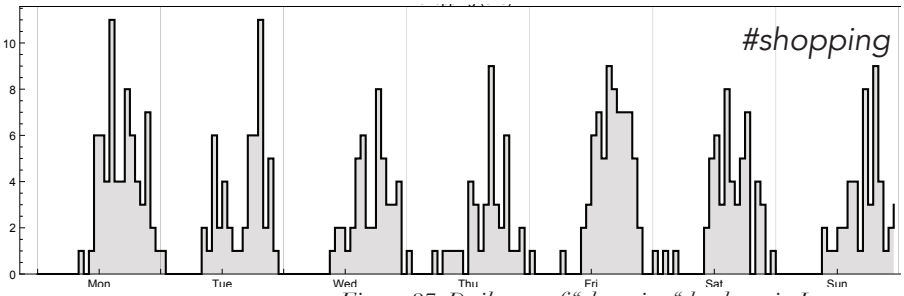


Figure 27. Daily use of "shopping" hashtag in Instagram

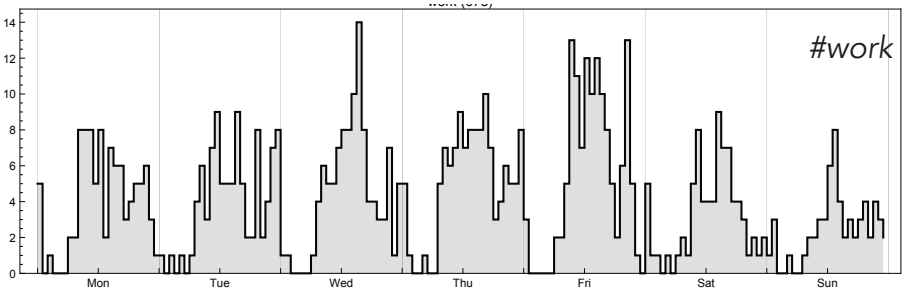


Figure 28. Daily use of "work" hashtag in Instagram

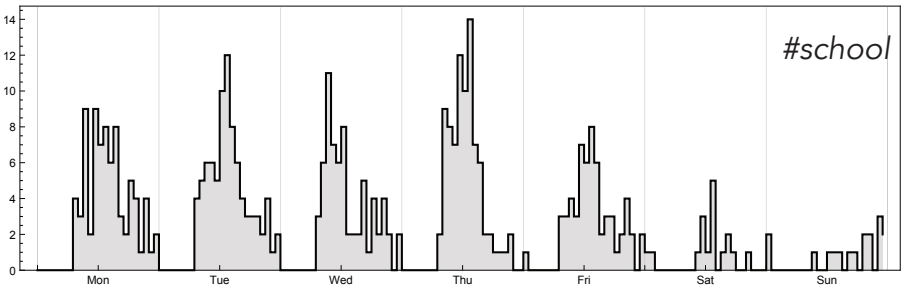


Figure 29. Daily use of "school" hashtag in Instagram

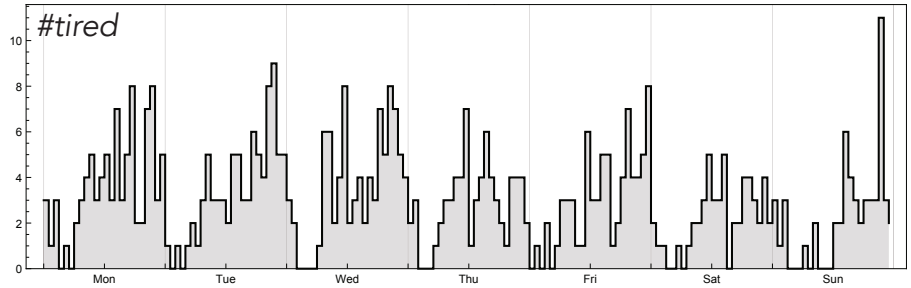


Figure 30. Daily use of "tired" hashtag in Instagram

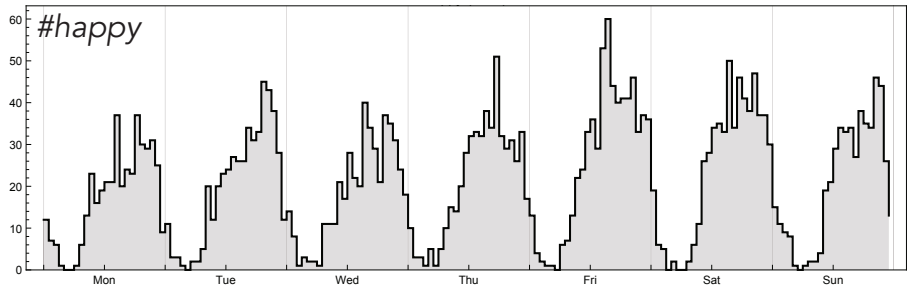


Figure 31. Daily use of "happy" hashtag in Instagram

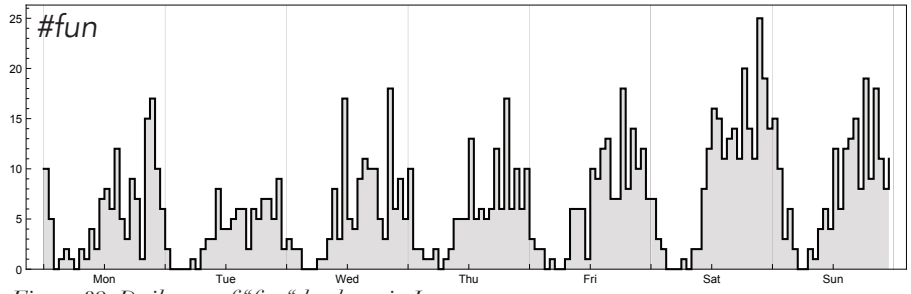


Figure 32. Daily use of "fun" hashtag in Instagram

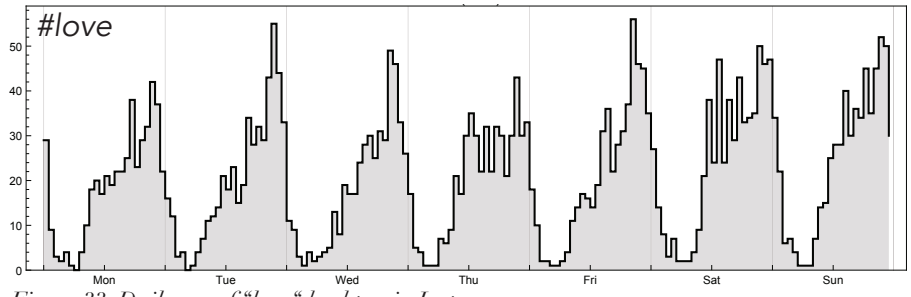


Figure 33. Daily use of "love" hashtag in Instagram

TOP 50 HASTAGS

turku -18205
finland -7035
summer- 3817
love -3518
happy -3499
me -2974
selfie -2922
åbo -2657
finnishgirl -2412
ruisrock -2047
my -1655
vscocam -1594
suomi -1535
girl -1530
party -1486
friends -1441
finnish -1438
today -1340
kesä -1315
food -1307
aurajoki -1303
instagood -1262
tb -1210
ruisrock2014 -1181
home -1173

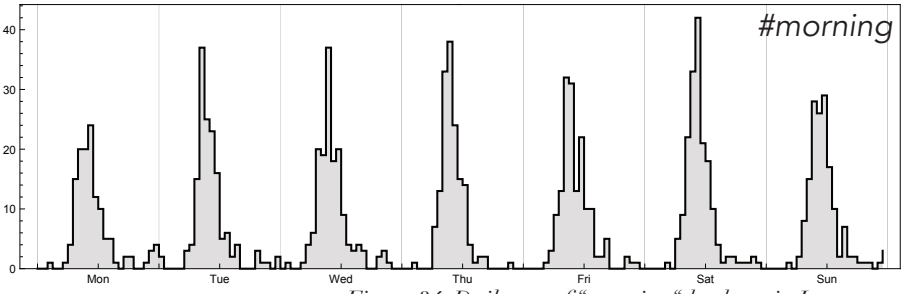


Figure 34. Daily use of "morning" hashtag in Instagram

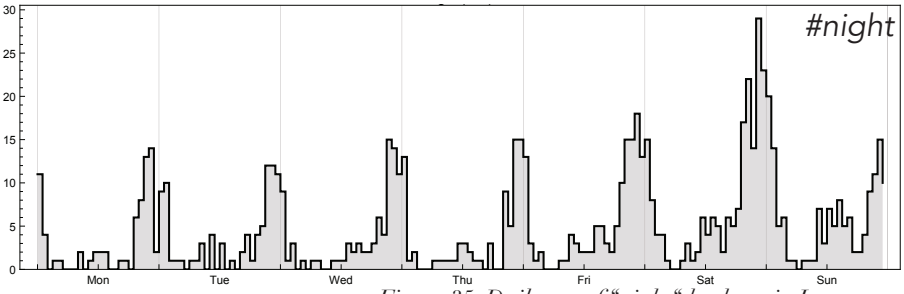


Figure 35. Daily use of "night" hashtag in Instagram

autumn -1144
morning -1078
fun -1064
cute -1021
beautiful -1019
sun -1007
finnishboy - 976
kissmyturku - 956
cat - 950
spring - 925
pets - 899
fashion - 896
smile - 880
dog - 871
dogs - 868
100happydays - 861
nature - 849
photooftheday - 841
котопёс - 835
followme - 827
ootd - 811
labrador - 798
girls - 791
night - 773
with - 767

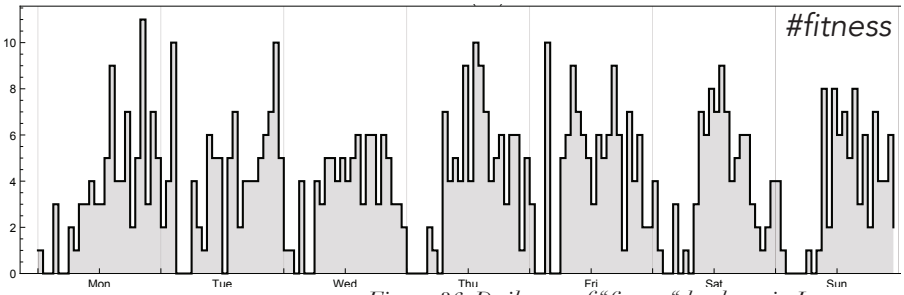


Figure 36. Daily use of "fitness" hashtag in Instagram

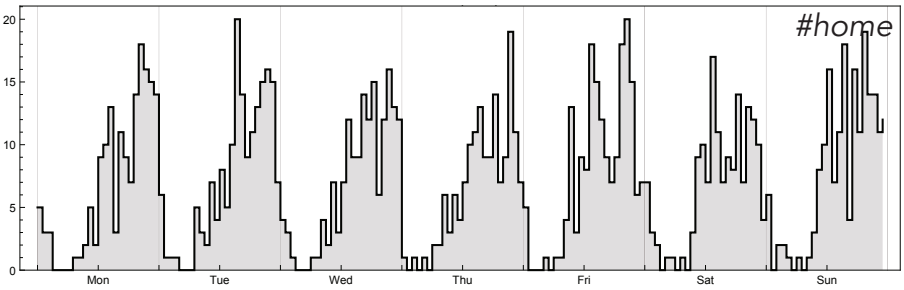


Figure 37. Daily use of "home" hashtag in Instagram

Hashtag maps

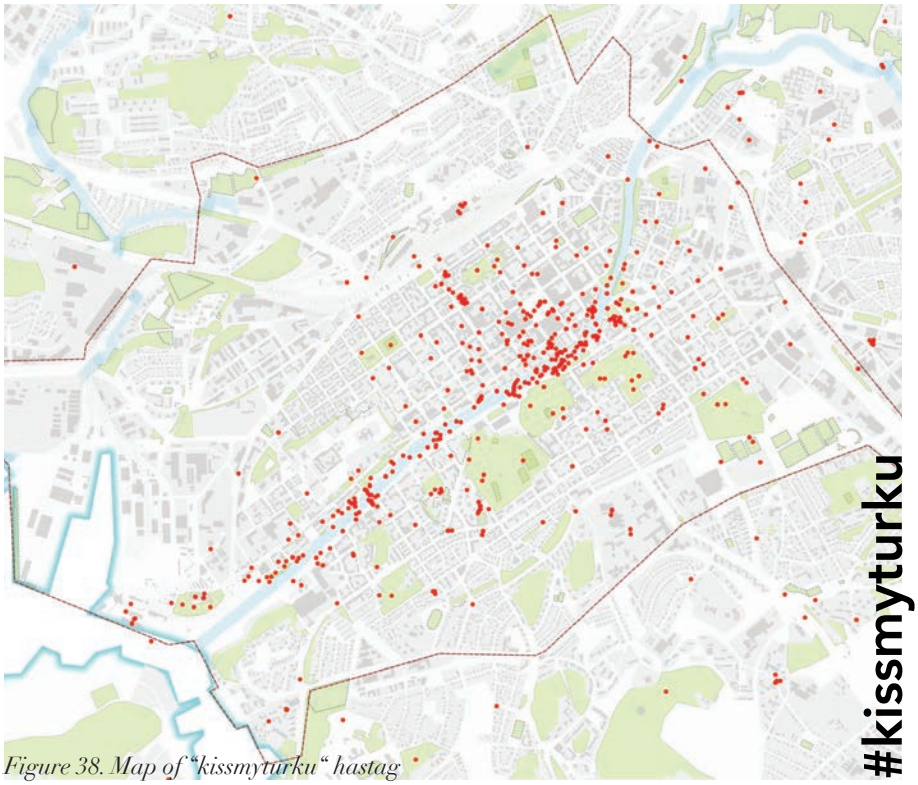


Figure 38. Map of "kissmyturku" hastag

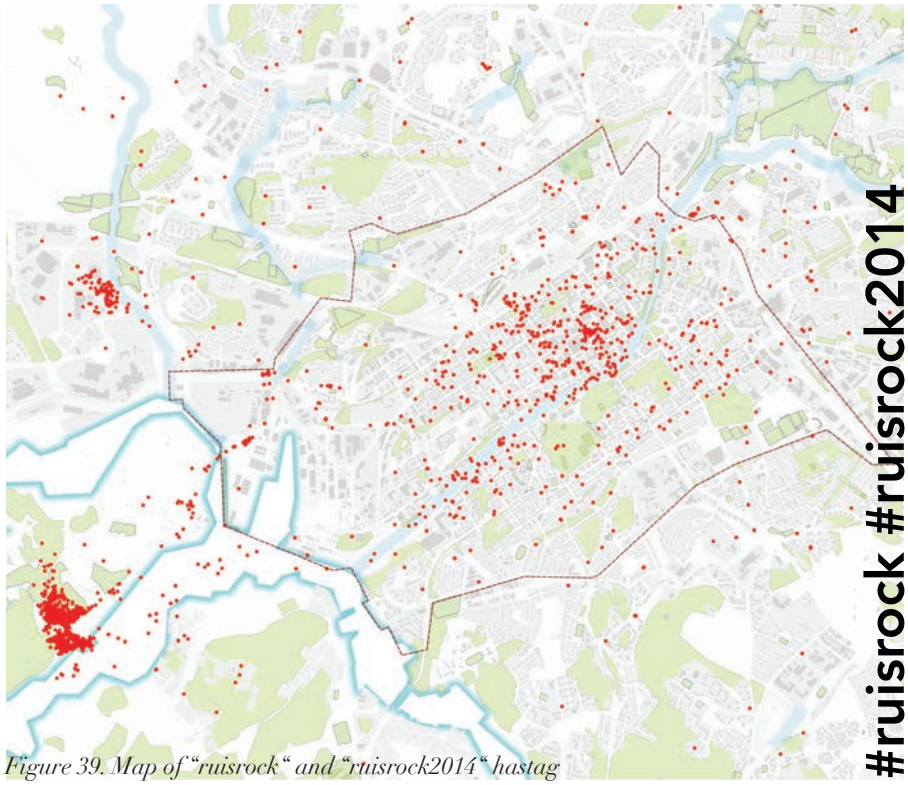


Figure 39. Map of "ruisrock" and "ruisrock2014" hastag

Hashtag maps

As presented above, certain hashtags show visible patterns if plotted on the temporal line while others can reveal spatial patterns if displayed on a map using the geographic coordinates of the location. So we have drawn up a series of maps representing hashtags related to places, activities, topics and events, however, hereby we present only the ones that reveal interesting spatial patterns.

Success of cultural planning

Popularised in the 1990s by Landry and Bianchini, cultural planning has become an important integrative framework for spatial and cultural development. For the City of Turku, a concrete program of cultural planning is not in existence today but several initiatives have been undertaken in the past by interested individuals. At the same time the analysis of Instagram hashtags has revealed some elements of cultural planning in relation to the Kiss My Turku initiative as well as to Ruisrock music festival. The success of Kiss My Turku shows how cultural initiatives and programmes can be beneficial for the development of the city image and for increasing active participation in city life.

Events

Ruisrock is the largest event in Turku. It definitely shapes the image of the city, bringing a high number of people not only to Ruissalo but also to the city centre. During the music festival, there are also side events that generate movement and activities related to the main concerts but in different parts of the city, thus creating a positive spillover effect on activity. While we do not know their exact character, our data suggests high potentials in generating city-wide activity during the main events, such as Ruisrock

or Tall Ships Race. Whole city could temporarily "change outfit" during events, making the added value accessible to everyone.

Marketing

"Kiss My Turku" initiative has proven itself as a great success. Many users connect to the slogan by taking images about parts of the city and places or landmarks they are most proud of. Clearly, people love the river. However, we found it still underdeveloped and under-designed, and as such, the area has the strongest potential for further development. This is because there are very few permanent services compared to its popularity. The combination of new programmes, which would provide alternatives to the current few floating bars, and continuing the marketing of "Kiss My Turku" as the overarching brand of multiple new initiatives (both hip and low key) would be a formula for success.

