**DEPARTMENT OF LITERATURE,
HISTORY OF IDEAS, AND RELIGION**

WOMEN'S WOVEN WEB

Activating the Biographical Dictionary of Swedish Women through Social Network Narratives

María Guadalupe Alvarez Díaz

Essay/Thesis:	Master's Thesis Project DH2330, 30 hp
Program and/or course:	Master's Programme in Digital Humanities, H2DHU
Level:	Second Cycle
Semester/year:	Spring 20
Supervisor:	Daniel Brodén, Johan Åhlfeldt
Examiner:	Jenny Bergenmar
Report no:	xx (not to be filled in by the student/students)

Abstract

Essay/Thesis:	Master's Thesis Project DH2330, 30 hp
Program and/or course:	Master's Programme in Digital Humanities, H2DHU
Level:	Second Cycle
Semester/year:	St/At/20xx
Supervisor:	Daniel Brodén, Johan Åhlfeldt
Examiner:	Jenny Bergenmar
Report No:	xx (not to be filled in by the student/students)
Keyword:	

Abstract: When the Biographical Dictionary of Swedish Women (Svenskt kvinnobiografiskt lexikon, SKBL), became freely available online, it opened the opportunity to examine and transform its text-based content in new ways. The purpose of this project is to apply and reflect on explorative visualizations of social networks as a method for presenting and analysing data from SKBL. The thesis examines a key moment for the history of textile arts in Sweden, through the construction of an interactive prototype for visual network explorations of datasets based on SKBL. The prototype for the thesis is built on the software platform for network analysis Gephi and the analysis is based on the collection of datasets from SKBL. The aim is to identify frequent practices and common patterns in social interactions between pioneers of the home handicrafts and textile art movement at the turn of the 20th century in Sweden. All graphical networks need narratives for interpretation and the interactive visualization of Gephi encourages such narratives. Thus, history is investigated in order to find out what stories about the movement are enabled by social network analysis. Results of the exploration indicate the presence of female personalities whose contributions to the movement have not been appreciated to the same extent as more well-known members of the movement. Visual explorations also suggest that educational institutions facilitated female social interconnections and educated experts who founded more schools. Of importance is that the quantitative visualizations presented the data in ways that suggested perspectives not evident in the existing biographical article format. The thesis conveys the benefit of using a mixed methods approach where the prototype together with its narratives open the possibility to capture the complexities of social interactions and its impact in historical movements.

Key Words: SNA, Social Network Analysis, mixed methodologies, lexicon, SKBL, IDN, Interactive Digital Narratives, Swedish domestic handicraft, Swedish textile art, 19th Century, 20th Century, Swedish Technical schools, pioneers, entrepreneurs, network visualizations, female studies, digital humanities.

Foreword

Projects in the humanities are no longer an individual effort but an ensemble of persons from a variety of disciplines, thus it is important to acknowledge the generosity of specialists to this thesis. Thank you to Johan Åhlfeldt guiding the construction of datasets, the selection of software tools and the critical thinking on data material. The insights of Maria Carlgren pointing out biographies related to the textile art movement and her valuable literature references were key to the narrative interpretations, as well as Maria Sjöberg's publication about SKBL. Thanks to Jonas Ingvarsson for the thesis course, and his proofreading revisions and to PhD Ricardo Alvarez Pimentel for his support in language.

I would like to give special thanks to my keen thesis advisor Daniel Brodén, for his exceptional teaching, for have given me an opportunity to learn, over a considerable time, about the issues of scientific writing.

Last but not least, I´m grateful for Per Fredén, my husband, whose outstanding ability to team-up and his dedication to our daily life were crucial for making this master program an option for me.

Table of Content

Introduction

In March 2019, the first lexicon online of women's biographies in Sweden, The Biographical Dictionary of Swedish Women (Svenskt kvinnobiografiskt lexikon, abbreviation hereafter: SKBL), was launched by the University of Gothenburg. This was not a casual event but the culmination of a long history of scholarly efforts to challenge and provide alternatives to male dominant views on how the fields of history and history of art are understood as well as to recover the contributions of women to Swedish society and culture. As one of the project leaders, Maria Sjöberg, points out, the history of investigations over Swedish women's role in history, that preceded the SKBL project, are as old as from early women's history studies by Ellen Fries in the late 18th century.[1] So far, SKBL contributes with more than 1,000 articles which are freely available both in Swedish and English on prolific women, written by Swedish scholars, museologists and other authors with knowledge on specific historical persons.[2]

Sjöberg stresses that the result of the project is an online database where the personal background and social conditions of the biographed women are searchable and possible to fully quantify.[3] The content of SKBL is based on structured databases, which provides conditions to find patterns and common features through all the biographies included. These conditions also open further opportunities to apply research methods from the digital humanities to the data.

The SKBL database became interesting to me as I have an interest both in working with relational data visualizations and in its potential for the studying of interactions among social actors, for its possibility of applying social network analysis. In the present thesis I will explore this potential by creating a prototype for the interactive visual exploration of data from SKBL, using social interconnections between members and institutions involved in the so-called home handicrafts and textile art movement at the turn of the 20th century in Sweden as a pilot study. This is a subject familiar to me since I investigated Lilli Zickerman, a key personality to the textile movement, in a previous work.[4] This movement has the particularity of having been articulated through activities rooted in the daily home life of women, that, at that time, acquired a higher symbolic value and also served to link individuals to a larger web of social

[1] Maria Sjöberg, "Om behovet av Svenskt kvinnobiografiskt lexikon", *Skandia: Tidsskrift för Historisk Forskning* 2019:band 85(2).
[2] Maria Sjöberg, "SKBL 2.0 är på väg", *Humtank*, 2020-01-22, http://humtank.se/skbl-2-0-ar-pa-vag/ [retrieved 2020-06-02].
[3] Ibid. p. 107.
[4] Ma. Guadalupe Alvarez, *Experiencing Play with Digital Heritage through Mobile AR Technology.* Master Degree Project, Skövde: University of Skövde, 2016.

connections.[5] Social relationships between handicrafts professionals are one of the central subjects in SKBL. The database is abundant in quantifiable data on this theme which makes it appropriate for social network analysis. At an early stage of my work, I was particularly curious to find the recurring appearance of two educational centers in the biographies of the professionals in handicrafts and textile art, and found their degree of influence in the ideas and professional life of the pioneers to be an interesting subject to further investigate. For this reason, I have focused on building two networks. One that I am calling Network of Contacts, that visualizes personal relationships between various professionals and pioneers of the movement, and another network titled Network of Educational Institutions that presents their professional activity in relation to educational institutions.

Purpose and Aims

The overall purpose of this thesis is to apply and reflect on explorative visualizations of social networks as a method for presenting and analysing data from SKBL. I am mainly interested in investigating the potentials of network analysis as an approach to reworking information on social relationships and their impact in social movements. A more specific purpose is to conduct a case study and examine the structure of two networks connected to the home handicrafts and textile art movement at the turn of the 20th century in Sweden, to better understand the social structure that drove their collective action, identifying regularities in their lives, in their relationships, in common places and in common concerns. By focusing on a particular phase of the movement, I will be able to handle a manageable quantity of elements in the scope of this project. At the same time, the social network analysis will allow me to explore the potential of insights that visualizations provide, and to some extent, contribute with a new perspective to the research on the movement.

