

# Constructing digital twin of Amsterdam social network

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## 1 Abstract

Social networks are at the root of practically every social phenomena, from financial crises to pandemics. To simulate such occurrences, agent-based models (ABMs) mainly rely on the reconstruction of complicated social interactions. In order to make a good representing ABM of Amsterdam one needs to recreate the communities within the society and to study how the structure of the network influences the dynamics of social norms within it.

For my thesis, I will create a large-scale multilayer social network of Amsterdam utilizing data from big cohort studies, census, and social interaction data from the Central Bureau of Statistics. In addition, a model of the network's dynamics will be developed.

## 2 Research context

Social networks have been used to study a variety of phenomena, including the relationship between actors' social network positions and information spread[7], the genesis of homophily[11] and reciprocity[8].

Although this type of structural approach to social understanding is still a very powerful tool for uncovering the hidden structures underlying social activities, it has become increasingly clear in recent years how a monodimensional analysis is unable to account for an increasing number of phenomena [10]. A multilayered network gives more insight into such phenomena and is therefore more interesting to study and construct. The area of multilayer social network analysis in engineering is crowded. A few interesting papers and books regarding this topic are published by Kivela et al.,[9] Bianconni [2] and Dickson et al.,[5], whom show the importance of the construction and analysis of a multilayered network.

### 3 Research methods

For my thesis, I propose to develop a complex network of Amsterdam using CBS data. The CBS data covers four 'layers': household, family, neighbors, and work/school, together with the number of links between two social groups for each layer. These social groups are classified according to gender, age, ethnicity, and educational level. The network's edges are determined based on this information. CBS also provides a dataset indicating the number of people within each group. Based on these two data sets a network can be constructed.

The objective of my thesis is to create a complex social network that represents Amsterdam. To make such a network, various methods of connecting network nodes will be explored. Examples of such methods are the scale-free method offered by Alebert and Barabasi [1], the random method proposed by Erdos and Renyi [6] and the Small-world network[14]. Other principles, such as reciprocity and homophily, can also be used to connect the nodes.

These methods can be tested by collecting statistics from the proposed networks and comparing them to an objective function based on geographical data and metrics such as the segmentation and isolation index [3, 12].

In addition, I will compare the most recent network (based on CBS data from 2021) to an older data set to see how interactions change. Which could be investigated using the stochastic actor oriented model [13].

Finally, I would like to mention that I will be mostly using the programming language Python, together with the packages pandas and networkx to engineer and analyse the complex network.

### 4 Significance of Research

The provided network can be used to investigate the probable mechanisms of the establishment and maintenance of various attitudes (social norms) about body weight within groups of varying socioeconomic level (SES)[4].

Furthermore, complex network analysis of the network can assist in identifying the reasons of such socioeconomic inequality, in addition an ABM based on this network allows for the investigation of potential interventions.

### References

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## A Tentative Timeline

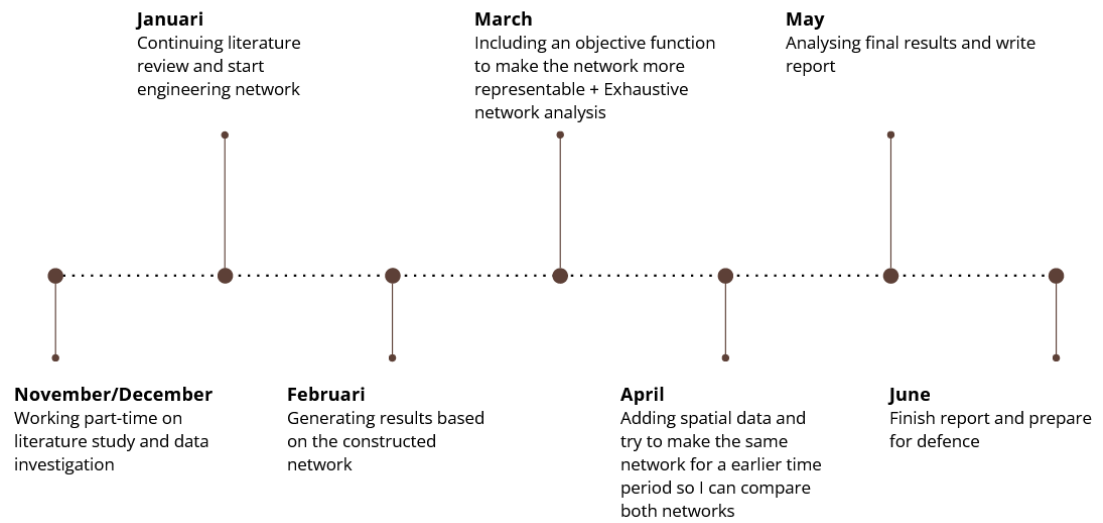


Figure 1: Tentative timeline