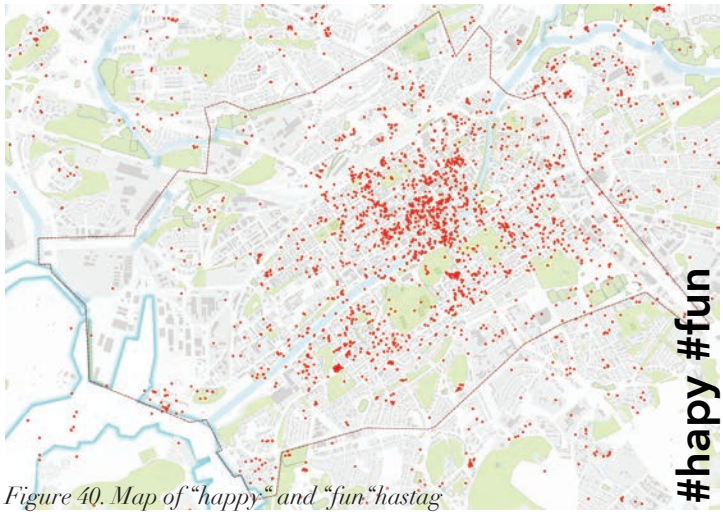


Figure 40. Map of "happy" and "fun" hastag

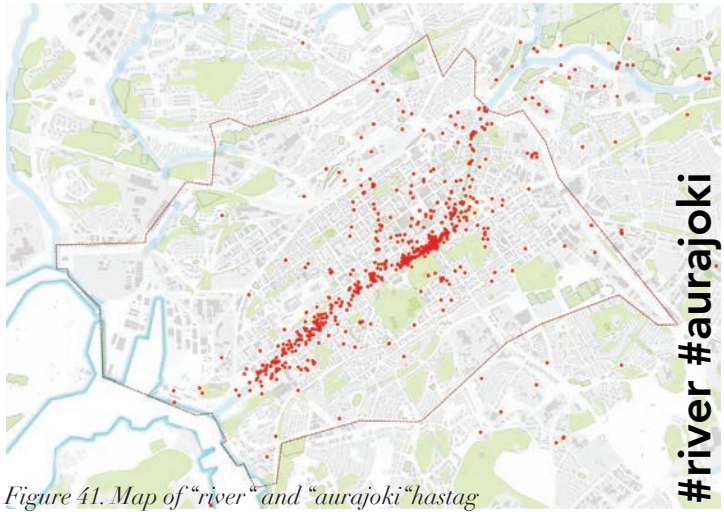


Figure 41. Map of "river" and "aurajoki" hastag

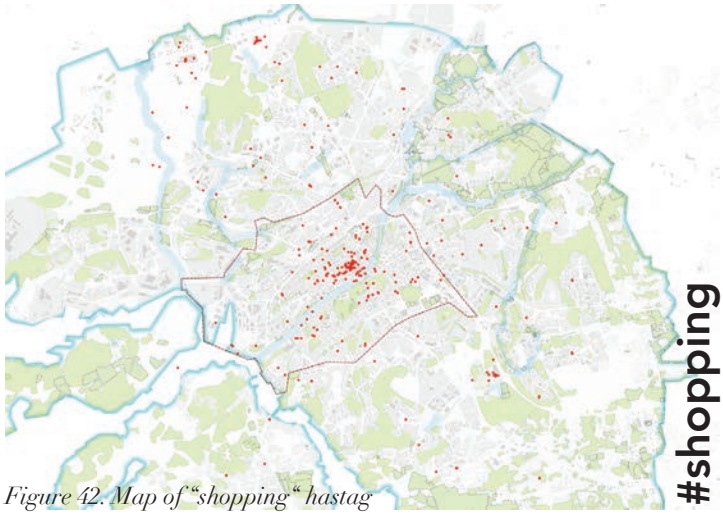


Figure 42. Map of "shopping" hastag

A sense of place

Instagram enables third parties to obtain the URL of publicly shared images, creating an overview of all geolocated pictures taken in Turku. This data is a hidden treasure for researchers aiming at studying the perception of the city. For this project we studied the subject of the pictures taken (or uploaded) in five selected public spaces of Turku.

Based on advice from Turku's specialists, we took five examples of relatively differently functioning public spaces with different characteristics and locations. They are Humalistonkatu, the two squares of Kauppatori and Vähätori and the two bridges Kirjastosilta (the Library bridge) and the railyard pedestrian bridge. In each case we collected a sample of pictures randomly chosen within a small radius from the public space. The number of pictures chosen in each case depended on the approximate total number of pictures from that specific area. Afterwards we observed the pictures and remarked the frequency of certain groups of subjects, such as buildings, people or pets. We also identified if pictures were taken indoors or outdoors. Eventually, the same information was used to compare different spaces according to the different types of pictures people preferred to take. The results are strikingly different between more and less liked public spaces.

The size of the sample was: Humalistonkatu – 200 pictures; Kauppatori – 200 pictures; Vähätori – 100 pictures; Kirjastosilta – 50 pictures; and railyard pedestrian bridge – 50 pictures.
Representation of these case studies cannot be presented as picture board in this report due to restrictions in Instagram's terms of use.

Humalistonkatu

Humalistonkatu connects the main railway station to the very centre of the city. Although this relatively long and tense street mostly includes apartment buildings, the street level is occupied by mixed uses and spaces for activities along the entire street. This typical urban configuration with relatively tense housing generates topical hotspots of human activities at the corners where Humalistonkatu intersects with other streets.

The first notable observation is that out of 200 pictures, 124 were taken indoors and only 27 outdoors. Secondly, most popular topic of the pictures were the authors themselves, as a single person or a group (79 pictures). There were also pictures consisting of single objects (a hole in a stocking, an apple) and images of other medias (of a poster, a poem, a humorous sentence, etc.) which do not reveal much information about the space itself but rather communicate to the people involved in the network (48 pictures). Another topic strongly present was food – especially indoors and mostly in a "homey" environment (22 pictures). Animals are present in 8 pictures, also at home, indoors. The images that would be most interesting to analyse the public space, such as views or public landmarks, were mostly absent and represented only in 10 pictures. Even though ground floors include mixed uses and different offices, services etc. can be found along the entire street that could foster multiple activities and social interactions, the collective image does not reflect it. Instead, most of the activities take place in a home environment (from a selfie to a view taken from a balcony), concentrating on perceiving moments of daily life at home or at gatherings with friends. The street itself does not stand out with anything remarkable, it does not reflect lively street life, rather a space which is passed by.

Considering Humalistonkatu's role in the central network of active streets, the result suggests a need for a revitalisation programme. In its current form it appears to lack attractivity to be pictured neither by its own residents nor by visitors.

Kauppatori

Kauppatori represents a big central square rounded by bus stops and businesses. Public transportation, shops and bars form an active border almost all around the square. Nevertheless, Kauppatori as a public space or the buildings that give it the square shape are present in only 24 pictures out of 200 – even if some of them have quite distinctive architectural qualities. Surprisingly most of the pictures are taken indoors (102 pictures indoors vs. 58 outdoors). The most extensive category of pictures are selfies with one or several persons – 62 pictures. Most of these are clearly taken out of home, whether in a gym, bathroom, cafeteria or a bus stop. Similarly important are images containing views and food (28 pictures).The third group combines objects and images of other media (43 pictures). Objects are mostly commercial items – images taken in the shops or posted by the shops (shoes, clothes, glasses, etc.). The square comprises a very wide area. Although it is the most central spot in Turku, it is not recognised as a lively square in the pictures' collective image. Yet many selfies, pictures with friends, food and objects are taken there. This should be seen as great potential for the redevelopment of the square, which apart from the morning market is currently functioning mostly as crossing space between different bus stops or other attractions at its edges.

We can conclude that the square is currently recognised only because of the functionalities surrounding it. An idea could be to activate it with temporary uses to make the square active throughout the day and the weekend. A new sheltering pavillion might also offer the spark to host multiple activities through all the seasons. If well designed, it could create a new and recognisable image of the square.

Vähätori

This small stone-paved triangular square is situated along an active pedestrian street next to Aurajoki and the Turku Main Library. The scenic pedestrian path along the river inspires walking and cycling, socialising and enjoying the surroundings, while several restaurants and public benches next to the river attract people through different times of the day and during different seasons.

Out of the 100 pictures we collected, 51 were taken outdoors and only 22 indoors. Most pictures were representing views of and from the square to all the directions, showing the library and a fountain, the square, views to the river and streets nearby (37 pictures). After that there are pictures involving people (23 pictures), out of which 9 include one person and 14 mostly two persons. Several pictures (26) display objects or references to other media. Pictures of food play a moderate role (10 pictures) but presence of different places providing food have a much important role as a background to group pictures, views indoors and places to enjoy food outdoors.

Pictures taken in Vähätori are always about Vähätori, showing the strong appeal of the public space, even though as such it is a relatively new one.

Based on the data, we can confirm Turku's success in developing this square since it has formed a strong popular identity among people. The image of the square is strongly present, whether as the main subject of pictures or as a background for social activities, rather than being constructed by the services. People value the outdoor public space and enjoy it in all possible ways. Most common activities observed from pictures were having a drink outdoors or enjoying food at the newly opened restaurants, sitting on a fence, enjoying public events or simply scenic views. It looks like a quite touristy place, but it is obviously appealing for local citizens of different age groups as well.

Kirjastosilta

Kirjastosilta is a brand new pedestrian bridge across the river. Out of 50 pictures, 35 were taken outdoors, out of which 22 depict views including the bridge at night which glows blue due to its glass and lighted railing structure. Images involving persons on it (15) are closely connected with the river or bridge shown in the background. Third important group is food (6 pictures). All of these pictures are taken in restaurants and bars located close to the bridge. Other pictures play a minimal role.

Apart from the very strong presence of the river and bridge in most of the pictures, which can be predictable, it is interesting to note the importance of pictures taken in the night of the lighted bridge but also of the river and riverside. Indoors is present only as an eating and drinking place.

Railyard pedestrian bridge

This long pedestrian bridge reconnects the northern part of the city that is disconnected from the centre by a railway. It functions as a link between the parallel running Köydenpunojankatu and Ratapihankatu with rail tracks in-between. The biggest category of pictures again involve the views – 18 pictures out of 50. As expected, most pictures were taken outside (24 pictures, while 11 pictures were taken indoors). 12 images involved persons in them but the bridge was present on the background only twice. Objects, other pictures and food were seldom represented.

In general there were two kinds of pictures: firstly those strongly connected to the railways – romantic views of the bridge, railway and trains, train stop and station; secondly smash-up of mostly indoor pictures of persons, objects and other images.

Short conclusions

Observing Instagram pictures allows us to characterise an area through the eyes of the users, giving new information on the meanings people attach to urban spaces. Instagram pictures provide a quick and immediate opportunity to gain an understanding of the "sense of a place", to study what could be missing or possibly improved in order to direct the area in a preferred direction from the social point of view.

A different method is needed to analyse pictures on a larger scale. Yet there are also technical questions to overcome. Most importantly – the areas cannot be defined very precisely as geographical locations are sometimes imprecise (e.g. in case of a bridge, there are pictures taken at home). For our analysis, we took a slightly bigger area covering the edges nearby the example areas (e.g. the square and the buildings surrounding it). Secondly it can be brought out that there are also always pictures that clearly do not belong to the area studied (e.g. in Humalistonkatu a picture of Ruisrock or vacation in Thailand). This can be explained by the fact that people do not necessarily post the pictures straight after taking them. This phenomenon is present especially in locations with a high number of indoor pictures. It seems that pictures taken outdoors are more likely posted immediately.

Ethical note

As researchers, our goal is to identify general patterns to learn more about our cities, not about individual users. The increasing use of the Internet and the growing popularity of social networks have raised the questions of anonymity, privacy and the third party usage of the information generated. The cases where the information about the users' exact location is used are especially delicate. Several studies reveal possibilities to predict users' movement or next location choice quite exactly even when his or hers phone's privacy settings do not allow to share any location information. Several programmes and applications allow third parties, just like us researchers in this project, to download, store and analyse users' location data without informing them. There are already applications, such as Open Path, which are collecting users' location data, but the third parties can use the data only if users accept their specific usage request. With this system each users is made aware of what is the final use of the data one produces and only then he or she can allow or deny third parties from using it.

We believe that the majority of users are not aware that third parties can use their data, including tracking their daily movement, reading what they write or seeing what pictures they post or like. In our ethical code we are willing to analyse users' data on a general scale, but not doing analytics of single users as they might not be aware of it. For the purpose of this research we have screened hundreds of instagram pictures to analyse what people see without knowing who is seeing that. Virtually it would be possible to study even individual user's profile, as many of them publicly share their full name, and easily figure out where they work, live or study. For this reason, when we are analysing the data, we have not downloaded the full name of the users but only their identification code or nickname. Furthermore, we have not studied any content of individual users.

ACTIVTY PATTERNS

The aim of this project is to study human activity patterns in order to assess what are the streets that are most likely to attract social interactions or have potential for new development in relation to the construction of the new tram line. Jan Gehl has proposed an efficient method for studying the complexity of people's behaviour in public space by grouping human activities into what he calls Necessary, Optional and Social activities. The necessary ones include all the activities that are part of our daily routine, such as going to work, buying groceries or shopping; optional activities include all the activities that we carry out when we have free time, such as walking the dog, jogging or visiting a museum; social activities include all the activities that comprise social interactions, such as meeting a friend in a bar, going to the church or participating in the collective cultural life of the city. This approach focuses on the activities themselves and it also requires weeks of intense observations and a team of expert surveyors, while our goal is to study the possible interactions occurring along streets by looking at what kind of activities are hosted by ground level functions and services, approximating such a detailed investigation remotely and in the short period of one week.

To do so we used OpenStreetMap (OSM) in combination with Google Street View to map all the visible uses on the street level – such as shops, bars, restaurants, offices, etc. We remotely surveyed each single street of central Turku during one week, mapping and categorising 2206 uses – these were mapped in an OSM database to make the information we produced available to the public. A small number of those were already available in the OSM database but we have verified all of them in this project. Eventually we used internet search engines and official information made available by the City of Turku, to verify the data we collected and add services that we might have missed. The main difficulty of this task was mapping pedestrian streets and other road sections that were not covered by Google Street View, therefore we visited the City of Turku for one day to map these streets and once again check for missing uses.

Many buildings are hosting uses at their upper floors, but as this study is centered on the social interaction that can be generated at street level, we focused on mapping all the uses present or with a direct opening to the ground floor.

The GIS base map of this project is also based on the OSM spatial database but as many streets, buildings and metadata were missing, we organised a mapping workshop to update the OSM database based on Google map satellite pictures.

We have contributed to the OSM database by mapping more than 8300 features such as buildings, streets and plots. We have also updated more than 1200 features that were already mapped but were wrongly represented, misallocated or missing the necessary metadata to characterise them.

As OSM is a crowdsourced platform, not all the users insert the data in the correct manner or with all the minimum information required. Often the attributes that characterise an element – such as "bar", "school" or "cafè" – were missing or were not structured in the correct format. One may simply leave all the elements with invalid metadata out of the sample but instead we decided to correct all the available data and fix all the strings of data that were structured incorrectly to make every possible information valid for use. Uses mapped in OSM were downloaded from the server and categorised (see Figure 43).

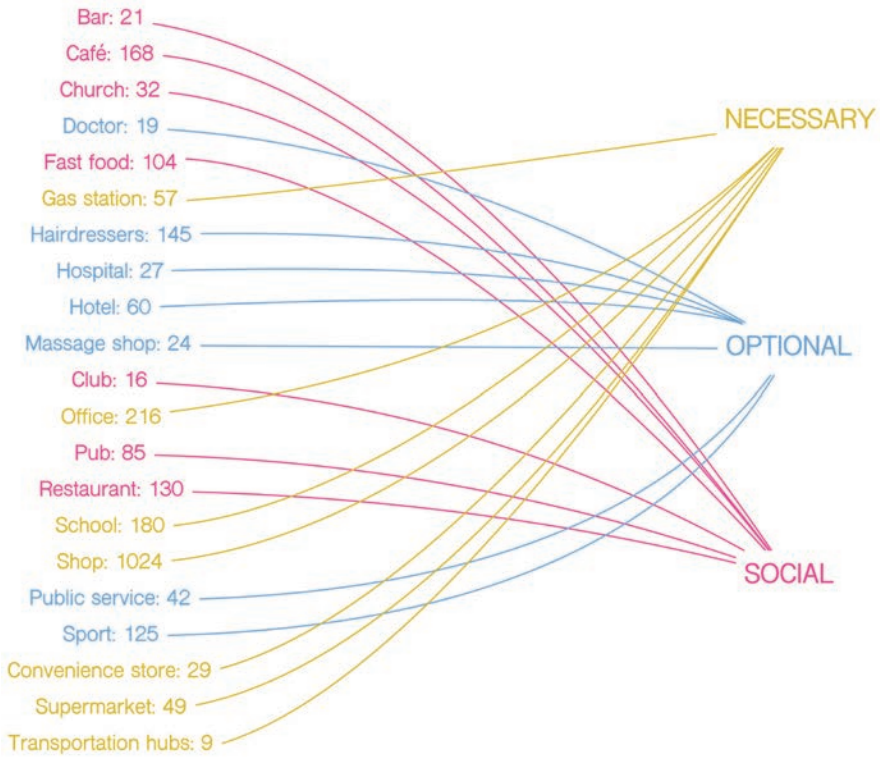


Figure 43. OSM data categorisation task

ACTIVITY MAP (version 1)

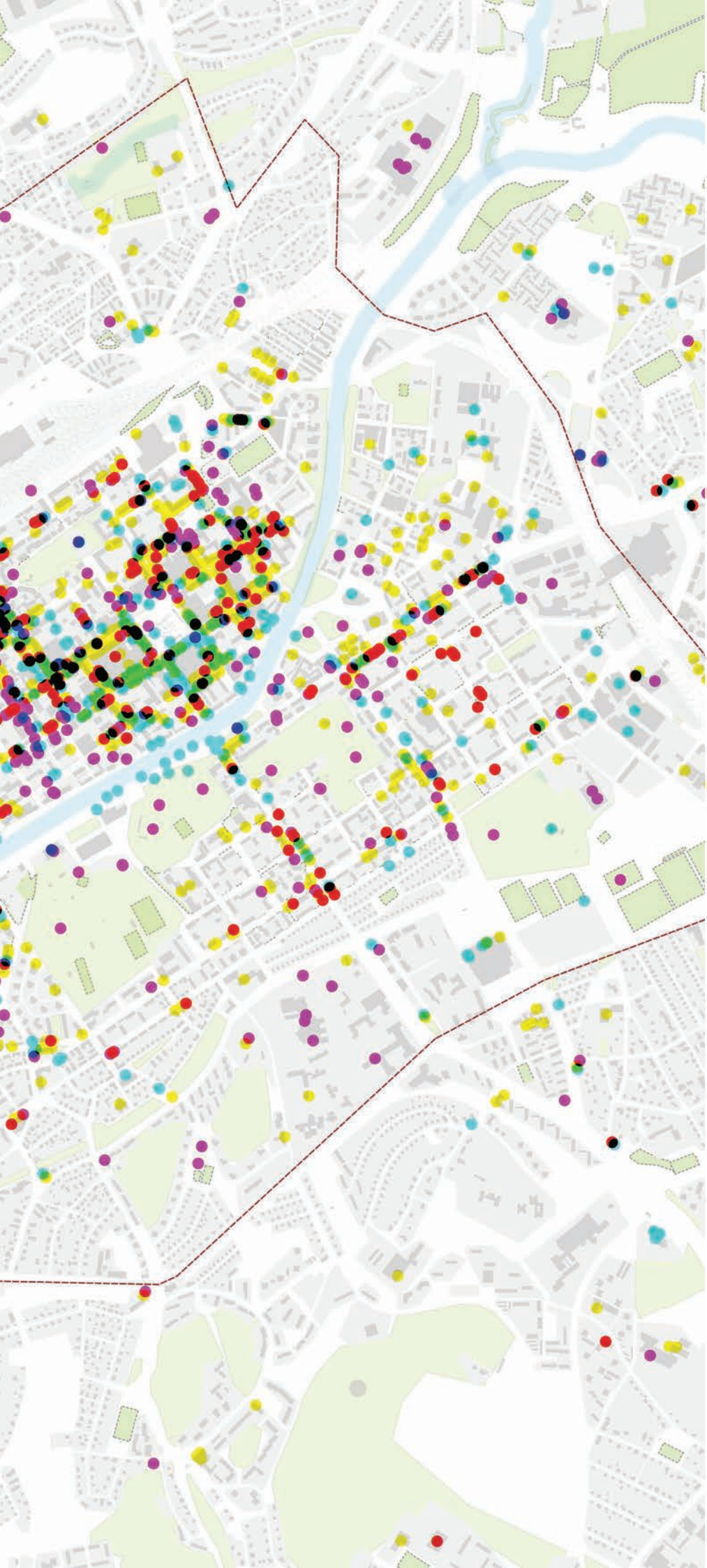
Inspired by the work of Jan Gehl, we have re-categorised the uses we mapped according to the activities they are most likely to host:

Necessary
uses that are most likely to host routine activities (e.g. schools, shops, grocery stores, etc.)