The research questions I will pursue are: How could content in SKBL be presented in novel ways so that the visualization of social networks provide alternative perspectives on specific subjects? What do network explorations suggest about the social interactions between professionals of the home handicrafts and textile art movement? What narratives are enabled by network analysis on collective interactions with educational institutions? How can network

[5] Catarina Lundström, *Fruars makt och omakt. Kön, klass och kulturarv 1900–1940*, PhD dissertation, Umeå: Institutionen för historiska studier, Umeå Universitet, 2005, p. 146.

visualizations encourage the search for content about social interactions between professionals and particular institutions?

The point of departure for my work, is the construction of an interactive prototype for visual network explorations of datasets based on the content of SKBL. Although SKBL's articles have a clear focus on women, they nevertheless constitute a wide account of professionals in the home handicrafts and textile art, some well-known but also many less explored, at the turn of the 20th century. Furthermore, the interactive visualizations in the thesis are hardly intended to be a comprehensive account of the home handicrafts and textile art movement, but rather to provide perspectives on the first generations of a larger formation of collective action, from the view of the authors of biographies included in SKBL. As my thesis draws singularly on SKBL data, the analysis will mainly be geared towards female contributions to history. As stated by SKBL researchers, sources for the period of the movement refer mostly to women from noble families, and women whose contribution has been documented in archives.[6]

The visualizations in the prototype will be based on the open access application for social network analysis Gephi, that supports the exploration of structural properties of social interactions. Applying Gephi offers two important possibilities. One is to transform processed datasets into interactive visualizations, that are recognizable to the human eye. The second is to compute statistics and run algorithms, with datasets as source materials, suggesting structures, and mapping relationships. These features will significantly enhance my possibilities to tease out "stories" or "narratives" about social interactions between professionals of the home handicrafts and textile art movement. Narratives will serve to complete the analysis with a more qualitative approach, where interpretations are a strategy to propose perspectives on how the relationships and professional actions resulted in a social and artistic movement. It is relevant to point out here that it is not possible to arrive to definitive conclusions based on visualizations, rather to encourage discussions on proposed reasons for new hypothesis and inputs for further investigation of the home handicrafts and textile art movement and its social networks.

Previous Research on the Textile Movement

The home handicrafts and textile art movement is a significant part of the history of social and artistic collective endeavours in Sweden. The movement has been widely researched since the early years of the 20th century and has drawn particular attention from gender scholars in the

[6] Sjöberg 2019.

last decades. With the advent of nationalism during the second half of the 19th century, the search for authenticity in Swedish culture, produced a gradual shift in the value of home handicrafts from a traditional domestic activity to an artistic production of heritage value: "Den slöjdande familjen blev symbol för det idealiserade allmogesamhälle som ansågs hotat och som man nostalgiskt längtade tillbaka till" Catarina Lundström observes.[7] This transition occurred over time also in textiles and dressmaking. In this process, women gained recognition for mastering the technics and transferring their competences and experience beyond their households to educational institutions.

From the perspective of my thesis, hierarchies and functions suggested by Lundström in her research on pioneers of the movement, becomes particularly important: that is, a stratification according to the combination of competences as performers, as leaders, as well as their skills to verbally articulate as theorist, and how they acquired status and power to the extent that these skills added up.[8] Therefore, formal education is deemed to have played an important role in building their interest in preserving and enhancing the craft and in shaping them as business developers. The schools functioned as spaces for reinforcing modernity and social connection, as Maria Carlgren stresses, in her studies of education of the Birgitta schools.[9] Furthermore, the movement was characterized by promoting the diversity of regional aesthetic expressions in both manufacturing and in textile designs. As exemplified by Agnes Geijer, the fusion of inherited techniques and patterns with temporally heterogeneous motifs, as well as local access to certain dyes and particular materials resulted in different landscape types or so-called local character (*ortskaraktärer*).[10] Pioneers of the movement developed contacts with local producers while traveling all over the country building catalogues of ancient pattern designs, while some others reworked those traditional patterns together with more modern design tendencies, giving birth to new textile expressions.[11]

Narratives are abundant in SKBL describing lives of women receiving formal education, at the turn of the 20th century, traveling and practicing a profession, an opportunity mostly

[7] Lundström, p. 150. "The skilled crafts family stereotype became a symbol of an ideal ancestral role model of society that was considered threatened, and to which people nostalgically longed to return", All translations from Swedish are performed by Guadalupe Alvarez, author of this thesis.
[8] Ibid., p. 157.
[9] Maria Carlgren, *Birgittaskolorna. Modeateljéer och sömnadsskolor mellan tradition och förnyelse.* PhD Dissertation, Göteborg, Stockholm: Makadam Förlag, 2016.
[10] Agnes Geijer, *Ur textilkonstens historia,* Slovenia: Tidens förlag (3rd. Edition), 1994.
[11] Birgitta Svensson, Louise Waldén, "Att hävda det textila", *Den feminina textilen. Makt och mönster,* eds. Birgitta Svensson, & Louise Waldén, Stockholm: Nordiska Museet, 2005.

available to bourgeois families. An example is described by Lena Hillerström on young women encouraged to leave the countryside to embrace an artistic and technical education in Stockholm.[12] SKBL is rich of narratives in this respect, the articles disclose female activism in the exercise of their professions, in their social activities, in their writings, and even in their conflicts, gaining social and political agency with their efforts.

Disposition

I will discuss the construction and analysis of my prototype in four chapters. The first, "Theory and Methodology", explains basic concepts of social network analysis, and then introduces the generation of knowledge as a natural consequence of reworking digital data. Further discussions in the chapter explain how I will be using social network analysis concepts in my work. The chapter continues with a discussion of the role of narratives as a more qualitative approach to analysis and as a strategy of network interpretation. This discussion is followed by a description of the datasets, where I approach some of the methodological challenges of this project with SKBL, as for example, the gender bias of the datasets. The chapter "Visualizing and Exploring Two Networks" is the central chapter of the thesis. Here, I discuss my work on and exploration of the home handicrafts and textile art movement using Gephi. I describe how the datasets were customized to fit the information required for social network analysis and discuss how the visualizations are employed as tools of analysis from a methodological perspective. To use the prototype two exercises are necessary, an exploration and an explication. The exploration is visual, with the support of Gephi, and accompanied by an interpretative explanation in the form of a historical narrative. After this, I start describing the prototype. First, I have created a network of personal and professional relationships between pioneers of the home handicrafts and textile art movement, which I named Network of Contacts. A second network presents relationships of these pioneers with their educational institutions, named Network of Educational Institutions. Through the exploration of the two networks I will account for the decisive role of schools to professionalize skills and consolidate networks of contacts in the textile industry and in the society around the production of handicrafts and textile. The chapter "Summary of Results" draws together key arguments and findings in the analysis. Here I

[12] Lena Hillerström, "'Insigt och flit': Kvinnliga elever vid Tekniska skolan i Stockholm 1850–1925", *Rummet vidgas. Kvinnor på väg ut i offentligheten 1880 – 1940*, eds. Eva Österberg & Christina Carlsson Wetterberg, Stockholm: Atlantis, 2002, p. 311ff.

particularly stress how the visualizations based on relational data, on the one hand, provide an overview of the structure of women's social network, which direct attention towards the relevance of specific persons, not evident in the existing format of SKBL (a multitude of singular articles); and, on the other hand, may enrich our understanding of the role educational institutions played as a point of origin for professional relationships within members of the movement. The final chapter “Conclusions” resumes the results and includes a reflection of the work with the prototype and its potential for further social network analysis.