Optional
uses that are most likely host leisure activities (e.g. gyms, museums, spas, etc.)

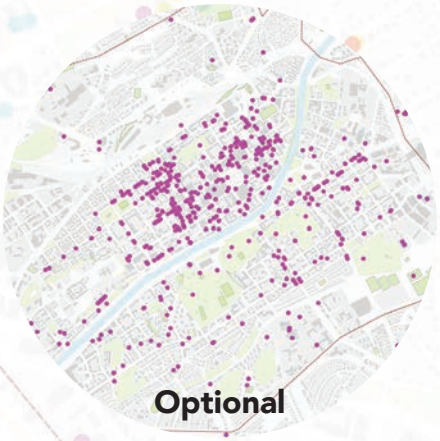
Social
uses that are mot likely host interpersonal activities (e.g. bars, cafés, clubs, etc.)

Figure 44. Activity map version 1. Each activity is represented with a circle



Necessary

+

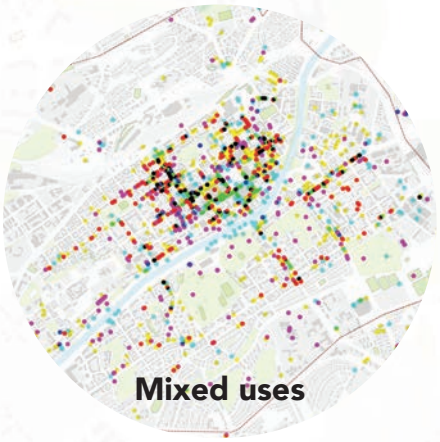


Optional

+

Social

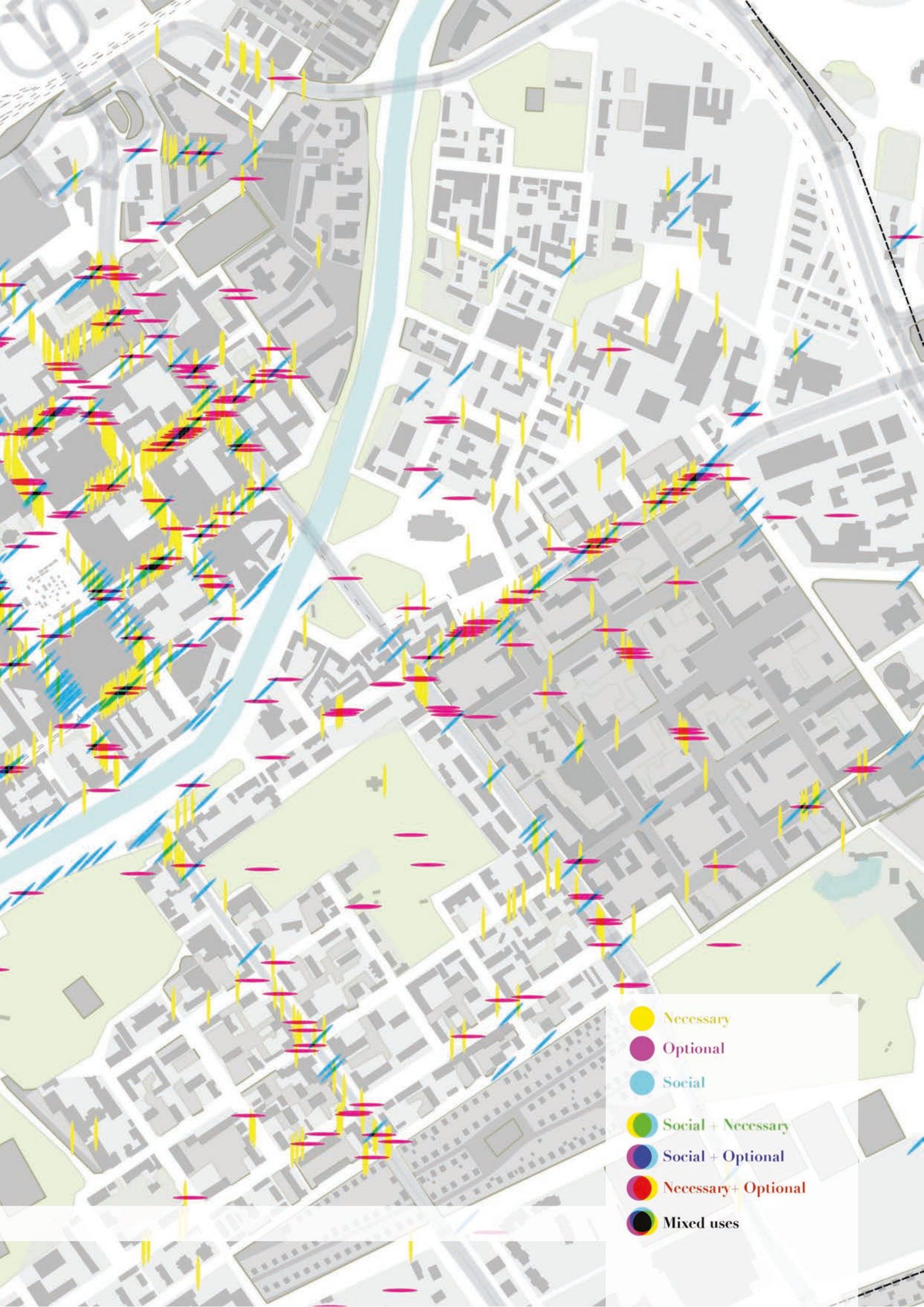
=



Mixed uses

Color code inspired by STAMEN

Figure 45. Activity map version 2. Each activity is represented with a dash


Necessary
Optional
Social
Social + Necessary
Social + Optional
Necessary+ Optional
Mixed uses

Temporal patterns

It is now necessary to understand the timeframe when the uses we mapped are most likely to attract human activities. In order to achieve that aim we carried out a short survey to estimate the general opening hours for each group of uses – bars, shops, offices, etc. – and designed a series of maps showing where and when certain kind of activities are more likely to take place. This series of maps can be used to understand where and when the city is most likely to attract certain type of activity as the spatio-temporal patterns change not only based on weekdays and weekends but also as a result of the opening hours of uses and services.

Brief comments

At first sight, the east side of Turku city centre is where most of the activities may take place. On the other hand, this series of maps reveal a dramatic functional shift from daytime to night time. Shops and services close early during the week or in the weekend, and after working hours the city centre turns from a multi-functional into a monofunctional urban environment capable to host social activities only along a few streets – such as Humalistonkatu

WEEKDAYS

MORNING
Optional 764/764
Ordinary 1242/1242
Social 200/556

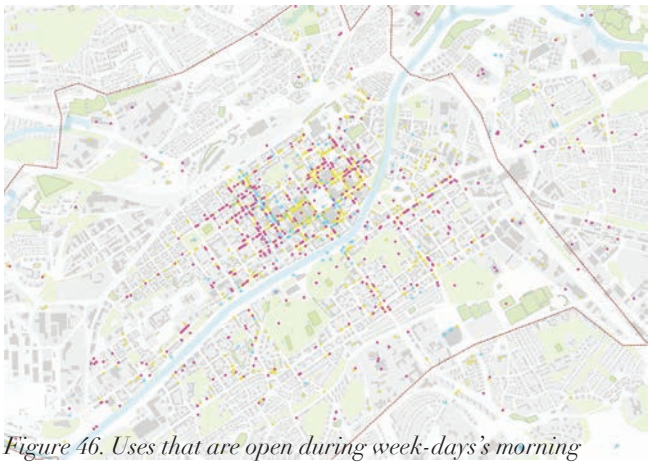


Figure 46. Uses that are open during week-days's morning

NOON
Optional 764/764
Ordinary 1242/1242
Social 540/556

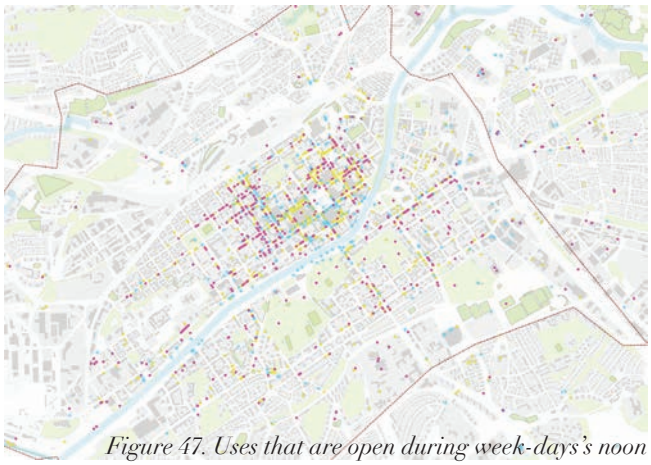


Figure 47. Uses that are open during week-days's noon

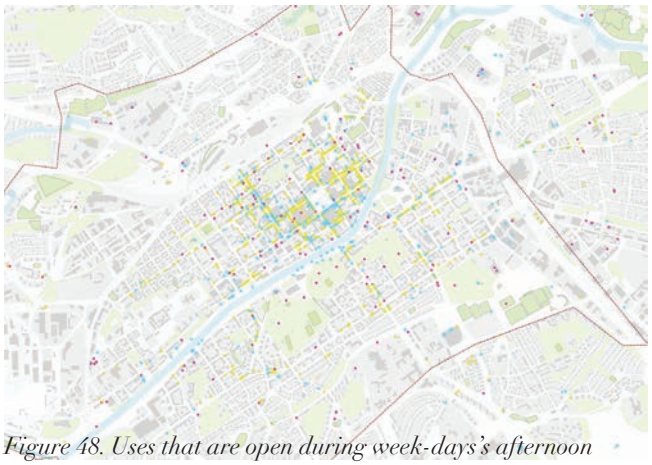


Figure 48. Uses that are open during week-days's afternoon

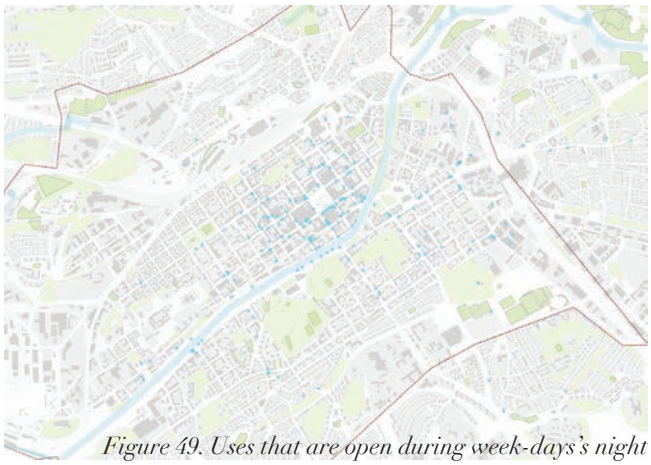


Figure 49. Uses that are open during week-days's night

AFTERNOON
Optional 297/764
Ordinary 1062/1242
Social 540/556

NIGHT
Optional 0/764
Ordinary 0/1242
Social 236/556

and streets surrounding the blocks of the Hansa Emporium and the Sokos Hotel. From the map of uses we found a market clustering phenomenon regarding certain activities such as bars and shops, which is strongly affecting the nightlife of certain streets. For instance, the retails cluster along the pedestrian section of Yliopistonkatu and the area surrounding the Hansa Emporium, has no space for uses that attract social activities such as bars, pubs or restaurants, making these areas idle at night during the weekdays - retails can also be negatively affected by the lack of uses linked to social activities. Pretty much all the social activities are clustered around Humalistonkatu, Eerikinkatu, Aurakatu and Kauppatori. From this map we can also deduce that Eerikinkatu is potentially the most important element of Turku city centre because it connects all the spaces with most of the activities cluster. This characteristic suggests that Eerinkinkatu has strong potential to become the most socially active street in Turku if developed by taking into account these considerations and the fact that it is one the streets that are most likely to favour light traffic.

WEEKEND

MORNING
Optional 722/764
Ordinary 1242/1242
Social 200/556

Figure 50. Uses that are open during weekend's morning

NOON
Optional 764/764
Ordinary 1242/1242
Social 540/556

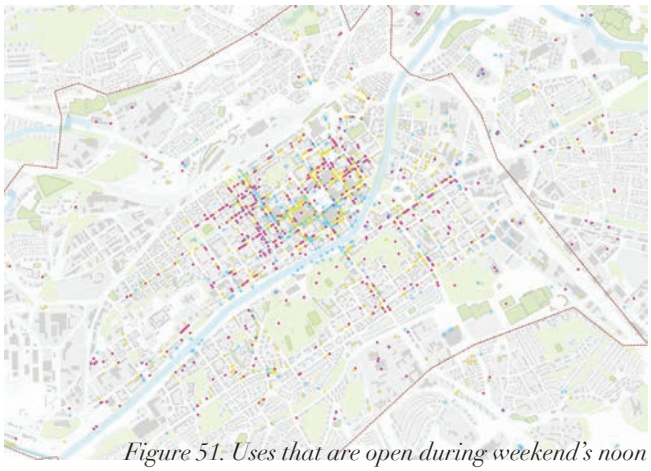


Figure 51. Uses that are open during weekend's noon

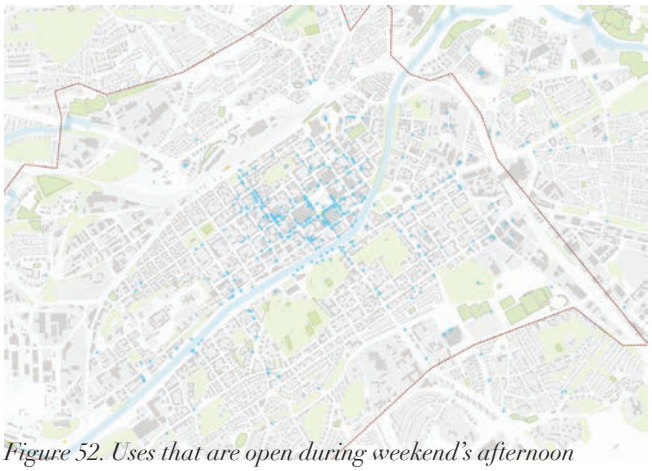


Figure 52. Uses that are open during weekend's afternoon

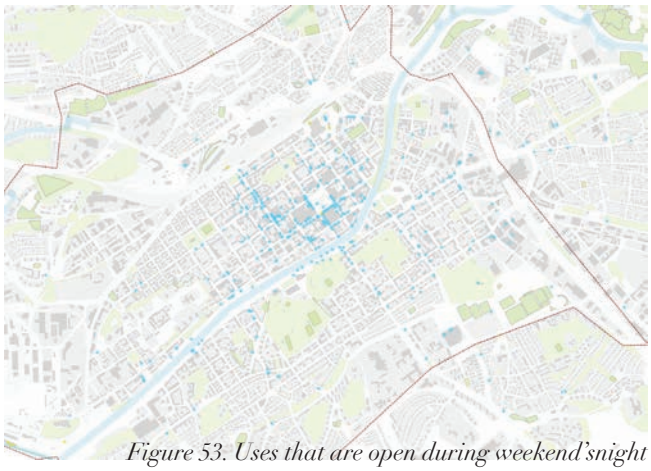


Figure 53. Uses that are open during weekend'snight

AFTERNOON
Optional 297/764
Ordinary 1062/1242
Social 540/556

NIGHT
Optional 0/764
Ordinary 0/1242
Social 524/556

ACCESSIBILITY

The spatial configuration of urban fabric can foster or hinder movement based on its geometric properties. The more a certain space is accessible and central in relation to all other spaces in the city, the more likely it will attract movement, social interactions and activities. Based on these criteria we used Space Syntax to assess where people are most likely to pass by – and generated data that will contribute to modelling the gravity maps. After drawing the axial and segment maps of Turku, we used Depthmap X to perform both classical Axial analysis (to study perceived accessibility) and Segment analysis (to study spatial accessibility). Axial analysis is performed by measuring the topological distance between urban spaces, represented by the longest line of sight which can be drawn in the urban fabric. Segment analysis is performed by measuring the metric and angular distances between urban spaces represented by segment lines. Each segment is the imaginary line between buildings from one crossing to another. In areas that are not densely built, streets are considered as corridors within which the axial lines are drawn. Once the Axial and Segment maps are drawn in GIS, we used Depthmap X to study accessibility based on Metric, Topological or Angular distances - at the local and regional scales. We did this to verify the correlation between Space Syntax analysis and actual car, pedestrian and bicycle movement data provided by the City of Turku. Our analysis focused on three major Space Syntax indexes that are often found accurate in describing movement:

Global choice

Highlights the urban spaces that are most likely to favour movement through all the city. It can be used to describe car movement as it is often found correlated with car traffic intensity. In the case of Turku we observed a certain degree of correlation between this measure and the real traffic data provided by the City of Turku.

Figure 54. Space Syntax analysis, global choice

Local choice

Highlights the urban spaces that are most likely to be passed by within a city district, mostly by pedestrians and cyclists. We did not observe a tight correlation between this measure and the pedestrian or bicycle traffic data provided by the City of Turku. Our observations suggest that people´s location choice is not dependent on the metric distance between different spaces or how cognitively easy it is to reach them. Local movement may be more related to transit or activity patterns and can be studied only with accurate surveys.

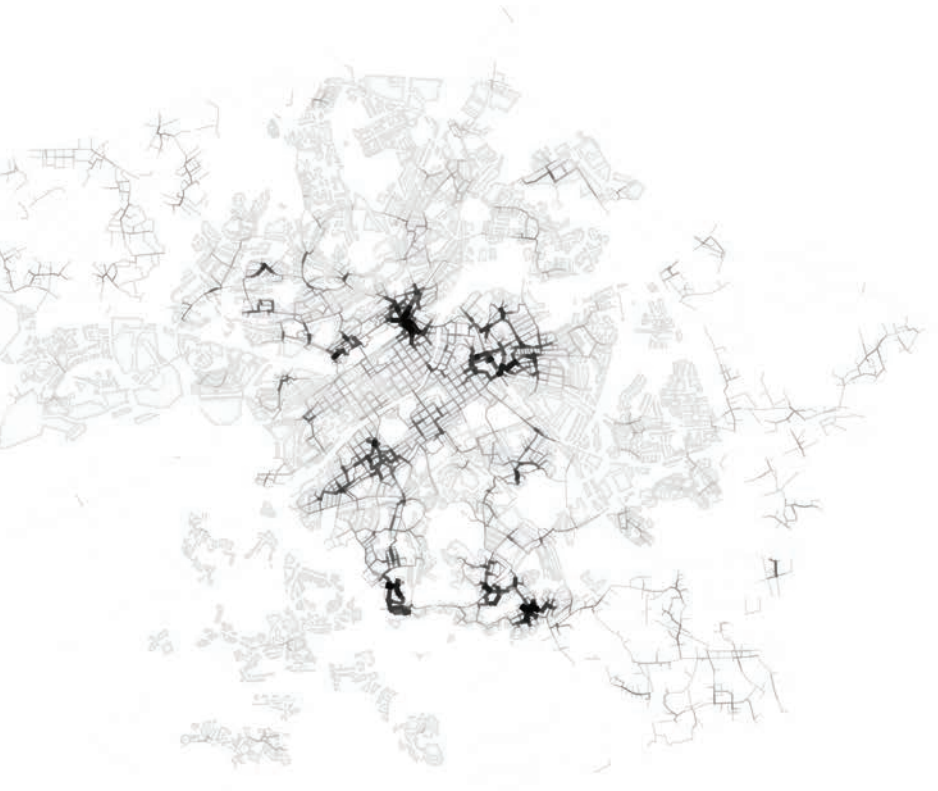


Figure 55. Space Syntax analysis, local choice

Figure 56. Space Syntax analysis, local integration

Local integration

Highlights the urban spaces that are locally closer to all the other spaces. As local integration measures how cognitively easy it is to reach one space from all the other spaces, this index has been used to describe the volume of pedestrians and possible social interactions. It has been observed in different cities and urban configurations, that the higher the integration of one urban space, the more popular the place for pedestrians. We have also observed a certain degree of correlation between local integration and pedestrian movement in central Turku but for the streets with highest traffic, suggesting that other factors such as land use or the location of key functions are the generators of movement – such as the train station, Kauppatori, the hospital or the university.

Figure 57. Turku traffic map

Turku traffic map

Presents the average estimated traffic intensity derived from actual measurements. The original map released by the City of Turku was digitised in GIS in order to populate our geospatial database. This information is used to validate the Space Syntax analysis and it is contributing to the realisation of the gravity map.

Short observations

Space Syntax analysis and the traffic intensity data were produced as contribution to the gravity map to estimate where people are most likely to pass by. Within the limits of this study we can only observe that Turku's urban morphology is very permeable at the local and urban scale, meaning that the form of the city itself can foster light traffic within the central grid but also car movement from the neighbouring municipalities. Eventually we observed a considerable degree of correlation between estimated traffic intensity and the axial and segment analysis. This information was used to calibrate the space syntax analysis, enabling to study how the tramline may possibly change traffic dynamics in Turku.

Dynamic analysis of pedestrian movement

With the new shopping centres established at the edges of the city, a great potential for the socio-economic development of Turku is retained in the city centre. Based on our study, most of the activities are located in the centre together with the highest concentration of social interactions. The transient character of the pedestrian flow generates opportunities for all the retail activities located along people's path. An accurate measurement of pedestrian flow – i.e. where people exactly walk – can be utilised to study their journeys in more detail, including origins and destinations, use of public space, and exposure to retail activities and services. Using a method that counts people at certain "gates" (usually crossroads on a street where the movement is calculated) enables quantifying the flow, but it does not provide qualitative information on its character. Dynamic pedestrian mapping methods such as counting people's encounters along a path or revealing the path taken from one transportation mode to another can tell more about why and how people walk in the city centre. Studies could propose methods for improving pedestrian mobility and the exposure to retail and services.

Figure 58. Sample map of dynamic analysis of pedestrian movement in Kuappatori

GPS traces

Figure 59. Map of GPS traces in Turku obtained from OpenStreetMap

As mobility patterns are an important factor for assessing where people are most likely to walk or drive by, we could have used Foursquare, Twitter and Instagram data to track single users along their daily paths. While it is possible to track the position of a single user, we will apply our ethical code and renounce from performing this analysis (see **ethical note** at page 35). It is possible to map and study mobility patterns of informed and aware users by using the OpenStreetMap (OSM) GPS database. All the GPS traces present in this database are shared by users who willingly track themselves using a GPS enabled device and manually upload their traces into the OSM server one by one. When users upload their data they can also select specific privacy setting for each track uploaded. This process is time consuming and requires a direct commitment, therefore the database is far smaller than the ones gathered by GPS service providers such as Garmin or Tom Tom, but users are well aware of sharing their personal information.

Collecting data and parsing

We have collected all the available OSM GPS tracks in the Turku metropolitan region but a considerable amount of data was invalid due to GPS signal loss or the incorrect use of the tracking software. For this reason we applied a filter to erase all those tracks that were apparently interrupted or incomplete.

Dataset

Period: all available from OSM database
GPS tracks: 5419

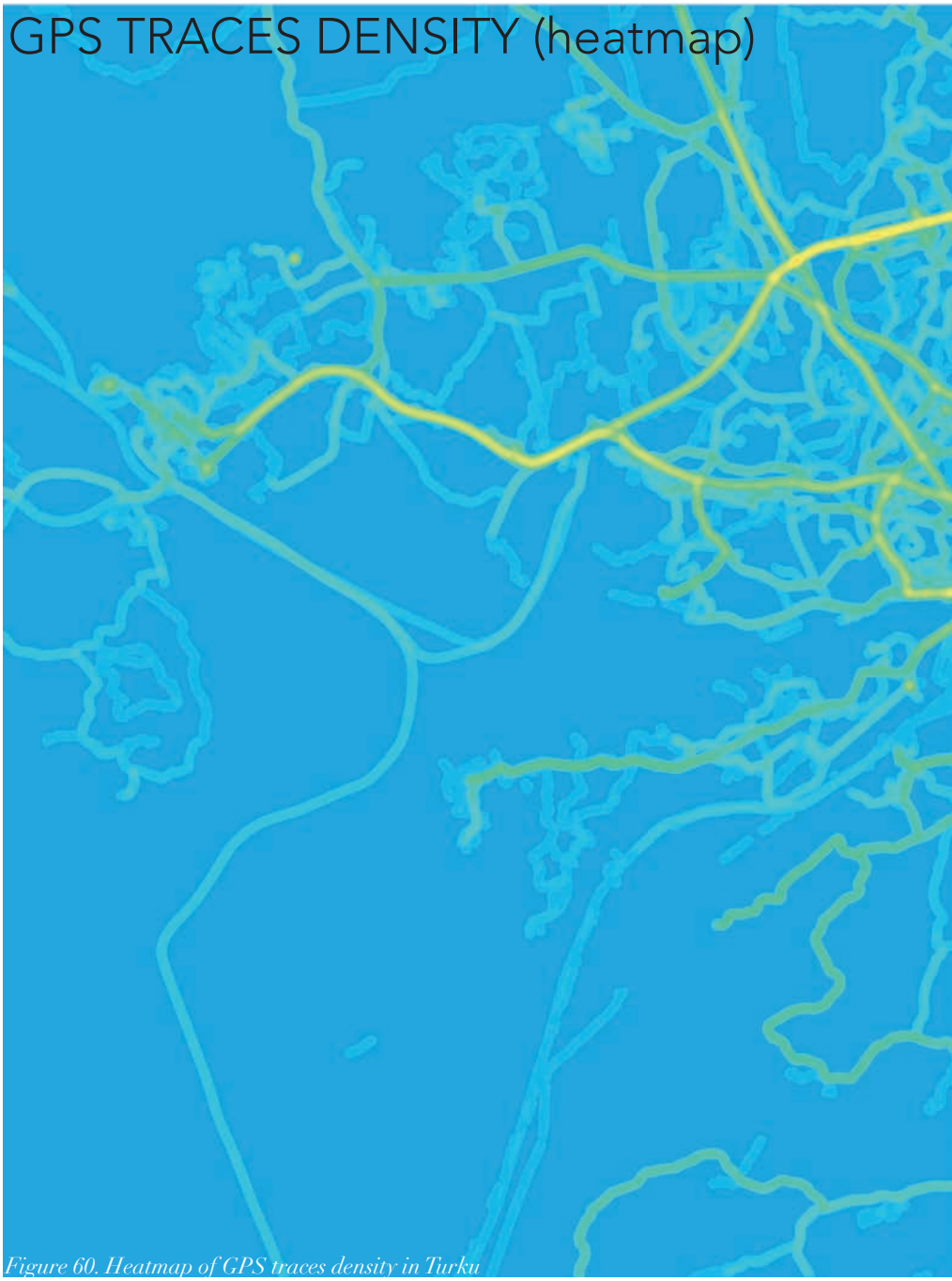


Figure 60. Heatmap of GPS traces density in Turku

Short conclusions

At first, 5419 GPS tracks appear to be a very small amount of data to study and make speculations regarding mobility patterns in Turku. But during the data validation task we observed a strong correlation between the number of GPS tracks per street and the measured traffic intensity per street. It shows that in this very special case, a small amount of data can actually describe traffic intensity in a very accurate manner and allow us to use this dataset for our studies and eventually the creation of the gravity maps.

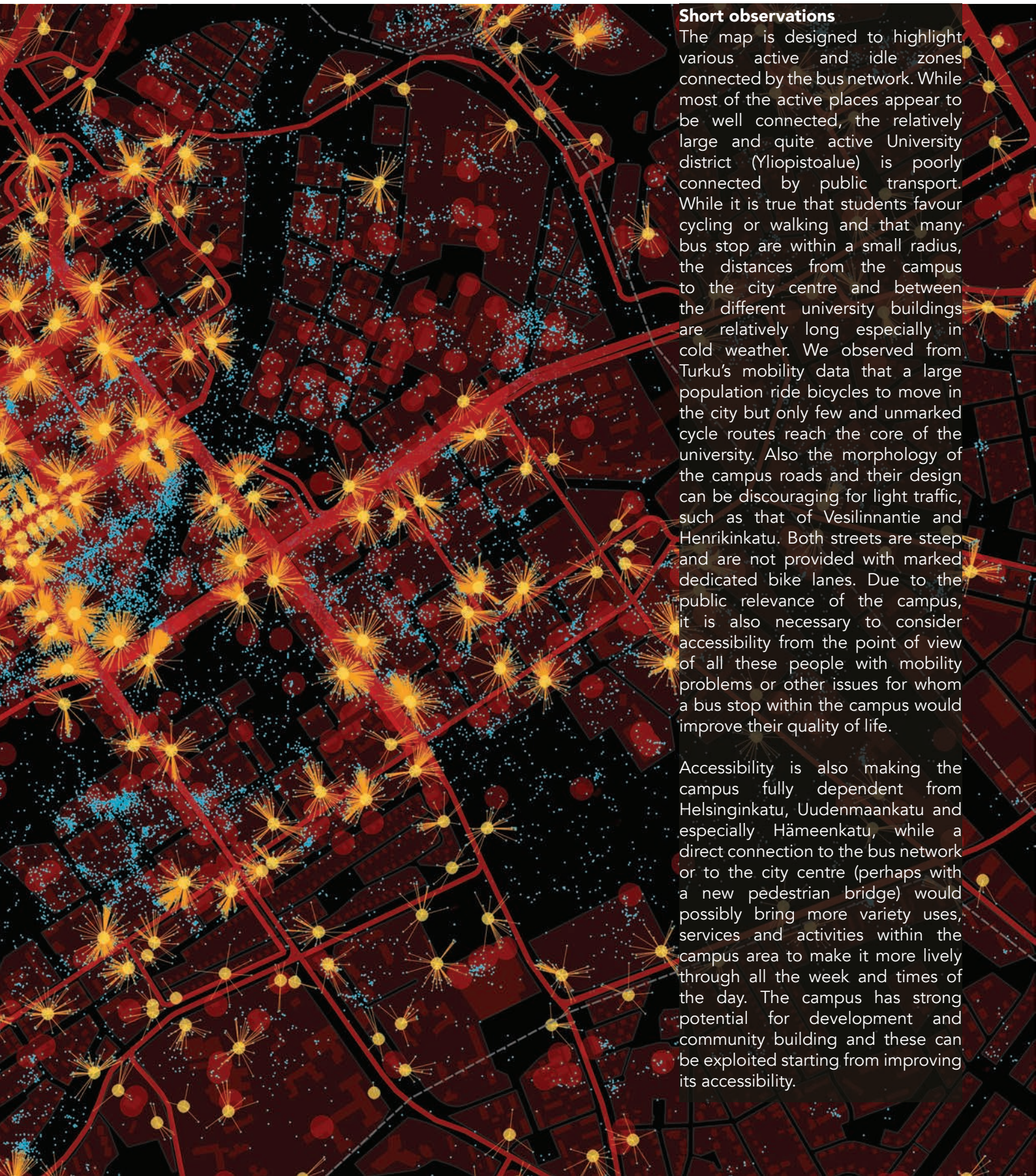
By mapping GPS tracks in Turku it is clear that a large portion of the car traffic reaching the city centre is generated from outside the metropolitan region. The city centre is attracting people from the neighbouring municipalities but we cannot assess what is the nature of those trips within the limits of this project. A dedicated study might reveal what are the origins and destinations of these trips and a wider area must be taken into account to evaluate the extent of commuting patterns. With the information at our disposal we can speculate that Turku city centre is highly influenced by the presence of regional commuting patterns stimulated by the labour market and the popularity of the centre.

Bus network

BUS NETWORK + GEOLOCATED INSTAGRAM PICTURES

Public transport in Turku relies on a widespread network of bus lines serving the urban metropolitan region as well as connecting the city centre to the neighbouring municipalities. Conventional route planning is a very complex process based on demographics, residential and retail location choice, economics, commuting patterns, politics, and can be more widely influenced by stakeholders and groups of interest. The advantage of using LBSNd is having the possibility to learn if bus lines are more connected to active or idle places within Turku. To do that we drew up a map showing the bus network together with Instagram pictures symbolising the activeness of a place. Each bus stop is connected with one line to all the Instagram geolocated picture within a 50 meter radius. At the same time all other Instagram pictures are displayed at the background. The map can be read intuitively – the more intense the array of lines around a point, the more active the place connected by the public network. This data is used mainly to build our gravity maps but it is also designed for planners and decision makers in the City of Turku as a tool for thinking about the policy making process and have an intuitive reflection on the current bus network route.

Figure 61. Bus network map with geolocated instagram pictures



Short observations

The map is designed to highlight various active and idle zones connected by the bus network. While most of the active places appear to be well connected, the relatively large and quite active University district (Yliopistoalue) is poorly connected by public transport. While it is true that students favour cycling or walking and that many bus stop are within a small radius, the distances from the campus to the city centre and between the different university buildings are relatively long especially in cold weather. We observed from Turku's mobility data that a large population ride bicycles to move in the city but only few and unmarked cycle routes reach the core of the university. Also the morphology of the campus roads and their design can be discouraging for light traffic, such as that of Vesilinnantie and Henrikinkatu. Both streets are steep and are not provided with marked dedicated bike lanes. Due to the public relevance of the campus, it is also necessary to consider accessibility from the point of view of all these people with mobility problems or other issues for whom a bus stop within the campus would improve their quality of life.

Accessibility is also making the campus fully dependent from Helsinginkatu, Uudenmaankatu and especially Hämeenkatu, while a direct connection to the bus network or to the city centre (perhaps with a new pedestrian bridge) would possibly bring more variety uses, services and activities within the campus area to make it more lively through all the week and times of the day. The campus has strong potential for development and community building and these can be exploited starting from improving its accessibility.

GRAVITY MAPS

The goal of this project is to provide a set of maps displaying the places that are more likely to attract people and interactions, in regards to the current situation and in the scenario of the new tram line built in Turku. To realise these maps we needed to combine the spatial and temporal information of the data we collected and produced – Spatio-temporal patterns, Activity patterns and Accessibility – into one single visual output to be used as a tool for analysing urban and transportation planning in Turku. To do so we used a parametric model that sums up the spatial information of:

Instagram
to model people's location choice

Activity patterns and bus network
to describe where people are likely to go

Accessibility analysis and measured traffic data
to estimate the movement

and the temporal information of:

Instagram
to describe the time frames when people are most active

Activity patterns
to describe when certain uses are most likely to attract certain activities

Altogether the gravity maps give a rough estimation of where and when people and interaction are most likely to happen depending on the days and time. The brighter the map, the more people and interactions one area is likely to attract. To enhance the readability of the map, the urban fabric is pulled to simulate an attraction force towards the areas where it is stronger.

There are countless parameters which can be used to describe the gravity of the city - such as job places, urban density, size and attractivity of uses and services – but as our study focuses on dataset we gathered, urban and transportation planners in Turku can use these maps to find potential areas of development and idle areas for what concerns human activities and possible economic transactions.