Theory and Methodology

The prototype developed for this thesis is an interactive visualization of social networks. A social network analysis is a quantitative process, aided by accessible and user-friendly software. At the core of the analysis is the construction of datasets, that is, the collection and structuring of data from a specific source. As stated above, the analysis specifically aims to identify frequent practices in social interactions between pioneers of a determined historical movement, the home handicrafts and textile art movement in Sweden, based on datasets from SKBL. Below I will present some key concepts of social network analysis and discuss the implementation of those concepts in my work.

Social Network Analysis

A network is an organization of intertwined components, "[a]n arrangement of threads" in the context of graphical display. In the context of a social environment, a network is a set of links between individuals. Franco Moretti defines network theory as the study of connections between large group of objects.[13] Those objects are known as nodes. Depending on the context they are also vertices, actors, agents, or points. Their connections are called edges but also relationships, arcs, links, ties, or simply, relations.[14] Moretti uses networks in his literary analysis as a way of arranging literary data that presupposed a principle of order "to gain intuitive knowledge of plot structures".[15] A literary study such as Moretti's has the potential to reveal structural characteristics of interconnections between people, if we treat them as units and from units to characters in a plot.

Studying graphical social networks is an approach to understand dependencies between nodes by representing their interconnections.[16] Connections then, are in focus, since they are the signs that help making sense in a group of nodes. Elijah Meeks is in line with Moretti's theory when asked for a definition more specific to the field of digital humanities: "The network is not a social network or geographic network or logical network but rather a primitive object capable of and useful for the modelling and analysis of relationships between a wide variety of

[13] Franco Moretti, "Network Theory. Plot analysis", *Literary Lab. Pamphlet 2*, 2011-05-01:Standford U., https://litlab.stanford.edu/LiteraryLabPamphlet2.pdf.
[14] Miriam Posner, "Social Network Analysis Glossary", *Beyond the Digitized Slide Library*, 2015:UCLA, [retrieved 2020-05-05] https://github.com/miriamposner/network_analysis_workshop/blob/master/social-network-glossary.md.
[15] Moretti, p. 12.
[16] Scott B. Weingart, "Demystifying Networks, Part I & Part II", *Journal of Digital Humanities*, Winter 2011:vol.1, no.1, http://journalofdigitalhumanities.org/1-1/demystifying-networks-by-scott-weingart/.

objects".[17] Relationships, or edges in graphical terms, have two characteristics of measurable value: Distance and weight.

When Matthew Jockers applied network analysis to literary history, he described similarities between novels, that can help to define "distance". In his analysis, books are nodes and edges are distances between them. The attributes he assigned to the edges were of stylistic and thematic features, so the distance depended on the similarities of those characteristics between books. The value of weight, on the other hand, corresponds to the strength of connection between two nodes, a value that is also pre-defined by the analyst. [18]

There are several considerations to make when defining relationships. The analyst needs clarity on what to look for, to define appropriate attributes and assign a value to them. It can also be the case that relationships have no weight assigned.

In early attempts of constructing networks, Moretti already indicated the need for mathematical intelligence to examine datasets. Software tools for the analysis of social networks are continuously developed and applied in multiple scientific disciplines. In the humanities, there are several alternatives currently in use. For instance, some researchers use the programming language F# for analysis, combined with JavaScript library D3.js for social network visualization and the statistical computing language R for network centrality analysis.[19]

In the context of social movements studies, social science researchers apply social network analysis utilizing definitions suitable to the present project. [20] Manuela Caiani defines social network analysis as a toolbox for the measurement, systematic description, and analysis of relational structures.[21]

Caiani sustains that network analysis consists in the study of structures. Relations among actors form social structures and a network is formed by links between nodes organized in hierarchies. These are based on the access of nodes to other network resources. Other factors to determine the hierarchy are the limits and opportunities the position each node offers.

---

[17] Elijah Meeks, "More Networks in the Humanities or Did books have DNA?", *Stanford University Libraries*, 2011-05-11:Stanford U., https://dhs.stanford.edu/visualization/more-networks/.

[18]Matthiew L. Jockers, *Macroanalisis. Digital Methods and Literary History*, Urbana, Chicago and Springfield: University of Illinois Press, 2013, p. 164.

[19]Evelina Gabasova, "The Star Wars Social Network", 2015-12-15, [retrieved 2020-05-01] http://evelinag.com/blog/2015/12-15-star-wars-social-network/index.html#how.

[20]Donatella Della Porta, "Social Movement Studies and Methodological Pluralism. An Introduction", *Methodological Practices in Social Movement Research*, ed. Donatella Della Porta, Oxford University Press, 2014, p. 2–23.

[21]Manuela Caiani, "Social Network Analysis", *Methodological Practices in Social Movement Research*, ed. Donatella Della Porta, Oxford University Press, 2014, p. 368–396.

This definition is relevant to the study of the Swedish home handicrafts and textile art movement because social actors in the network are seen as nodes, that is, entities with communication flow and interaction represented in the visualization as nodes. The analysis of the network structure may help us to understand the effect of network links over social actors. To be more specific, Caiani highlights five principles driving the analysis: The first principle is that social actors, represented as nodes, are interdependent units. The second principle is to focus the study on the relation between actors. The third principle is to emphasize the characteristics of relationships over individual features. The fourth principle is to conceive relationships as channels where resources flows. The fifth and last principle is to consider node position in the network and the neighboring of nodes as a factor for action.

As Caiani suggests from Wasserman & Faust, that social network analysis provides a set of methods of analysis with focus on relational aspects of the nodes: "the unit of analysis in network analysis is not the individual, but an entity consisting of a collection of individuals and the linkages among them. [22] Network methods focus on dyads (two actors and their ties), triads (three actors and their ties), or larger systems (subgroups of individuals, or entire networks)"[23] In the case of the present project, the unit of analysis is pairs of nodes. Therefore, the use of relational data is necessary in the construction of networks between pairs of nodes.

According to Caiani, the concept of network provides researchers with the possibility to study how social changes take place through three levels of view.[24] Those are a general overview that focuses on the structure or layout of the network, a detailed view level dedicated to the particularities of specific nodes and a middle level that explains the mechanisms of groups of nodes.

Network Analysis Values

A key characteristic of network analysis applications is their capacity to visualize the process of transforming statistical analysis into spatial layouts.[25] In this project I am using the open source technology package Gephi, which utilizes the Force Atlas algorithm to render a 3D engine that facilitate explorative visualizations. This spatialization algorithm is applicable in the social network analysis, where a simulation of the social forces takes place by triggering

[22]Stanley Wasserman & Katherine Faust, Social Network Analysis: Methods and Applications, Cambridge: Cambridge UP, 1994.
[23] Caiani, p. 368.
[24] Ibid. p. 383–389
[25]Ulrik Brandes, Patrick Kenis, Jörg Raab, Volker Schneider, and Dorothea Wagner, "Exploration into the Visualization of Policy Networks", *Journal of Theoretical Politics,*1999: vol.1 issue 1.

repulsion in nodes, and attraction in edges. Forces apply continuously while the layout is running, so a person can be exploring the network, make changes and see the consequences of those changes immediately. "Non-expert users need to observe the spatialization process and even to interact with it. Manipulating the graph while it spatializes helps to understand the difference between a graph layout and a Cartesian projection", Jacomy et. al. writes.[26] Gravity, scaling and preventing overlapping are the three values I am manipulating in this project. The three concepts are affecting the layout, changing the values produces proportional expansion or contraction of the network in the space.