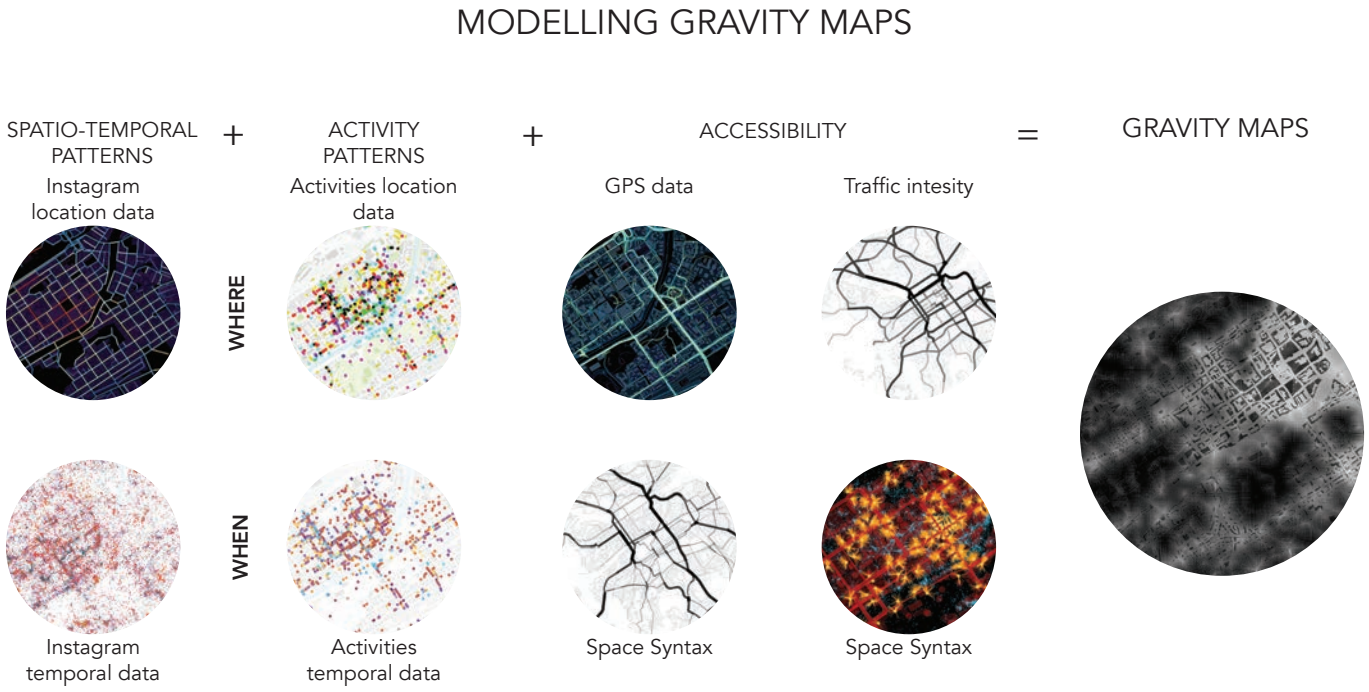


Figure 62. Scheme of the model used to realise the gravity maps

GRAVITY MAP

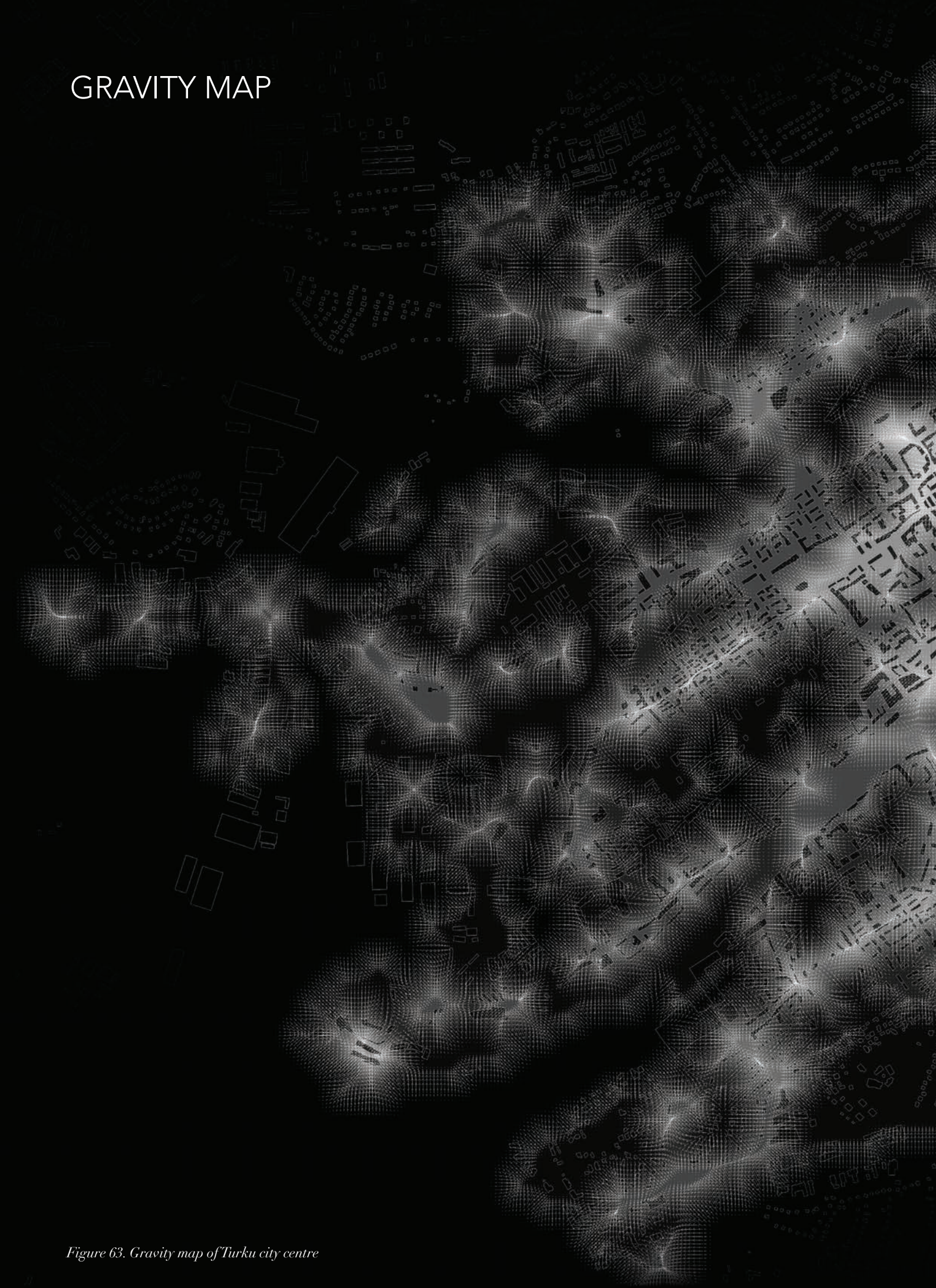


Figure 63. Gravity map of Turku city centre

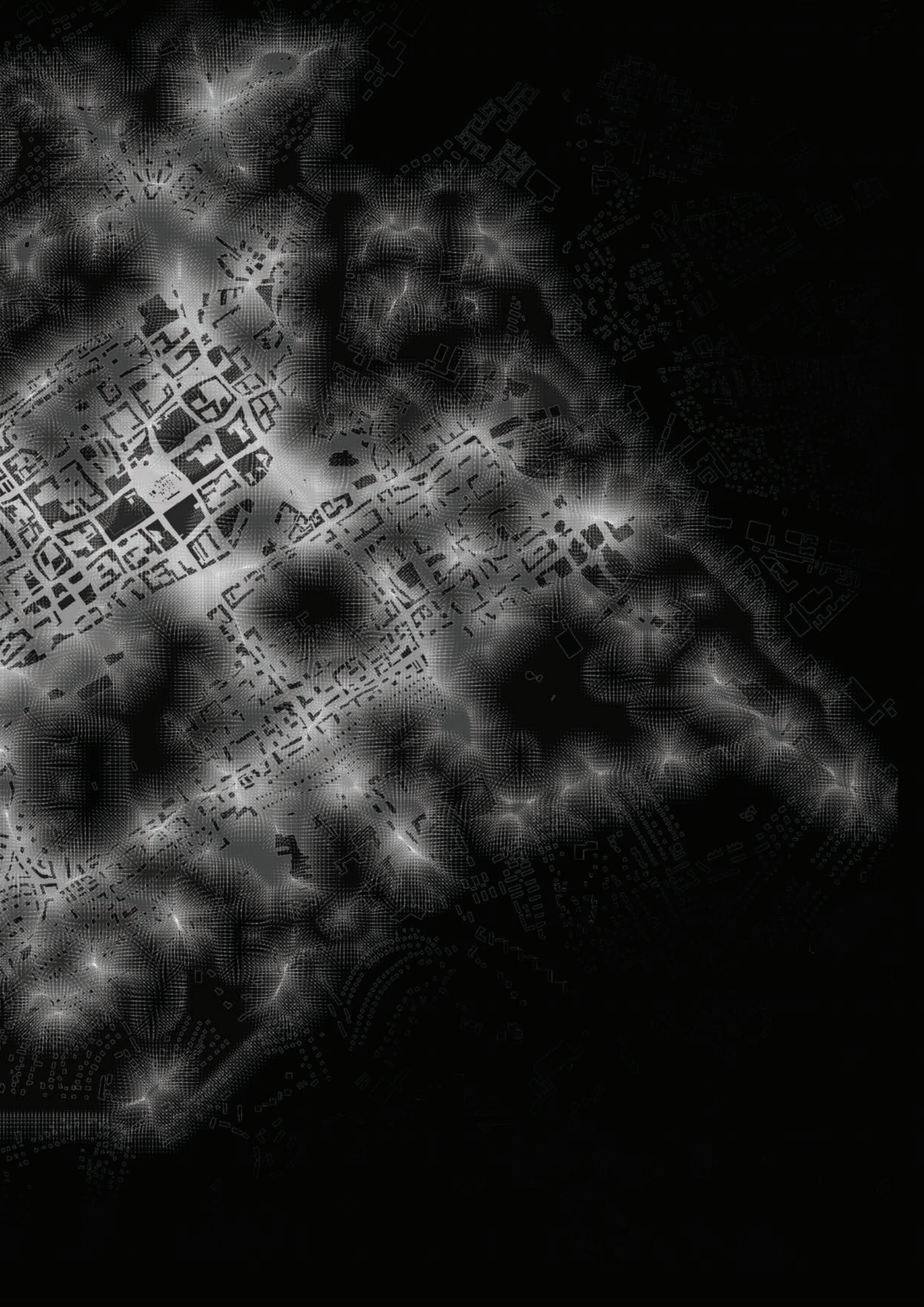


Figure 64. Gravity map of Turku city centre for weekday's mornings

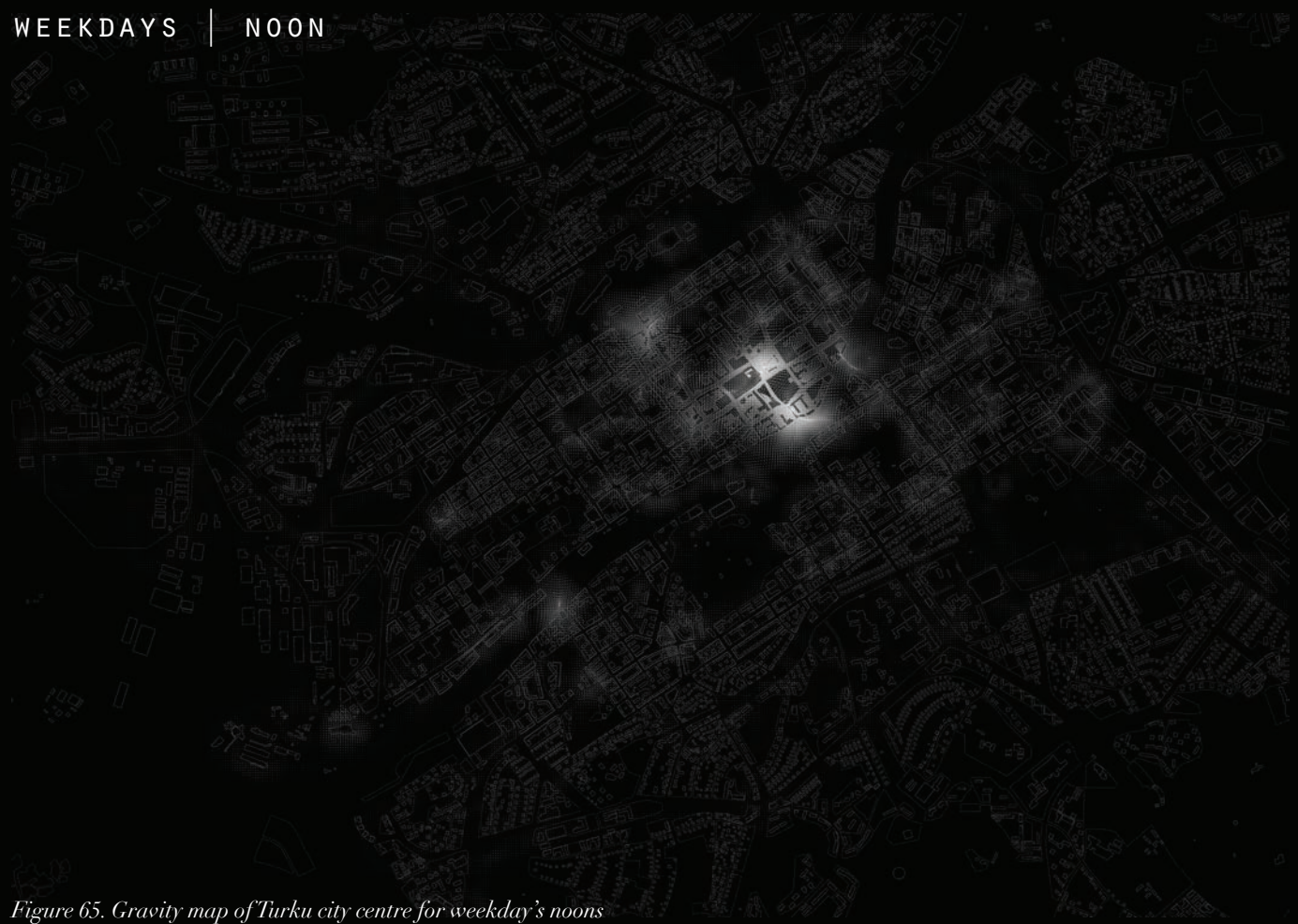


Figure 65. Gravity map of Turku city centre for weekday's noons

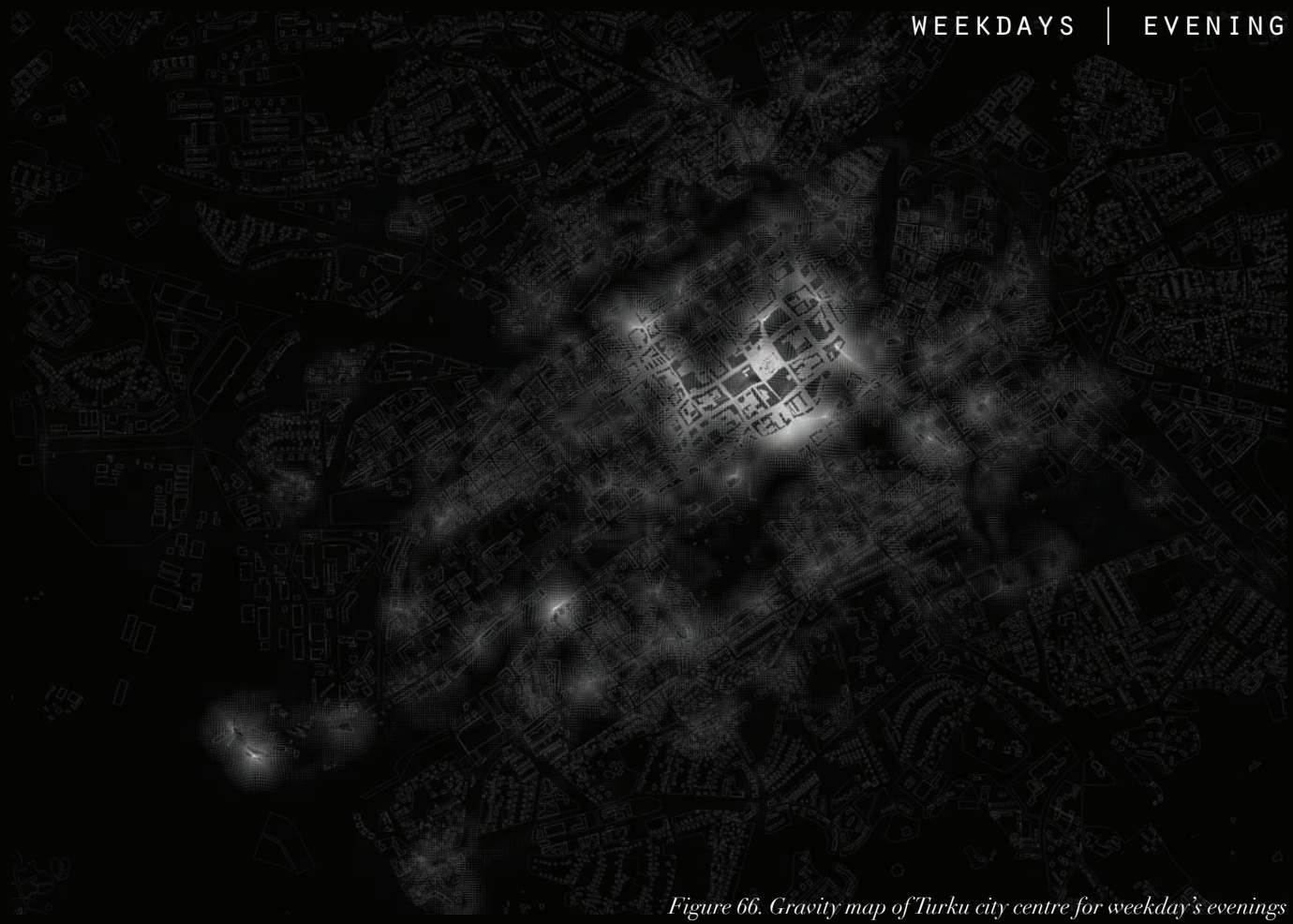


Figure 66. Gravity map of Turku city centre for weekday's evenings

Figure 67. Gravity map of Turku city centre for weekday's nights

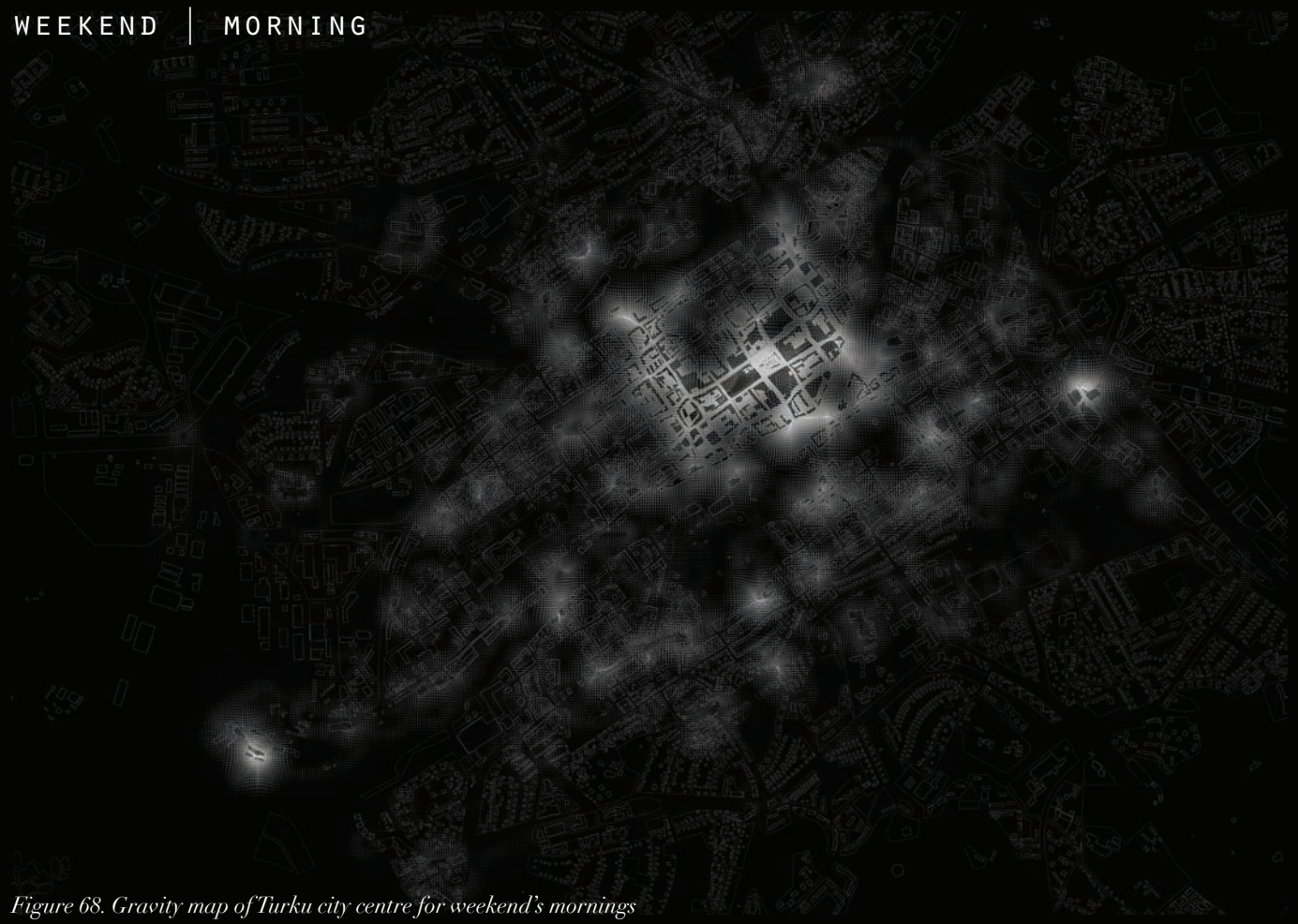


Figure 68. Gravity map of Turku city centre for weekend's mornings

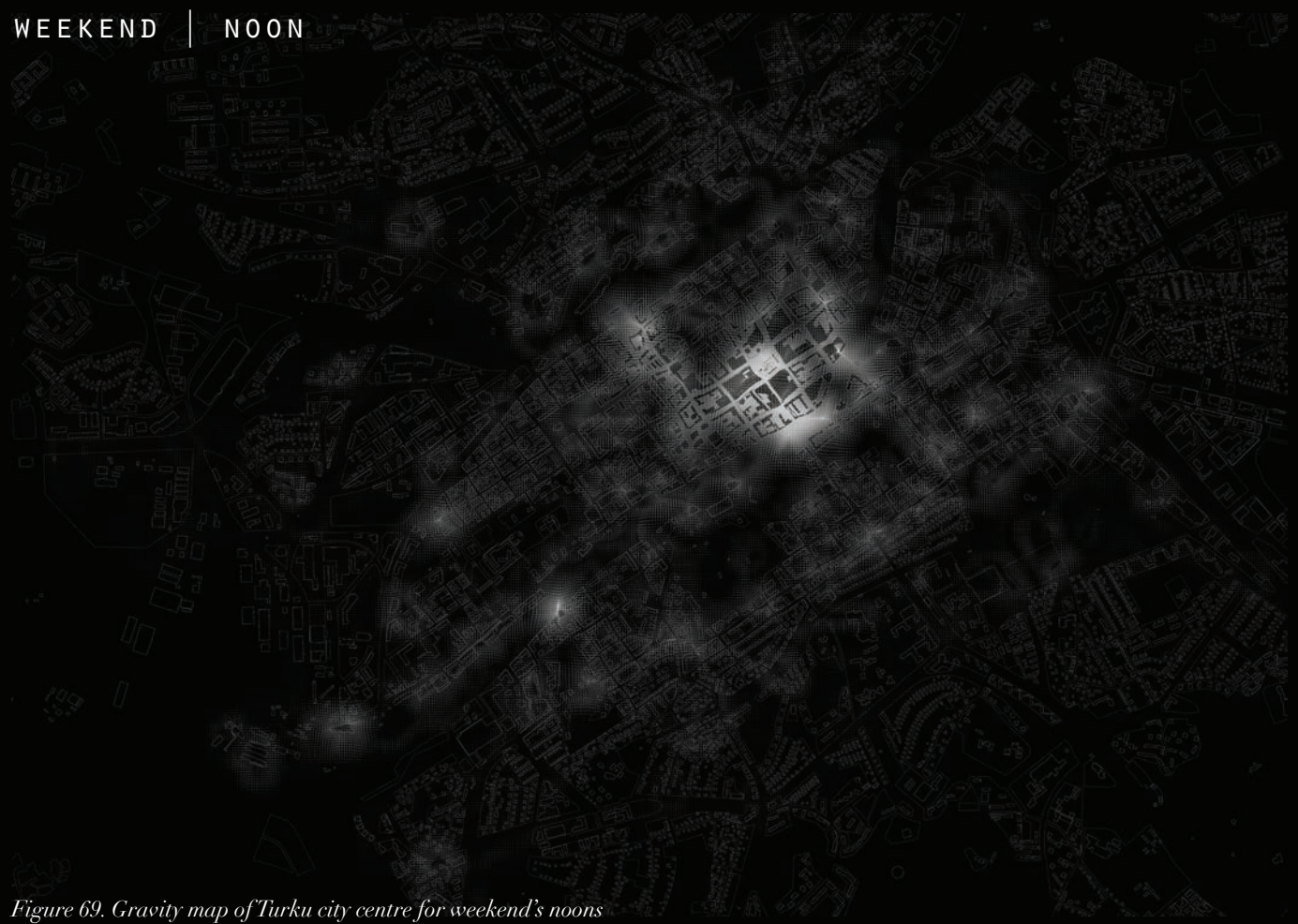


Figure 69. Gravity map of Turku city centre for weekend's noons

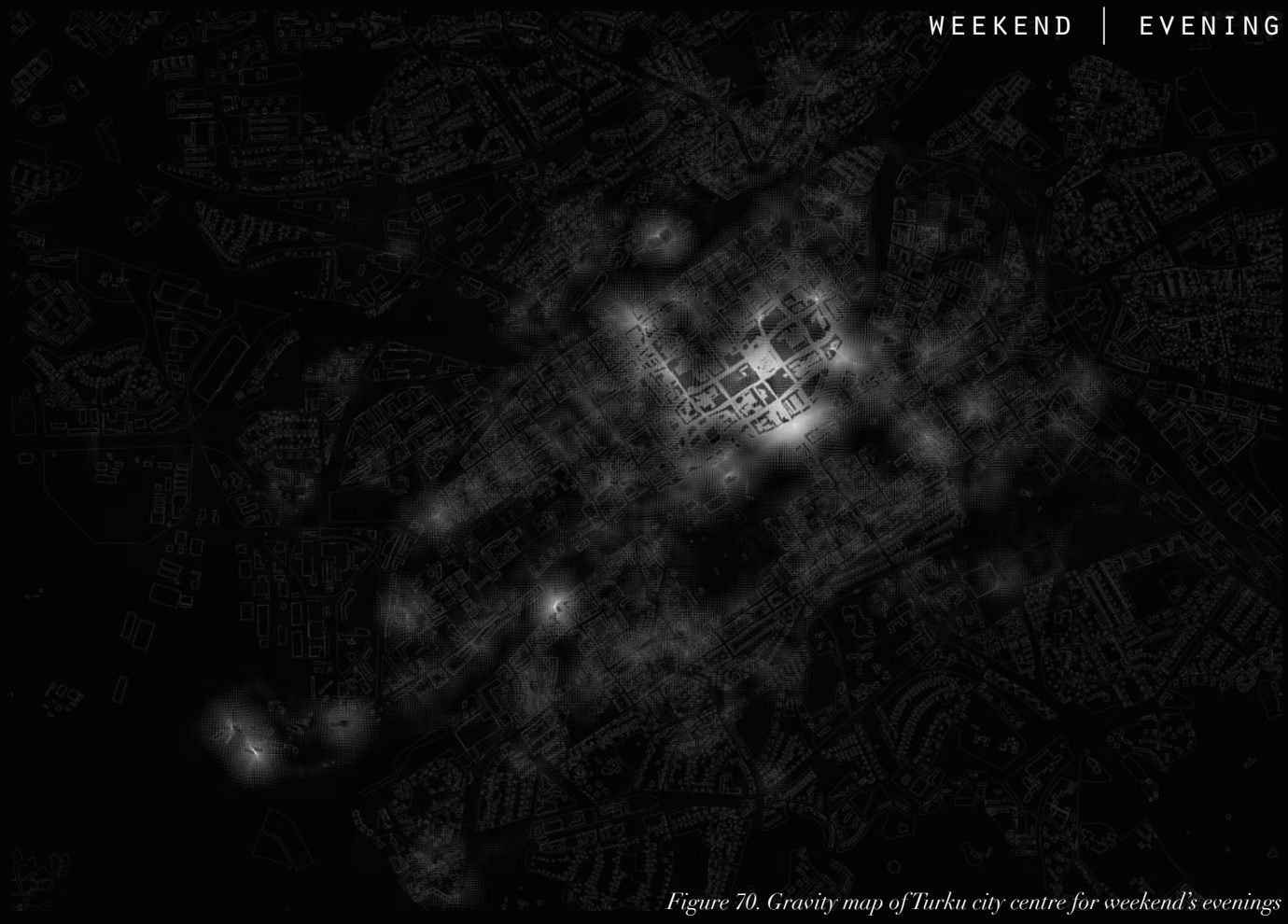


Figure 70. Gravity map of Turku city centre for weekend's evenings

Figure 71. Gravity map of Turku city centre for weekend's nights

Short conclusions

By comparing all the different gravity maps it is possible to recognise an ideal H shaped area where interactions are most likely to take place throughout the week and during different times of the day. The major streets where attractivity is constant are Humalistonkatu and Aninkaistenkatu, their vicinity and Ylopistonkatu and Eerinkatu connecting them. At the center, connecting all the streets, there is Kauppatori, as it is a place with the highest attractive power in the city of Turku. Overall the gravity maps were designed as a tool for thinking to support the decision making process in Turku, therefore more observations may be made by the expert eye of specialist, city officials and resident researchers.

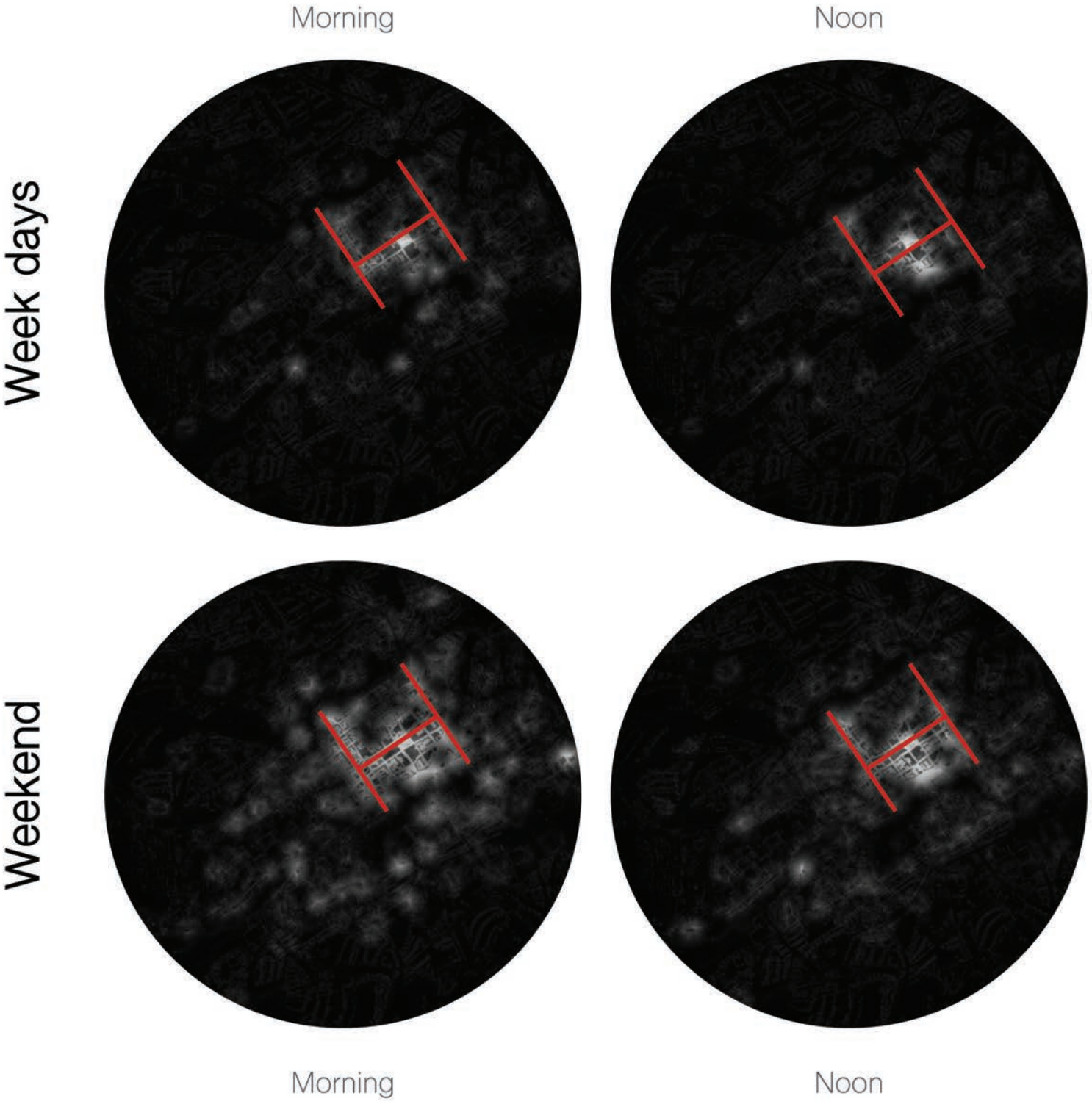
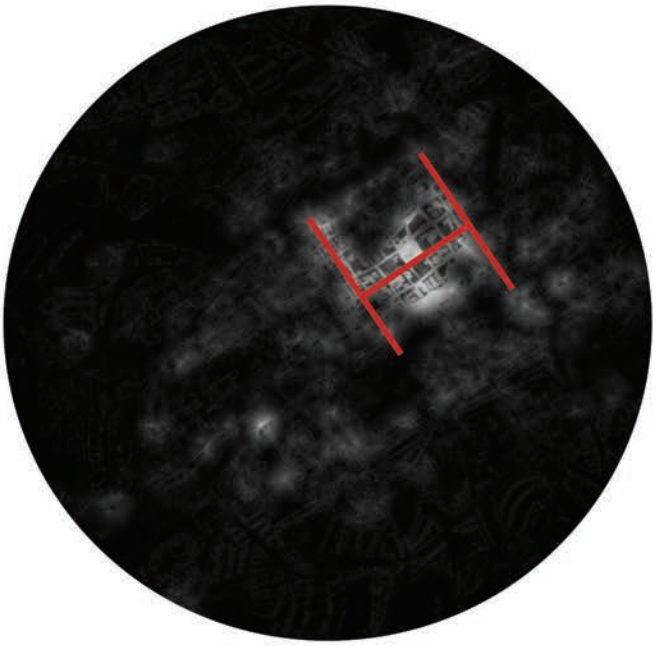
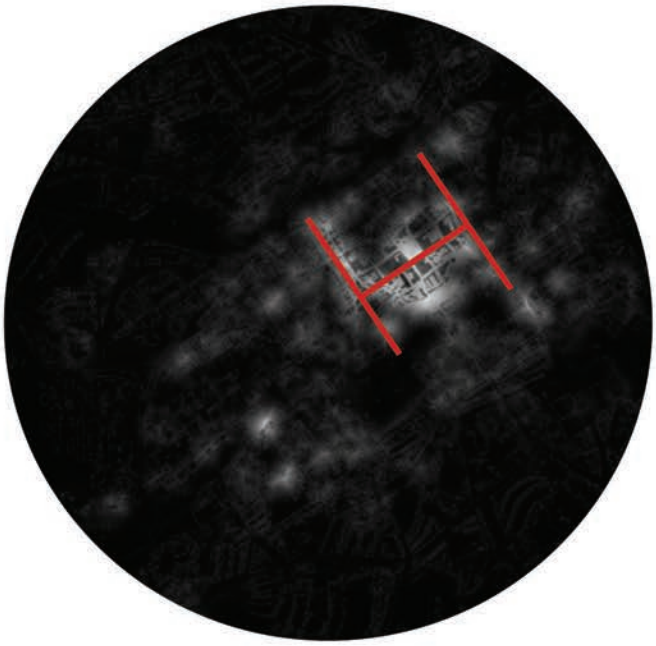


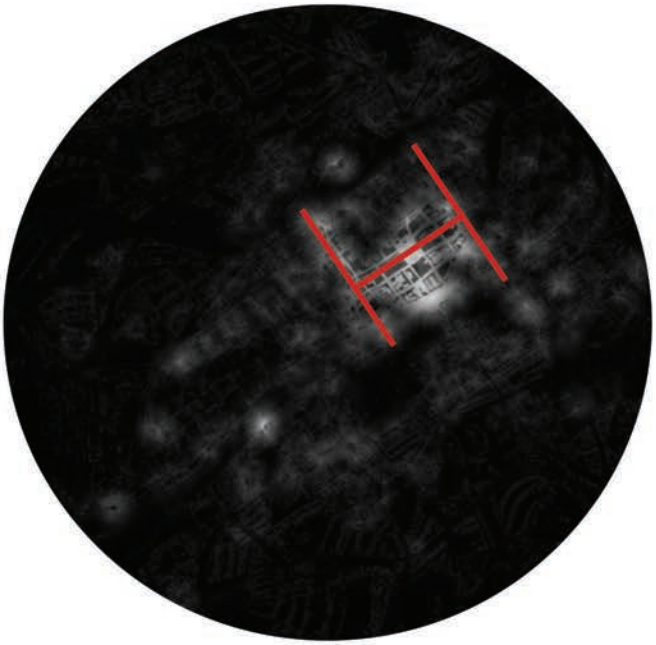
Figure 72. Gravity maps grouped

Afternoon

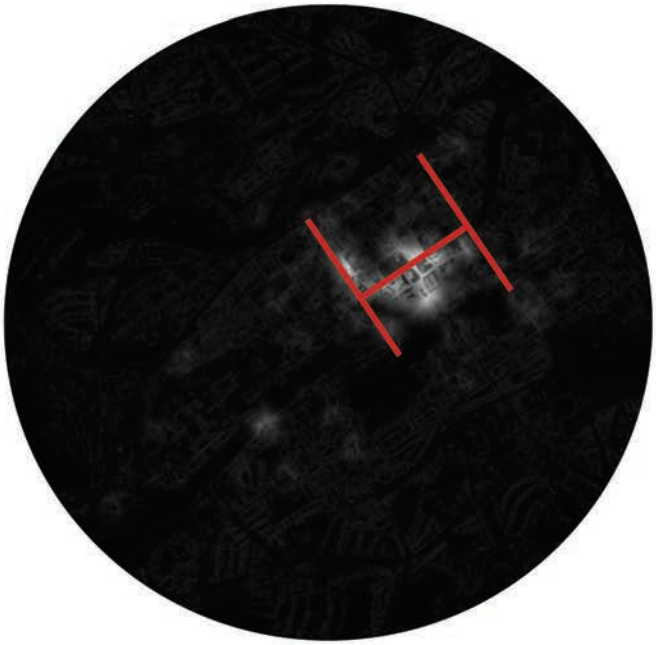


Night





Afternoon



Night

THE TRAM QUESTION

Assessing if a new tram line is going to increase the activeness of the city centre and its popularity is a complex task. Full analysis would consider demographic changes, existing and emerging land-use patterns, qualitative study of private and public transportation usage, a wide range of scenarios about car usage in the future, urban development trends and new area typologies, real estate market, regional economic forecasts, origin-destination analysis, behavioural patterns, housing and shopping preferences and so forth. Even extensive research leaves considerable uncertainties, because urban processes are complex and involve several feedback loops and self-organising phenomena. Our study is one small element of this knowledge platform, aiming to answer this question according to the data we gathered.

Is a new tram line going to increase the popularity of central Turku?

From the perspective of the data we treated, the new tram line is going to increase the popularity of Turku city centre as a whole while providing new reliable means of transportation for the suburban areas. Current transportation network is connecting the same areas that will be served by the future tram line but the tram itself is most likely to attract more users. From the social perspective, a tram is worth building in Turku only if it brings more pedestrians to the city centre and fosters the use of a public transportation as a whole.