Repulsion by degree is one of the concepts I use. Degree in the nodes refers to the number of connections or edges of a node, where highest degrees are given to nodes with most connections. In graphical social networks, if all the nodes are of the same type – "persons," for instance – then the highest degree is of the person with most connections or edges with other persons. Visually, it is represented by the size of the node. If a node only has one edge it is usually pushed to the periphery, practically out of the canvas.

Centrality is a measure based on the degree of nodes. In graphical social networks it could, depending on the context, mean the degree of influence of specific nodes over the network. That depends on the interpretation of node size in the qualitative analysis. When the statistical calculation of centrality is made in Gephi, it values three different types of centrality. To this project, the specific centrality considered is *Betweenness centrality*. Betweenness centrality correspond to those few nodes that bind the graphical network together because through them passes edges to connect other nodes. The degree of nodes can provide insights to the social interactions in the totality of the network.

It should be pointed out that one of the two networks that make up the prototype is bimodal (Network of Educational Institutions). A network is bimodal when it has two types of nodes. One type of nodes is *institutions* and another type is *persons*. The relationships displayed are of many persons to few institutions. The degree value is then a major contributor of knowledge of the social interactions in bimodal networks because the nodes are usually directed, providing an intuitive sight of positions held by nodes, in relation to all other nodes.

[26] Mathieu Jacomy, Tomasso Venturini, Sebastian Heymann, Mathieu Bastian, "ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software", *PLoS ONE* 9, 2014: nr 6, https://doi.org/10.1371/journal.pone.0098679.

Network as Knowledge Generator

Network visualizations provoke the interest to search into it for more content and discover further information of interest. That is why my visualizations aim to serve as *knowledge generators* instead of representations, that is, in this case, the capacity of network visualizations to produce or encourage the search for new knowledge. [27] The dictionary SKBL already, to some extent, constitutes a knowledge generator since each search more and less brings forward new perspectives on specific subjects. Johanna Drucker makes a clear distinction between representation and knowledge generators. The first are static knowledge already gained, while the second are dynamic and require the intention and interest of whom search for it. Knowledge generators are, in the case of my project, visualizations that encourage intellectual inquiry and are capable of creating new knowledge through their use, another good reason to produce alternative modes of visualization for the SKBL database. If one could have SKBL printed in a shelf together with other dictionaries, instead of having it available online with dynamic updates, the task of building a graphical social network based on it would have been much harder, as there would be no datasets behind the network to use and rework; it would, in the best case, be static layouts of meaning-produced information.[28]

The prototype constructed for this thesis project focuses on the generative capacity of SKBL and, to exploit its possibilities of being combinatoric, producing multiple results by processing variables against each other. As a researcher of multimodal forms, Gunther Kress recognizes the need of understanding how knowledge is acquired and the role of information. By comparing the past with the digital era, Kress notices that in the actual circumstances the Internet provides users with the accessibility necessary to search content, when there is a need for it. The act of searching, selecting, and consuming becomes an act of transforming information into knowledge.[29] The experimental work in this project of constructing graphical networks could, in a way, be understood as an act of transformation, as this process itself is expected to provide a new and better-informed understanding. The intent is not to assess the software applications merely as tools but also as media in which one gathers information for further analysis.

---

[27] Johanna Drucker, *Graphesis. Visual Forms of Knowledge Production*, Cambridge, Massachusetts, and London, England: Harvard University Press, 2014, p. 65–135.
[28]Ibid.
[29]Gunther Kress, "Where Meaning is the Issue", *Multimodality. A social semiotic approach to contemporary communication.* London: Routledge, 2009, p. 1–17.

Method Implementation

Social network analysis uses the capacity of visualization as a means to directly convey the structure of a network, social actors, and the relationships between them. As stated before, visualizations are not only illustrations but also tools of analysis. The visual presentation of results from data processes allows, between its most common features, comparisons across structures of different networks, presentation of its characteristics and discovery of specific relationships between persons. These processes may confirm results obtained through more traditional methods of history research, although results are not precisely similar. Not least, these results differ due to the method reaching to them is different. In a social network analysis, a quantitative process is introduced, where software tools support the qualitative analysis with statistical calculations, translated into visual representations of relational data.[30]

From the visualizations derive a qualitative analysis, that consists of an exercise of interpretation to describe, explore, and summarize numbers.[31] The interpretation takes the form of narratives, that explain or give meaning to the visual results.[32] These narratives have a component of comparison based on observations between visual results and earlier research sources on the subject. In the case of this project, these sources are previous investigations about the home handicrafts and textile art movement.

Gephi, a Platform for Social Network Analysis

The application Gephi which is developed by the Maison des Sciences de l'Homme in Paris since 2008, is at the core of the prototype. In the next chapter, I will present some static images of the application in order to illustrate the analysis, although these images do not convey the dynamics of interaction with the prototype. It allows for the exploration of the graphic network and for displaying scenarios based on statistical measurements, using filters and plug-ins to customize the network and provide the capability to manipulate all elements and its values. Gephi provides "access to network data and allows for spatializing, filtering, navigating, manipulating and clustering", writes Bastian, Heymann and Jacomy.[33] By applying a few of the

[30] Ulrik Brandes, Patrick Kenis, Jörg Raab, Volker Schneider, Dorothea Wagner, "Explorations into the Visualization of Policy Networks", *Journal of Theoretical Politics* 11(1), 1999, p. 75–106.
[31] Ibid.
[32] Mireia Bolíbar, "Macro, Meso, Micro: Broadening the 'social' of Social Network Analysis with a Mixed Methods Approach", *Quality and Quantity* 2016:50(5), p. 2217–2236.
[33] Mathieu Bastian, Sebastien Heymann, Mathieu Jacomy, "Gephi: An Open Source Software for Exploring and Manipulating Networks", Paris, France: *Association for the Advancement of Artificial Intelligence*, 2009.

elementary features of the application it is possible to construct rich visual material for this project.

Network Analysis as an Exercise of Interpretation

The present project assumes that visualizations are based on interpretations. The humanistic approach of the project implies ambiguities and subjectivities inherit in the act of observation, as the means to create material, in contrast with the standard use of graphics to visualize metrics in most disciplines. Johanna Drucker sustain that similar technologies applied in different disciplines treat their graphical visualizations differently, some are more humanistic, and some are more oriented to science.[34] There might be differences between, for example, network analysis applied in medical studies and social network analysis applied in the humanities. The first studies use general, defined parameters and fully standardized coding; while in the second, codes are constructed during the process of building the databases and their definition refined as more experience is gained – units, events, as Drucker understand them, are based on interpretations, becoming standard only in the scope of specific projects.

Building datasets, a process previous to the visualization in which the content to be visualized is selected from the source and organized in tables, involves a certain degree of interpretation. In this sense, interpretation facilitates conveying a specific point of view in the graphic visualization. In this project this facility is exercised by making choices in the use of metrics when producing content material, layout, and design of the network. Units, events, have multiple dimensions. For instance, in graphical network constructions Drucker emphasizes the subjectivity of graphs with a humanistic approach, indicating that nodes can carry multiple dimensions. That is, the co-dependence in relationships that each of these dimensions may have are part of a system where all elements are abstractions serving to convey the designer's purpose. Drucker describes these relationships as "entangled [premises with] co-dependences and contingencies".[35]

Collection of Datasets

Even though my datasets are constructed based on one single source, SKBL, they reflect a rich compendium of female biographies, organizations, institutions, and national and international activities related to the development of Swedish society, but also reflect its limitations. To name

[34] Drucker, p. 130.
[35] Drucker, p. 133.

one relevant to this project, the presence of almost anonymous social actors from the home handicrafts and textile art movement, whose contribution is not sufficiently documented to create an article in SKBL but referred in several biographies, was quantified and listed during the collection of data. The resulted visualization incorporates their names together with more known actors in the social network.

The construction of social networks in this project started by building datasets. It is an act of transforming content, wholly and exclusively extracted from SKBL. While this provide a wide amount of valuable data, it also is determined by the human capacity of accounting for comprehensive information on female actors of this movement. SKBL is a dynamic compendium that aims to be comprehensive and be enlarged over time. Nevertheless, there are margins of error that needs to be taken in consideration, both when it comes to SKBL as a source and in my own collection of data.

The data collection posed unexpected challenges since the application of the collection principles was limited by the search options to the databases, through the SKBL website.[36] The point of departure for my data collection was the biography of Lilli Zickerman (1858–1949), a key personality to the textile movement I investigated in a previous work.[37] From her entry in SKBL, I collected her list of contacts, that is, a list of names with respective type of relationship, available at the end of their biography, completing personal references. I selected all contacts that also have an article, to find more contacts. Soon I found other key actors similar to Lilli Zickerman and found more contacts from their biographical information.

While reading articles and collecting contacts that had a relationship, I realized two things: First, that there were additional contacts with influence in their professional and social life not included in the specific lists of contacts of the articles as well as names in the lists that did not appear in their biographies. Second, that some names repeatedly appeared with high resonance in article's texts but did not have an article themselves. Also, in some cases, articles did not have a contact list. I decided then that the collection process should be driven by the corpus of the article; in that way, each connection was motivated. The criteria to select which personalities to include was of inferred influence in their social activity and professional circles. Some contacts were left outside of the datasets because either they did not play a role in the

[36] Nina Tahmasebi, video-lecture "Ett litet sidospår. Maskininlärning", *Studiecirkelträff 2. Språkbanken Text*, Gothenburg: University of Gothenburg, 2019.
[37] Ma. Guadalupe Alvarez, *Experiencing Play with Digital Heritage through Mobile AR Technology*. Master Degree Project, Skövde: University of Skövde, 2016.

professional life or in the social activity of the person biographed. When names were registered in the list of contacts of articles, but not in the corpus of the biography, a search in other sources was necessary to confirm their inclusion in the Network of Contacts.

Collecting and reworking existing information from SKBL's database presented other methodological challenges. Visual structures are evident when observing graphical networks and they bring forward regularities in the behaviour and roles of communication in society. The analysis of those structures features possible biases of the source as well as biases in datasets. These factors have a methodological implication: Data collected from SKBL, which is my primary source, is characterized by the intention of highlighting experiences and contributions of women specifically. A particular discourse is more or less evident in the articles, in which the home handicrafts and textile art movement is explained by selecting contributions and initiatives found in the narrative of women's lives. Male contributions do not explain the movement to the same degree as female contributions, and there is not comparable accounts of actions and competences. Rather, men are referred to in terms of their relevance in the life of a woman.

The following is an observation to regularities particularly obvious in the Network of Contacts. The nodes of men have a single connection to a central female node. There is a concept in network analysis called Ego Network, in which the disposition of nodes is in the form of a star, around a focal node called "ego". The nodes around the "ego node" are called "alters". Except for two nodes, Henrik Sørensen and Gunnar G:son Wennerberg, all male nodes are "alters" and all "ego" nodes are female. This result is understood as consequence of the gender bias in SKBL. This observation confirms that in this database, the role of men in the history of the home handicraft and textile art movement is often associated to a woman. As colleagues their work complement each other, for instance, in artistic collaborations, as architects or co-designers of industrial production. They act as project facilitators, sharing initiatives or executing strategies defined by others. Their contribution depends on the coincidences of competencies with a woman, such as, in journalism or as politicians of ideas.

As an online dictionary, the SKBL database is continuously updated with new articles, thus is necessary to mention that the date for data collection in my project ended 31st of March 2020.

SKBL has the following frequent types of relationships listed: Friend, colleague, mentor, love relationship, life partner and relative. For relatives, SKBL has multiple types of relationships under another category, family relationships, that is civil status, mother, father,

brother, sister, daughter, son, partner, husband. While I did not collect family relationships as contacts in my datasets, I made some exceptions when, in the corpus of an article, there were references to family members that influenced their professional and public life, and who thus affected their social interaction.

I collected three sets with the following categories:

Set 1. Individual names with three identifications: The ID from SKBL, the ID from Wiki-authority control and an ID for my project.

Set 2. Pairs of contacts: Person 1 with Person 2; type of relationship: For example, a colleague. An institution name where the contact took place; and the period with two dates, one for start and one for end of the relationship.

Set 3. Names of institutions with one identification. City where the institution was located; and coordinates (latitude and longitude of those institutions).

The datasets span a period of 100 years (1860–1960) and contributors and professionals related to home handicrafts (*hemslöjd*) and textile art (*textilkonst*). Since the selection was driven by the narratives in the biographies, I included figures with other professions, persons with influence in the social interactions, especially colleagues with architectural and engineering background, artist and writers who were spreading ideas. For instance, Selma Lagerlöf or Henrik Sørensen. With the readings also came the need for defining the scope of the social network in a number of generations. Consequently, the period of analysis was shortened to 60 years (1880–1940), reconstructing the interactions of nearest generations to the turn of the century.

Even though the period 1880–1940 spans two of the generations of pioneers, an assumption in this thesis is that people in the explored network exist more or less simultaneously. Rather than an overview of the evolution over time, the layout includes an interpretation of the flow of communication at an initial phase of the movement.

From the three datasets I selected the content of files to be analysed in Gephi. I built two networks, one of contacts and one of educational institutions; each of them required data tailored specifically. I built separate tables of nodes and tables of edges for each network. In the case of the edges, each relationship has a source node and a target node. It was also necessary to define whether the relationship was directed or undirected. For instance, as Kerstin Cardon was a mentor to Thyra Grafström, that relation can only go in one way, because Grafström cannot be a mentor to Cardon – that is, thus, a directed relationship. However, in the

case of two schoolmates, the relation is undirected because there was reciprocity between them. In the Network of Educational Institutions, the edges between institutions and persons are directed. In the case of nodes of persons, these are attributed as male or female. The nodes of institutions do not have attributes.

The total number of nodes of persons were of 116 nodes. When the period of study got adjusted to 1860 –1940 through Gephi, the total number got reduced to 108 nodes. When Gephi built the Network of Contacts it selected 92 nodes of persons from the original table, which were the nodes of persons who had a contact with another person. That means there were persons in the dataset that had contact with an institution but not with a specific person.

The scope of history in the Network of Contacts and the Network of Educational Institutions ends with the actions of first pioneers after the decade of 1930. By then, many women of this movement, who were born at the end of the 19th century was settling in their professional activities. Mentors to these young professionals had already constructed areas of female development in the field of textile and handicrafts production.