From our perspective further requirements include :

- An organised transportation system where bus and tram routes work in synergy supporting each other.
- The edges of the tram route connect to regional mobility patterns.
- Transformation of Kauppatori into a functional transit hub – while maintaining the functionality of the market through the week with new architectural solutions such as a pavilion connecting Hansa centre with the market, which can be also used to shelter the bus stops.
- Public initiatives to promote the use of the tram line.
- A thematic plan to support the tram route with the development of new key public spaces.
- Extension of public space around the most central stops.

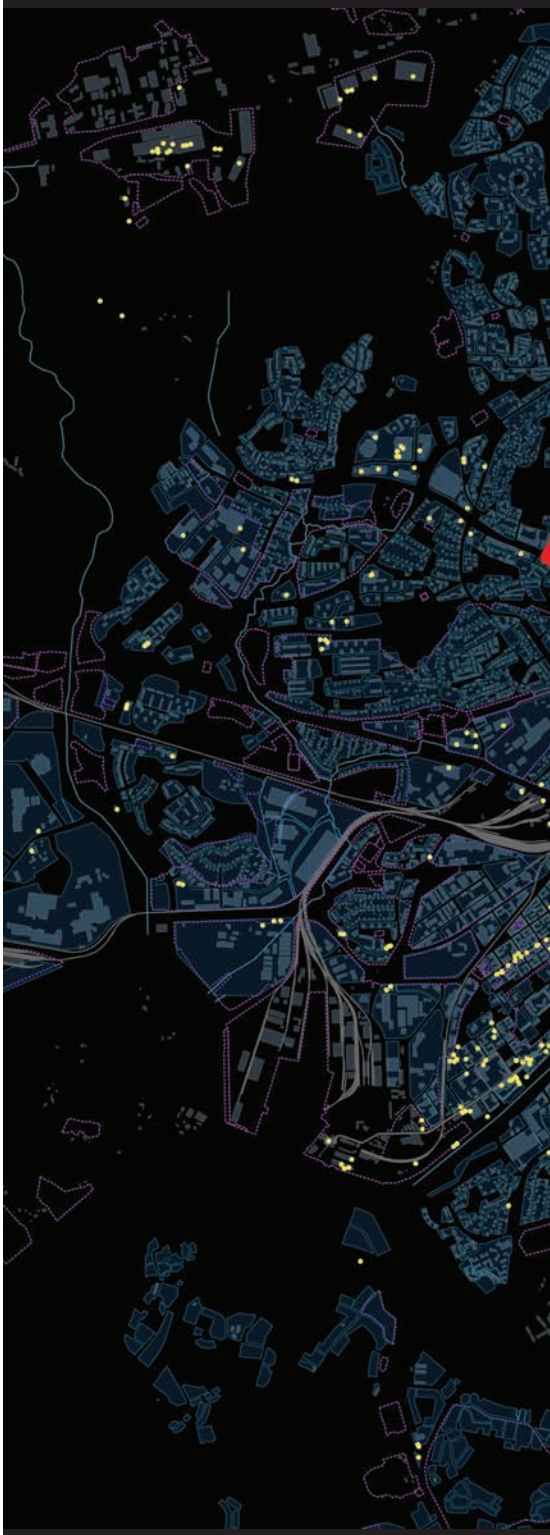
Sharing benefits

Generally there is an idea that building a new tram line will provide socio-economic benefits to the areas along the tram route, together with the rise of real estate values. The tramline, the way it is proposed today, will empower the part of the city where all the activities and economic transaction are already taking place. This means that most benefits are likely concentrated around the areas of Kauppatori, Hämeenkatu, the Hospital pole (Turun yliopistollinen keskussairaala), Vartiovuori, and the riverside. If this creates a dramatic increase of popularity, it might lead to a new kind of over-centralisation, creating a divide between this part of the grid and the rest of the city centre – in terms of socio-economic development and real estate values. In these terms, the tram line may constitute a spatial and social divide but further research is needed for a better understating of this phenomenon. The planned route is not reaching these axes where activity and spatio-temporal patterns suggest the possibility for future socio-economic development. Puutarhakatu and the area between Puistokatu and Humalistonkatu have remarkable potential as the typomorphology would be capable to support new urban developments.

Last stops

The edges of the tram line are the most delicate tiles of the entire project. The selected suburbs will benefit in terms of better accessibility to the city centre, greater reach to the labor market and an increase in real estate values. Consequently it offers opportunities for construction of new housing as well as for public space development around which new functions and activities could be hosted. At the same time the last stops are often perceived as negative places. Both edges of the planned tram line are functionally and spatially resembling a cul de sac. To increase the sense of a continuation and dynamism, the last stops might be integrated with the bus network, park-n-ride or other facilities that favour movement and turn the edges of the tram line into transit hub – perhaps regional hub, connecting surrounding municipalities with the city centre, turning last stops into next stops. To summarise, the new tram line should provide shared benefits beyond public transportation and sustainability issues while supporting and exploiting the hidden potentials across the grid.

Figure 73. Accessibility maps and tram line



TRAM + ACTIVITIES

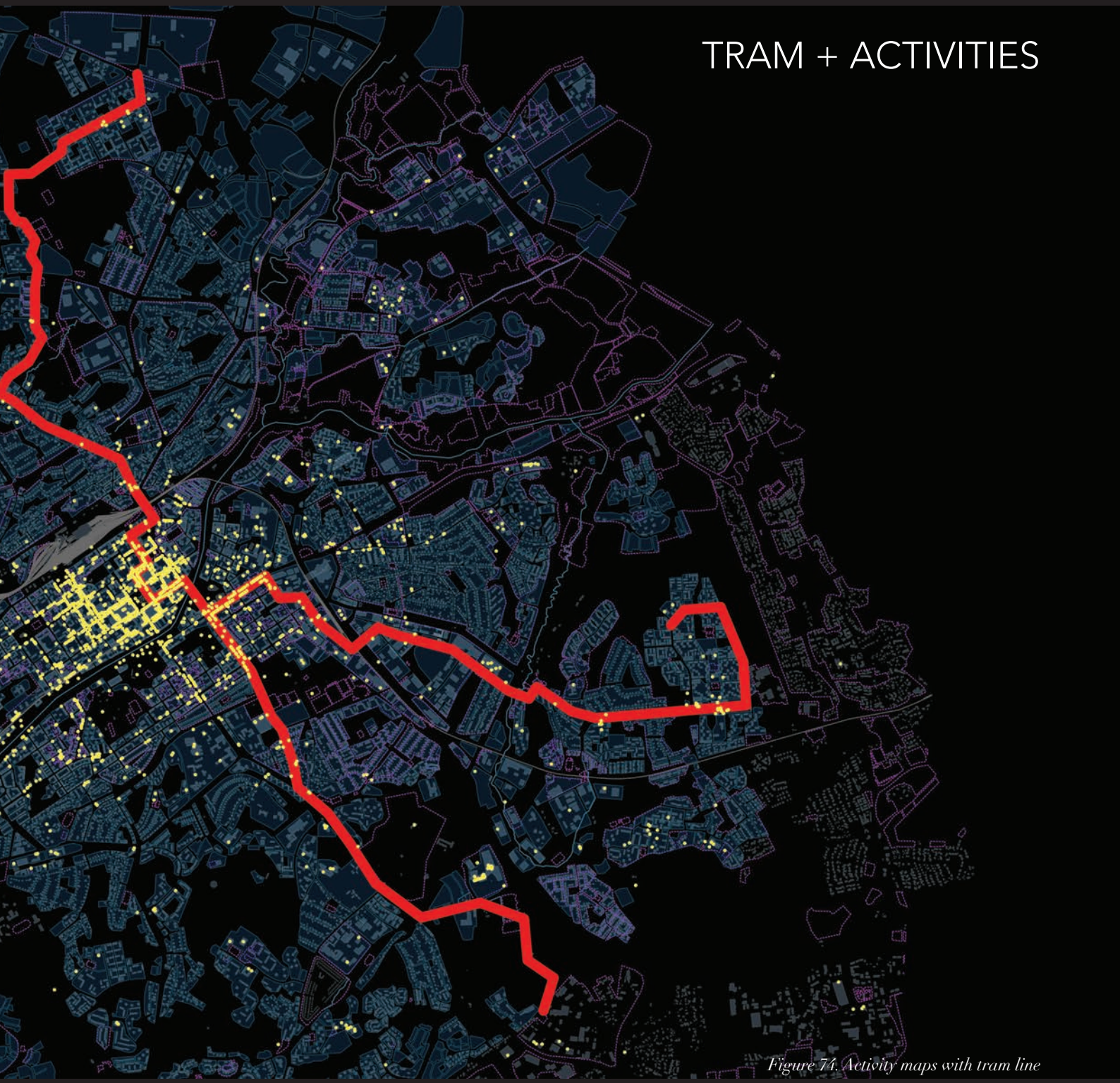


Figure 74. Activity maps with tram line

Tram + activities

The tram line is likely to empower the central spaces of the city that already today are the main attractors of people and activities. Activity patterns show that the planned route is going to touch areas that are already hosting mixed uses in great number. On the other hand the route is not going to touch areas that are not very active today but present the strongest potential for socio-economic development, such as Puutarhakatu districts.

Tram as a planning tool

City's moderate growth and the relatively low density outside the historic grid would not suggest developing a tram line in Turku. Nonetheless, the project provides a good platform for open discussion about future visions. If built, the tram should be seen as a tool to provide new, more urban and less car-dependent environmental typologies that have a regional effect over time. A key would be to direct a very big part of new development to the tram corridor, within a short walking distance to the tram stops.

At the same time, the Internet and the "Internet of things", i.e. ubiquitous computing and smart devices, are generating an ever changing society with visible mutations. Human proxemics, the way they are understood today, have to be re-conceptualised. The private and public space can take material or virtual forms and the way we share our privacy is no longer related only to the physical distance between one person and another. The labor market is also changing, making people more mobile, as the working space is no longer tied to one specific location. Many of us are constantly using trains, buses or airplanes as offices, meaning that transit can no longer be considered only as transportation means, but a place in its own right. Tram lines can surely reduce car and bus traffic but there are new reasons and new uses to be explored for the construction of a tram line.

Merging modalities

Public transport should be simultaneously conceptualised on two scales, urban and regional transit. While the tram is a regional planning tool, gathering new dense land uses and shaping the regional pattern of use and flow, it should simultaneously be seen as a nuanced device to develop the grid towards more urban configuration. The flows can not be separated and shared spaces can bring more people while discouraging car usage in the city centre without the use of visible barriers or regulations.

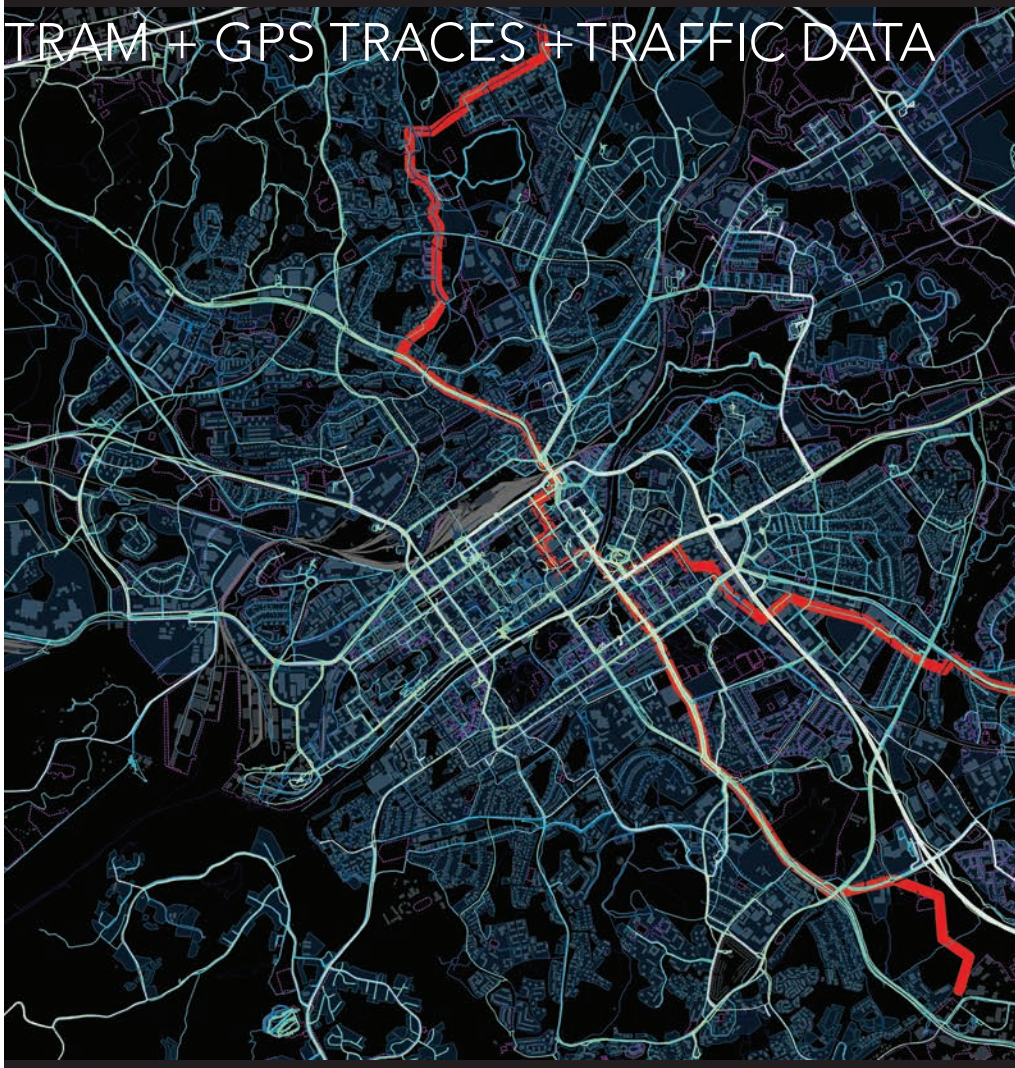


Figure 75. GPS traces and traffic data with tram line

Tram + GPS traces + traffic data

From the GPS and traffic data we can observe that car movement in Turku is generated by commuters coming from outside the urban region which cannot be reached by the tram line. On the other hand, the car traffic intensity from suburb to the centre might be not as intense as from the other municipalities because people might be intensively using the bus network. This would explain why fewer trips appear to be generated in nearby suburbs than in the neighbouring municipalities.

While almost half of all the trips have their origin or destination in the city centre, the tram is not running on the routes that are most dense in traffic, suggesting that park and ride facilities could be used to diverge transit to the tram.

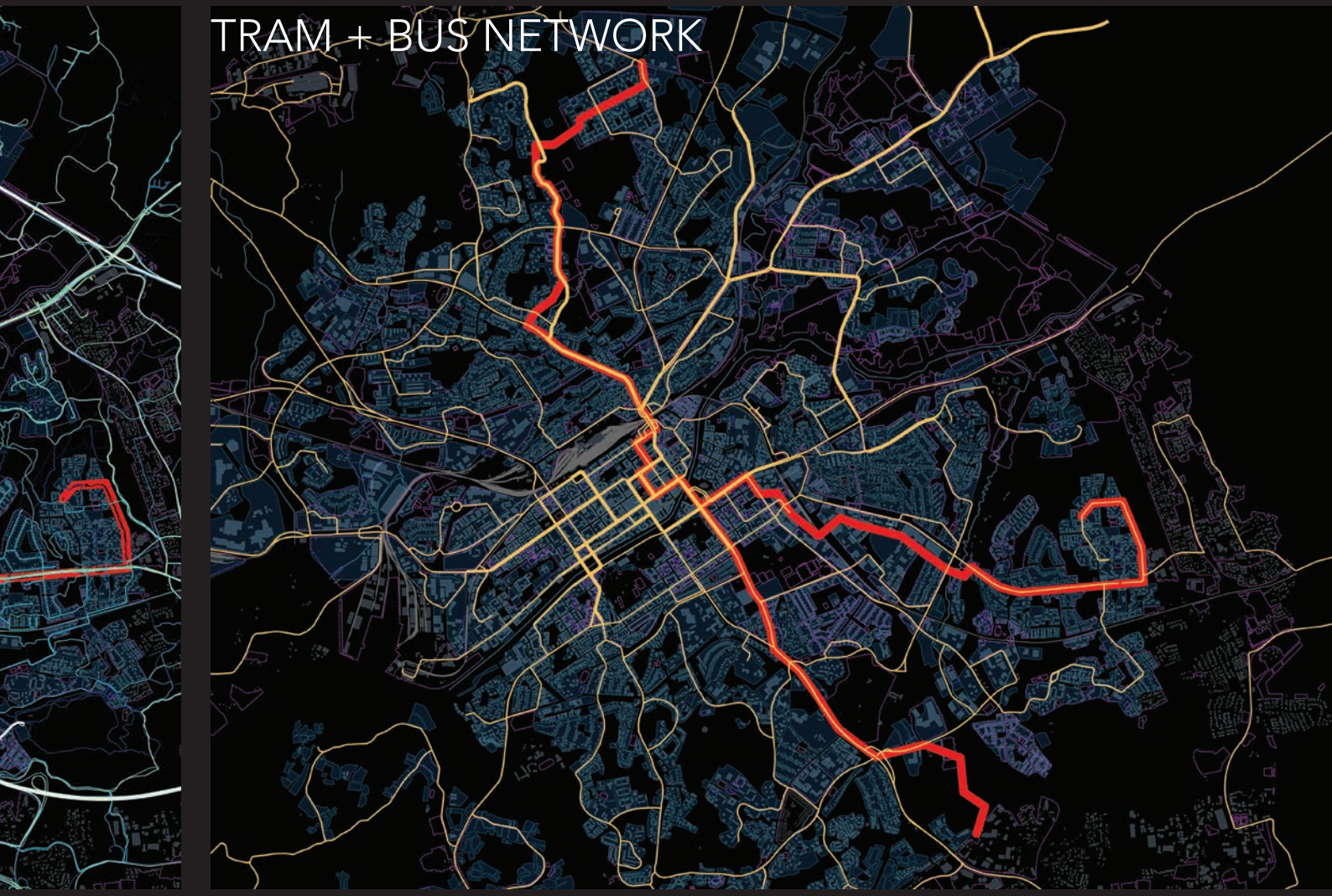


Figure 76. Bus network map with tram line

Tram + bus network

The route proposed for the new tramline appears to be aligned with currently existing bus routes. A longitudinal study of these bus routes might reveal the possible effectiveness of the tram line. Perhaps the tram could be used to link all these bus routes that today are serving the area to foster movement and interactions.