Narratives as an Approach to Network Interpretation

In my analysis, the visualizations produced in Gephi – which are basically diagrams of networks displaying precise sets of actors and their relations – are followed by an interpretation in the form of narratives. All graphical networks need a narrative to provide significance to the signs on display, and thus, I am going to interpret the diagrams by, in a way, "telling a story". This story is based on my readings of SKBL biographies and a review of references on previous research on the origins of the home handicrafts and textile art movement.[38]

The narratives presented in this project can be viewed as a strategy for analysing qualitative information derived from the visual result of values given to spatial features, and from visual elements in the network. Narratives constitute a qualitative analysis consisting of a comparative exercise of observation under visual exploration and references in SKBL and sources about the movement.[39]

The term *narrative* here is used in the context of cultural analysis, rather than of literary studies, consisting in historical overviews with aspects of social situations and context of the home handicrafts and textile art movement. I try to encourage narratives and provoke

[38] Maria Carlgren; Agnes Geijer; Gunnela Ivanov; Catarina Lundström; Birgitta Svensson & Louise Waldén; Eva Österberg & Christina Carlsson Wetterberg.
[39] Ibid.

discussions about roles and contributions of both known and less known persons in the network, on the basis of the data shown in visualizations. I propose to use the prototype for moving around through each visualization, and by navigating through the networks in Gephi, to imagine narratives from what nodes and edges can say about their relationships. To construct narratives that can be based on observations by exploring and describing the network in Gephi, making inferences drawn from a specific social reality the networks present.[40]

While this approach contributes with clues to new hypothesis, it does not aim to bring forward concluding statements of reality; for the contrary, it aims to create propositions for further research and discussion.[41] As a tool for cultural analysis, the scope of my narratives is precisely in the possibility of creating discussions about meaning.

Narrative is as expressive form in digital media, resulting from the experience of participating in a process of a computational system.[42] As a strategy for qualitative investigation, it is serving to describe a social and historical context to support the understanding of network visualizations. Rather than applying here a traditional definition of narrative, where the story and the discourse are fixed, static subjects, I adopt this notion proposed by Koenitz for narratives in interactive digital environments. This expressive textual form corresponds to the specific affordances of digital media, by being procedural, dynamic, and flexible.

[40] Roberto Franzosi, et.al., "Network analysis of narrative content in large corpora", *Natural Language Engineering*, 2013: 21 (1), Cambridge University Press.
[41] Roberto Franzosi, "Text Genres, Narrative, and Story Grammars" *Quantitative Applications in the Social Sciences: Quantitative Narrative Analysis*, Thousand Oaks, CA: SAGE Publications, 2010, p. 8.
[42] Hartmut Koenitz, et. al., "Towards a Specific Theory of Interactive Digital Narrative", *Interactive Digital Narrative: History, Theory and Practice*, NY: Routledge, 2015, p. 98ff

Visualizing and Exploring Two Networks

The visual exploration of networks in Gephi starts by observing the overall display of nodes and edges, identifying a general structure in the graphic representation of the network. That level of analysis I called Network Overview. The observation follows an order from the area of major concentration of nodes to the periphery; from the largest nodes to the smaller and the neighbouring between them. Then, based on those observations, I write an interpretation on what the layout suggests.

The interpretation required as well, to consider a historical context for the period included in the prototype. The Network of Contacts and the Network of Educational Institutions include historical data from the period 1880–1940, when women gradually replaced men in the domain of textile crafts towards the second half of the 19th century. Figures as the painter artist Sophie Adlesparre, and the intellectual Ellen Key, made significant contributions inspiring other female producers of later decades. This is the point of departure for my account of the movement. These women shared experiences with notable promoters of industrial art, encouraging female activation not only in the production, gaining education and recognition, but also involvement in organizations and institutions.

The edges in the illustration below are an example of how two types of nodes, persons, and institutions in this case, can connect. In the illustration, persons are nodes in blue and institutions are nodes in green. An arrow tip from blue nodes indicates targeted institution.

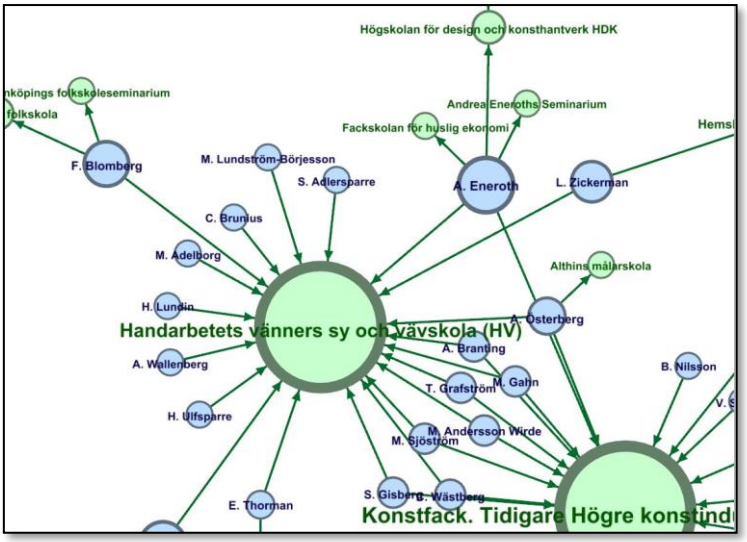


Figure 1 Detail of Network of Educational Institutions

There are more edges and nodes in other sources that potentially could have been integrated if my objective were to investigate the home handicrafts and textile art movement. However, I am primarily aiming to explore the potential of alternative modes of visualization to SKBL by reworking its content, and the movement is the vehicle to explore that possibility.

In this chapter, I will introduce the prototype that I have developed in Gephi, drawing on three levels of analysis, which consists of a general overview of the structure; a close look to the particular relationships between pairs or triads of nodes; and a middle approach consisting in the study of causes and effects in the integration of subgroups.[43] Both of the two networks, Network of Contacts and Network of Educational Institutions, will be examined using the following path: 1) Analysis from a view of the whole network, describing and studying structural properties of the networks; 2) Analysis of the nodes. Studying features and relational resources of individual groups or organizations; 3) Analysis of sub-groups. Studying exchanges among sets of nodes.

Network of Contacts

My first network is intended to display relations between members of a community of professionals from the home handicrafts and textile art movement selected from the databases of SKBL.

1. Network Overview Analysis

While putting together the data files for the Network of Contacts, I formulated some questions to have in mind when tailoring the datasets to the network. In this first phase of building the prototype, these questions are necessary to orient the social network analysis towards the answer to the main research questions, in which the central point is to find out how to provide alternative perspectives of biographical data related to social interactions: What can a network built over SKBL data say about the underlining structure of relationships between nodes? What regularities are visible in interactions among members of the graphical network? I also wondered if the visualization would show who were the drivers of social interactions and if it would be possible to establish to what degree they were leading the community? What social resources does each person have, for example, what other persons are close by, and who

[43]Caiani, p. 18–24.

connects them to other persons in extension? What did the social circles of these women look like? And what members of this network served as mediators between different social circles?

The Network of Contacts brings forward 108 persons in the form of nodes. Each corresponds to one person. 92 of those nodes have a relationship with another person, the other 16 are nodes that have contact with an institution but not a direct contact with a person that has been documented in SKBL, and for that reason not included in the network.

40 percent of all members in the network of contacts, have a specific biography in SKBL; the other 60 percent were mentioned in the text of the biographies. I included the latter because they were professionally related to other members of the Network of Contacts and their activity were characterized as relevant to the home handicrafts and textile art movement in the SKBL's articles. 31 percent of the members are men and 69 are women. This confirm what early research on the subject says about women growing in dominance in this sector at the turn of the century, but it also, as pointed out above, demonstrates an expected perspective bias in the datasets.[44]

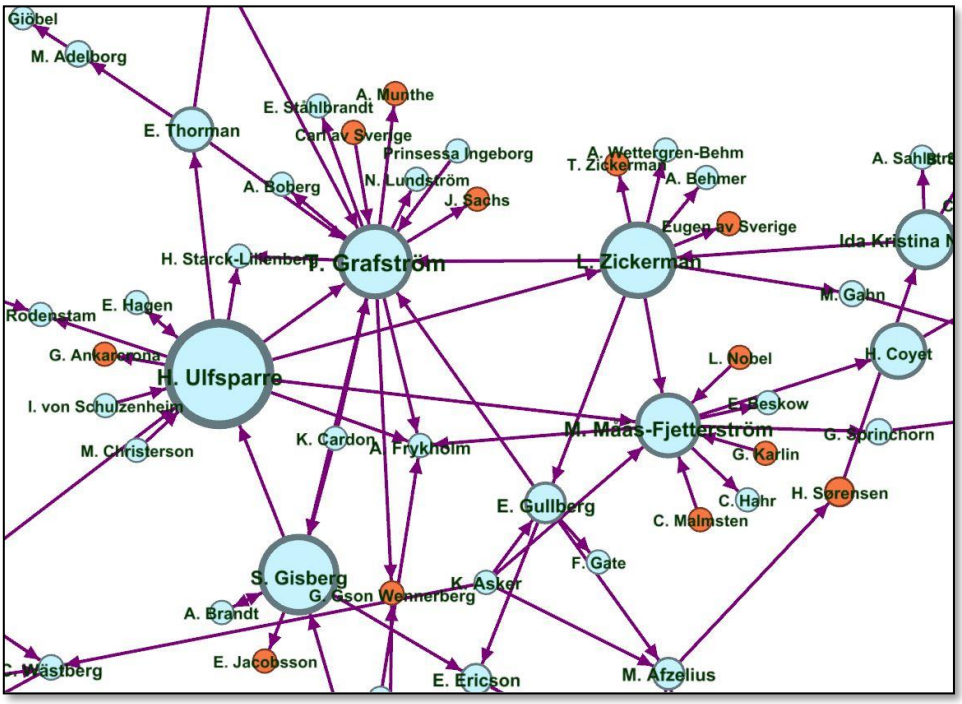


Figure 2. The two most connected nodes: Thyra Grafström and Hedvig Ulfsparre (see graph in Appendix A)

[44] An account of the datasets, but with an extended period to 1960, resulted in a decrease from 31 percent to 25 percent of male members. Which shows a decrease in male participation over time.

The graph in Figure 3 is single mode (see Appendix A for a complete view of the network), which means that all nodes are of the same type since each of them represents individual persons. The relationships between them are expressed with edges or lines connecting each node. Some relationships are directed, and others undirected: Directed when the relation is in one way, for example, in the case of a person that was a teacher or a mentor to another person; and undirected when the relation is valid in both ways, such as when two persons were colleagues or partners in a business store. However, as Luke et. al. recommend, clarity is improved by defining all the nodes in the same diagram as either directed or undirected.[45] I created both scenarios and compared the results (see comparison in Appendix A). There are some differences, but these are not significant to the structure, nor to the social interaction. Therefore, I chose to define edges as directed. I also had the choice of providing specific weight in the dataset to each relationship, but I decided to assign the same importance or weight to all connections, since I did not find enough evidence for each person in the network.

To observe the shape of the Network of Contacts is an important part of this method because it allows us to grasp a structure of social interactions in a glance. Nodes and edges form a structure that is based on specific properties, which are taken into consideration in the calculation of the network layout.[46] A principle of attraction or repulsion between nodes is applied with the help of a layout algorithm of Gephi, defined as Force-based algorithms. The layout algorithm applicable to this graphical network is named Force Atlas.[47] The attraction or repulsion between nodes depend on their links, the more connected a node is, the closer it is to other nodes. I applied default values to each of the properties suggested in the configuration of Force Atlas, except for the repulsion, where I increased the value to augment the separation of nodes, easing the visualization. This repulsion by degree increases or decreases proportionally the distance of nodes, with the benefit of improving the clarity to identify connections between nodes, without modifying the structural disposition.

The Network of Contacts is centralized, which means that it has a few main nodes that are near each other and connected among themselves. While smaller nodes remain integrated to the

[45] Douglas A. Luke, et.al., "Social Network Analysis", *System Science and Population Health*, eds. Abbdulrahman M. El-Sayed & Sandro Galea, 2017: Oxford University Press.
[46] Mathieu Bastian, et. al., "Gephi: An Open Source Software for Exploring and Manipulating Networks", Paris, France: *Association for the Advancement of Artificial Intelligence*, 2009. Relevant to this thesis are speed, gravity, repulsion, auto stabilize, inertia and size-adjust.
[47] Ibid.

largest group, there are a few others slightly distant with their own clusters. I will argue that this disposition coincides with hierarchies and social roles identified in previous research on the home handicrafts and textile art movement by Lundström, Carlgren and Svensson & Waldén.[48]

2. Individual Nodes Analysis

As my approach here concerns the study of individual nodes and their edges, I will introduce the historical context of the home handicrafts and textile art movement to better clarify the presence and location of each main node of this network.

In studies of the handicraft's movement, researchers have found evidence of how women empowered themselves and others through their social networks. In her dissertation on the two Birgitta schools of Stockholm, Maria Carlgren explains that the first Birgitta school was initiated thanks to the contact network of its founder, Emy Fick. In her account Carlgren explains how women gained influence as their expertise in the field became socially recognized.[49] Experts in textile techniques and arts came to exert their influence in the definition of taste, a quality in the execution of handicraft production and textiles as a fine art. Recent research on female contributions to the movement account for the roles each of these women played professionally, socially, and personally, and how the strength of their relationships grew in their social circles.

[48] Lundström; Carlgren; Svensson & Waldén.
[49] Carlgren, p. 33.

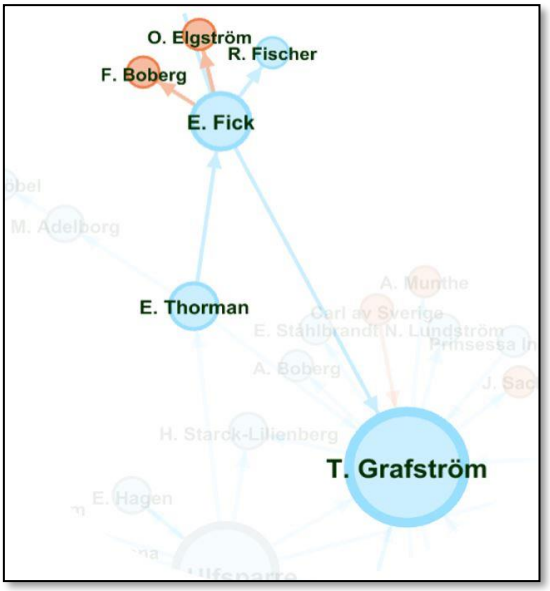


Figure 3 Thyra Grafström's node connected with Emy Fick's cluster

Catarina Lundström points out hierarchies and functions, in the newly industrial -19th century society in Sweden where the field of soft handicrafts was considered properly female.[50] The difference between how women from the elite conceptualized cultural textile heritage and the basis in which artisans at their homes, mainly in agrarian societies, perceived their own production and tradition is well-documented. The bourgeois notion of textile heritage was primarily associated with a duty of heritage preservation and of expressions with symbolic value.[51] That value in handicrafts was determined by those with expertise and experience in their design and production, who in this case, also acted as spoken persons and journalists. Researchers agree on that there were a more or less regionalized propagation in the production and preservation of handicraft traditions and legacy designs, especially towards the turn of the century.[52] This propagation of interest for the authenticity in original regional design is understood as an achievement for an elite of women, constituted mostly by members of wealthy, culturally formed families, and governors' spouses, who performed a public role in spaces only available to men.[53] Regional handicrafts associations encouraged this development as well.