TODAY

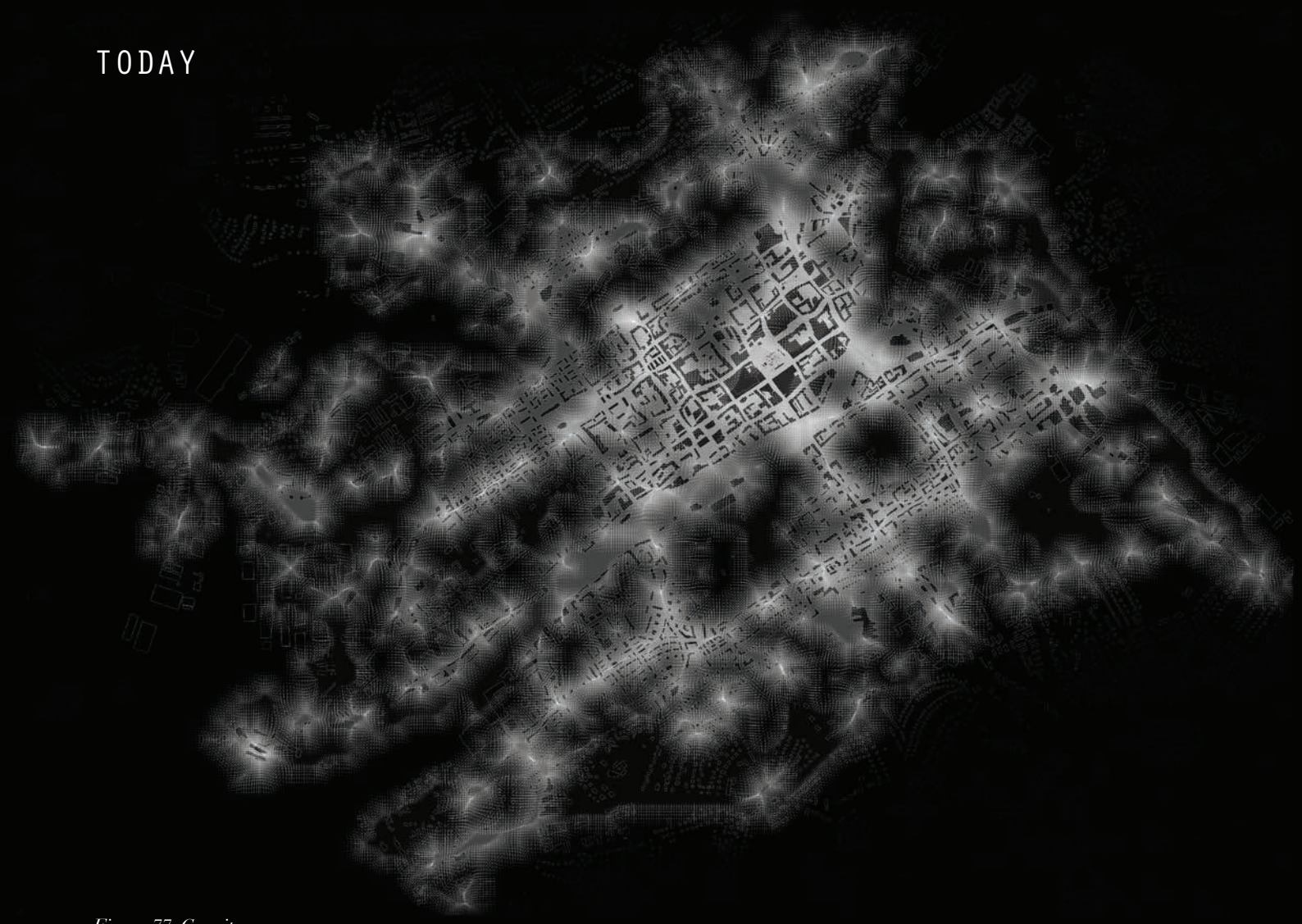


Figure 77. Gravity map

Gravity map - tram line scenario
The new tram line is going to empower and attract more people in the surroundings of Kauppatori, Hämeenkatu and the hospital areas. Socio-economic benefits may spread to the wider area of the city centre but the current route will not exploit the potentials on Puutarhakatu in full length and surrounding areas.

Figure 78. Gravity map modelled to show the impace of the tram line

DISCUSSION

Location based social network data provides new insights into the use of urban space and the meanings that people attach to it.

While Turku, like so many other cities around the world, is concerned about popularity of retail developments in the outskirts and the risk that the city centre would lag behind commercially, our study emphasizes the solid position of the city centre as a location where most of the activities and social interactions take place. It has all the potential to be exploited through spatial and cultural planning as the pillars of the new successful plans.

The planned tram line would increase the popularity of the city centre as a whole, but it must be supported by other initiatives. At the micro scale, the planned route would share its socio-economic benefits within limited areas of the city centre, while strengthening the connection between the suburbs and the main functions in Turku.

The centre is the centre of the urban region

The analysis shows that the city centre has all the characteristics of a city centre. It is the place where people of Turku live the active part of their lives and with undoubtedly where people have most of their social interactions and the majority of economic transactions occur. Due to the high concentration of mixed uses and the permeable spatial configuration fostering pedestrian movement, the old grid is a place of opportunities for now and for future development. Shopping malls at the outskirts may be convenient for some but they lack the complexity that the grid and its activities can offer. The typomorphological configuration of the grid and the capability of almost any building to host virtually any sort of activity, make it more attractive for people to stay and interact with each other and with the city itself, which can be clearly observed in our maps. The concentration of user logs in the city centre is far higher than in the malls at the outskirt. Taking into account that Instagram data is biased to younger generations, we can say that at least they are not places favoured by the younger population.

The high concentration of bus stops generates a transient movement that is vital to the city life. This flow can be studied and the location of bus stops optimised to foster the pedestrian movement according to its natural flow.

Accessibility maps + GPS traces + Traffic data

The correlation between accessibility, density of GPS traces and traffic intensity is noticeable at a first glance. On the other hand the traffic intensity measured on the road linking the highway and the northern bypass do not correlate with accessibility maps as expected. This is an indication that strong regional mobility patterns are in action and we can describe them only by extending our area of interest towards other municipalities that are clearly connected to the City of Turku. A study conducted by City of Turku shows that about half the trips measured in the city centre are starting from or ending at the city centre by car. Apparently most of the GPS traces we mapped from the OSM database are coming from an area even wider than the one we studied, making it not possible to use our analysis to learn where the other half of the trips are generated from.

Figure 79. Accessibility and GPS traces with traffic data

Activity patterns + accessibility

Activity patterns appeared to be strongly related to the measure of local accessibility, suggesting that these areas that are locally accessible today but are not hosting many activities – Itäinen Pitkäkatu, Linnankatu, Puutarhakatu, Koulukatu and the riverside – are potential areas of development. This can happen only if the current architectural typologies are redesigned or transformed to host new activities or new urban development takes place along these streets. For instance projects such as merging different properties to create semi-closed spaces or outdoor covered pedestrian paths could be considered.

Figure 80. Activity and accessibility maps

An urban future

Compact cities

We are witnessing a tidal shift that emphasises urban inner-city life while the EU policies place emphasis on compact urban development and stopping the process of land take by 2050 – to which new suburban development go in the opposite direction. Following these EU directives, Turku may focus on exploiting the potentials of its city centre to grow compact through densification and upgrading processes of the current urban heritage.

Amongst young generations, car-ownership is in decline. In many places families with children are choosing city centres as the preferred lifestyle and housing option. The long postwar process of suburbanization is challenged. Turku is well-placed to answer this emerging trend. Its historic grid is in human scale and still big part of population and jobs are located there. You couldn't have better potential! The grid provides a fully permeable space, calling for more activities and more users. Perhaps more closed courtyards and pedestrian streets with smart public transport could complete it.

Expanding urbanity

Activity patterns show potential to expand urbanity towards the two railway stations – the main one and Kupittaa. The most used and mixed street sections seem to hint towards these two directions. Turku should have a bold vision of not only intensifying the very centre (Market Square-library) but clearly expanding the scope of fully urban inner city. Big potentials are in Humalistonkatu / Puutarhakatu and Hämeenkatu / the University area. In both directions it is possible to expand the urban feel over the existing grid to the industrial transition zone. In these areas, new development should not be suburban in character. Turku could easily have at least three distinct urban neighbourhoods – Centre, Portsa-Linna and Kupittaa-University – each with unique identity and regional attractivity with the main streets and high quality public spaces. The new tram and other modes of public transport should be aligned to support that expanding field of high quality urbanity, making sure that these neighbourhoods become real destinations. Both cultural and spatial planning is needed in developing the new urban pattern of Turku.

Aura river as the nexus of Turku's image

Surprisingly, we found a big need to develop the uses of the Aura river. The river is morphologically central. Both residents and tourists love it. The landscape and natural features of the river valley are a luxury that only a few cities in Finland can enjoy. The river is evidently the most popular place of the city, but only very few permanent and temporary uses are present along the riversides. The main effort of making a place attractive is already achieved, now the City of Turku and other actors can easily study a plan to exploit this potential. Because of these reasons, the river should be much better programmed with temporary uses which would adapt to the rhythm of the city and the seasons. Meanwhile new design solutions to accommodate more services at the ground floors should be considered as well. There is need for activities, cultural events, floating platforms, galleries, running paths, urban gardens, not just drinking. Turku must turn from "A city by A river" into "THE city by THE river". One important aim can be extending the popularity of the river all along its path running from the Castle through the grid to the historic sites in Halinen. In a certain way, the river is part of all the three urban neighbourhoods discussed above and for this reason it could also be considered even as a possible path for an alternative tram line.

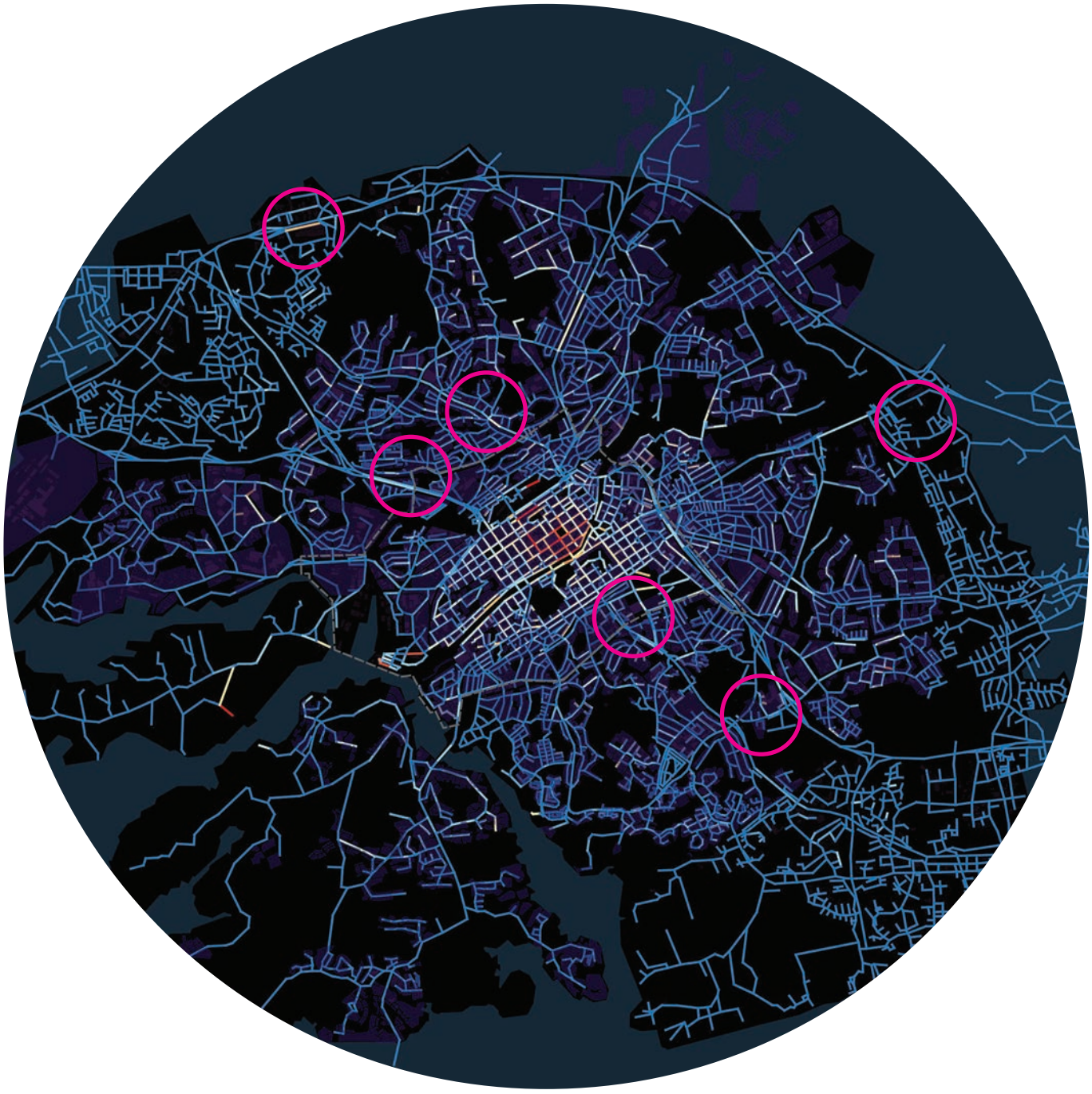


Figure 81. Map of geolocated Instagram pictures per segment and location of major shopping malls outside the city centre

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APPENDIX 1
Concise literature review

Study

Cranshaw, J., Schwartz, R., Hong, J. I., & Sadeh, N. M. (2012, June). The Livehoods Project: Utilizing Social Media to Understand the Dynamics of a City. In ICWSM.

Short description

This project uses Foursquare check-ins to study the character of different parts of the city based on the kind of venues people are visiting depending on temporal patterns. Researchers have used this data to redefine the notion of neighborhoods into livehoods which represents the spatial presentation of the collective dynamic activities of the residents and visitors.

Scale

Pittsburgh (metropolitan area), Pennsylvania

Dataset

Foursquare 7 months (collected in 2 sets) 42 787 check-ins 3840 users 5349 venues

Key findings

- administrative borders give a spatial definition of the neighborhood but most of the time the perceived shape of a neighbourhood is given according to the spatio temporal patterns that characterise it.
- the economic performances of certain streets or spots in the city can affect the shape of the livehood.
- architecture typologies and urban design affects the shape of the livehood by their capacity, or not, to host certain kind of venues and give them a distinctive character.
- demographics of Foursquare users is in constant mutation of size and behavioural patterns therefore it is crucial to monitor users activity to re-validate the data from time to time.

Study

Wakamiya, S., Lee, R., & Sumiya, K. (2011, November). Crowd-based urban characterization: extracting crowd behavioral patterns in urban areas from twitter. In Proceedings of the 3rd ACM SIGSPATIAL international workshop on location-based social networks (pp. 77-84). ACM.

Short description

In this study Twitter users' location is used to characterise districts by analyzing crowd behavior and cluster phenomena of a selected groups of activities. Eventually it is possible to characterise different urban areas and divide as: "bedroom towns", "office towns", "nightlife towns" and "multifunctional towns".

Scale

Japan, different cities

Dataset

Twitter 1 month 11 632 750 tweets (geo-tagged) 211 361 users

Key findings

it is possible to use Twitter data to study and define which are the characteristics of a certain urban areas.

Study

Kling, F., & Pozdnoukhov, A. (2012, November). When a city tells a story: urban topic analysis. In Proceedings of the 20th International Conference on Advances in Geographic Information Systems (pp. 482-485). ACM.

Short description

This study is aiming to find out which are the cultural borders of certain neighborhoods based on the semantic information of LBSNd. A new functional definition of neighborhoods is proposed to be applied based on when and where certain topics such as "morning", "lunch"," evening at home" or "nightlife" are emerging.

Scale

New York City

Dataset

Foursquare check-ins (over Twitter) 4,5 months approx. 740 000 tweets (user+automatically generated by Foursquare), 20 500 users 38 300 venues

Key findings

- the complexity of urban dynamics can be simplified and represented through the semantic analysis of LBSNd.

This can be done using a method that breaks down the semantic information of LBSNd into what has named "urban topics".
- spatio-temporal distribution of the urban topics differ from weekends to weekdays, showing that some districts have completely different characters within the time span of 7 days.

Study
Noulas, A., Scellato, S., Mascolo, C., & Pontil, M. (2011). An Empirical Study of Geographic User Activity Patterns in Foursquare. ICWSM, 2011, 70-573.

Short description
This study focuses on Foursquare users activity patterns. The aim is to learn which are the users' typical activities, such as doing sports or shopping, and how they relate to each other in space and time. In other words – observing people's habits to choose one certain kind of venue after another.

Scale
Global

Dataset
Foursquare over 3 months (111 days) 679 000 users 12 000 000 check-ins 3 mln. geotagged categorised venues

Key findings
users follow well defined spatio-temporal patterns in global scale. Check-ins of Foursquare users can be used to predict what venues are most likely to be chosen after another.

Study
Zhang, K., Jin, Q., Pelechrinis, K., & Lappas, T. (2013, August). On the importance of temporal dynamics in modeling urban activity. In Proceedings of the 2nd ACM SIGKDD International Workshop on Urban Computing (pp. 7). ACM.

Short description
This study analyses the distribution and type of venues together with users check-in temporal activity patterns to detect clustering phenomena.

Scale
Rectangular areas of 10m2 size in the city centres of New York City & San Francisco.

Dataset
Foursquare 5 months 11 726 632 check-ins (from 22 506 721 tweets) NYC - 277 503 check-ins, SF - 82 435 check-ins

Key findings
- activities that cluster in space do not necessarily cluster in time. For example a set of venues that are close to each other forming a cluster in space may not necessarily be visited by users during the same periods of the day.
- different parts of the city appear to be more popular in different times during the day.
- the temporal distribution of users check-ins reveal that in both cities people are mostly active during the afternoon.

Study
Cheng, Z., Caverlee, J., Lee, K., & Sui, D. Z. (2011). Exploring Millions of Footprints in Location Sharing Services. ICWSM, 2011, 81-88.

Short description
This study is introducing a method to reveal mobility patterns based on Foursquare check-ins. By connecting users check-ins in space and time it is possible to reveal how people move in the city. Researchers have also considered users social status and semantic analysis to study factors which can influence mobility.

Scale
Global

Dataset
225 098 users and 22 506 721 unique checkins 5 months over twitter from 1200 apps

Key findings

- mobility patterns can be related to social status.
- semantic analysis reveales that sentiments, social relations and geographic constraints can affect mobility patterns.
- users follow well defined spatio-temporal patterns in global scale.

Study

Preoțiuc-Pietro, D., & Cohn, T. (2013, May). Mining user behaviours: a study of check-in patterns in location based social networks. In Proceedings of the 5th Annual ACM Web Science Conference (pp. 306-315). ACM.

Short description

This study introduces a method to predict mobility patterns and cluster the users based on their behaviour. Data from Foursquare and Twitter are combined to detect frequent users and trace their trails to discover mobility patterns. Movement is analysed giving an emphasis on the users transit between one venue to another by analysing the relation between venues categories. This method highlights which venues are most likely to be visited by one group of users in a certain time of the day and could also predict what kind of venues they are most likely to visit next.

Scale

Global

Dataset

1 month frequent Foursquare/Twitter users (9167) for 959 122 check-ins

Key findings

- users mobility patterns analysed using this methodology relate to the real world expectations, therefore it could be valid to use to formulate detailed predictions of people's mobility patterns.
- LBSNd is comparable to mobile positioning data to study mobility patterns. On the other hand LBSNd contains a wide range of metadata that is not available in mobile positioning data.