[50] Lundström, p. 157, 146. In 1874 the seminar for home handicrafts for men was a well-known education by the pedagogue Otto Salomon. (Lundström, p.146). The earliest known equivalent for women was in 1882 with Hulda Lundin who was recognized as the first female inspector of handicrafts.
[51] Lundström, p. 161.
[52] Lundström, p. 145.
[53] Lundström explains how men remained formally at the top of social organizations, philanthropic and education institutions; (Lundström 2005, p.158). Men's positions at institutions of cultural preservation were

Lundström propose that it was their situation of privilege, together with their work and competences, that motivated a hierarchy in their social network. Governors' spouses were able to exercise several roles, not only in their acting as philanthropists, collectors, and consumers, but also as politicians of ideas, writing in specialized publications. Public and industrial exhibitions were areas of encounter for women who looked to promote their own business by exhibiting their artistic and technical skills. Their family origin facilitated access to education and traveling, making it possible to perform case studies, among other ways of international exposure. Catarina Lundström refers to women's roles with the following description:

> man kan beskriva hemslöjdens funktion som tredelad: ekonomisk, kulturell och pedagogisk. Hemslöjdsarbetet bedrevs överallt efter i stort sett samma agenda. Det handlade om att inventera och rädda äldre slöjdsföremål, att ordna utställningar där dessa kunde exponeras, att utbilda och handleda i slöjdsfrågor samt att öppna särskilda hemslöjdsbutiker. [54]

An interesting observation by Lundström is the distinction in the social interaction between women that were "doing" and those that were "driving", and she indicates the existence of a small group that exercised all three functions as producers, managers or as ideological leaders.

The disposition of nodes and edges seem aligned with social hierarchies referred by Lundström, it suggests several circuits or communication flow, particularly one at the centre of the structure with four main actors: Hedvig Ulfsparre, Thyra Grafström, Lilli Zickerman and Märta Måås-Fjetterström. Out of this four, is Hedvig Ulfsparre whose node has direct contact with each of these women and who, in accordance with Lundström's argument, is a pivotal figure for her moment. Her edges extend across the corpus of the structure.

nominative in most cases. However, there were situations where women were limited when the public sphere of men was challenged.

[54] Lundström, p. 149. "one can describe the function of handicraft as threefold: economic, cultural and educational. Handicraft work was conducted everywhere according to basically the same agenda. It was about inventorying and rescuing older handicraft objects, arranging exhibitions where these could be exposed, educating, and supervising handicraft issues and opening special handicraft shops."

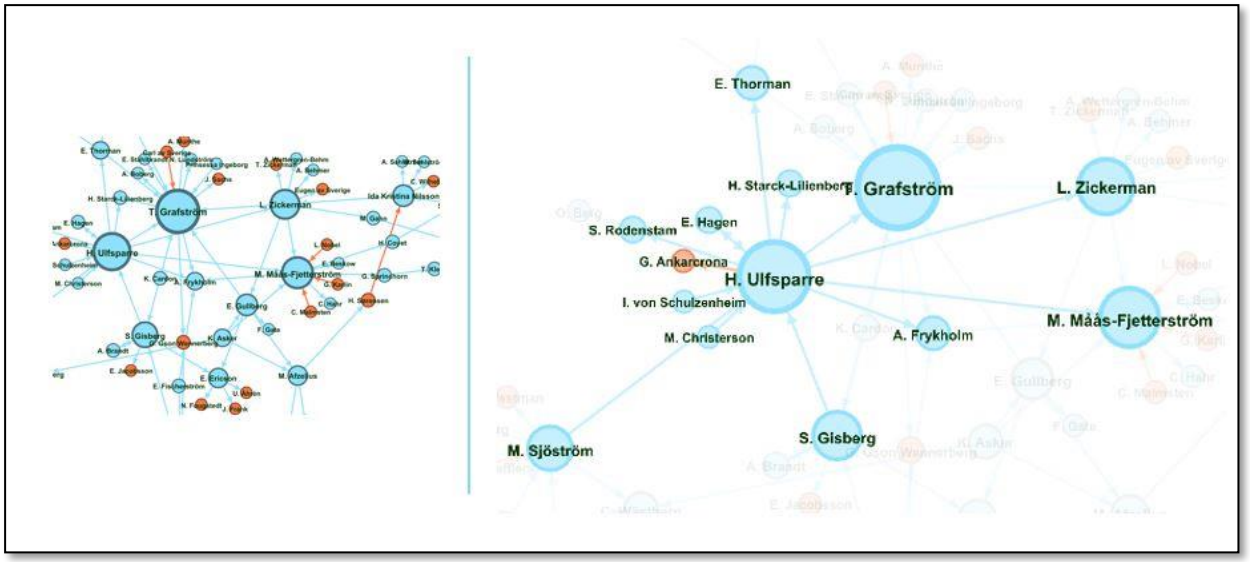


Figure 5 Largest nodes by frequency of interaction. (left) Ulfsparre, the only node connected to biggest nodes (right)

3. Sub-Groups Analysis

In this approach I am suggesting an explanation of the dynamics of groupings in the Network of Contacts. This is an analysis based on basic measurements applied in Gephi and here I describe sub-groupings according to the measures applied, explaining why they were used and how. These are: Size, centrality, density, and distance (see Appendix A for detailed illustrations of this network).

The number of nodes or persons in the Network of Contacts is 92. Some nodes are larger than others because a ranking is calculated based on their number of connections. This is also known as Degree Centrality. In Figure 5, Thyra Grafström had the largest node which points towards her being the most connected person, while the second largest is Hedvig Ulfsparre. In the case of Hedvig Ulfsparre, her node has the highest of a value called Eigenvector centrality, which case is not only of how many but how well connected are the nodes she is tied to. More surprising, however, is the presence of Annie Frykholm with a node positioned just at the centre of the structure, having a high Eigenvector centrality. This indicates that she was an important person for the movement, while scarcely recognized or studied in earlier research.

Similar to Frykholm, an exploration of the nodes at key intersections also suggests, for example, that Elsa Gullberg or Alice Lund were more important for the networking of movement than what has been recognized in prior research.

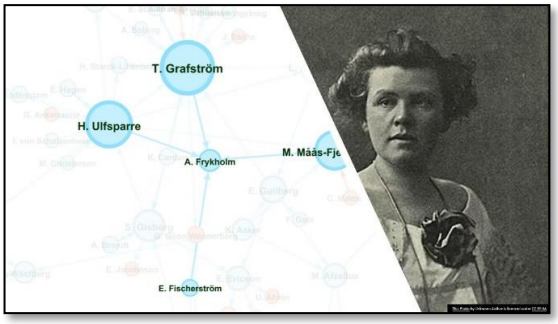


Figure 6 Artist Annie Frykholm

Statistics reveals how nodes are placed in the paths between other nodes in the network. The result highlights relevance and degree of connection of the following actors: Centrally (in Stockholm), the mentor Sophia Gisberg, and entrepreneurs such as Lilli Zickerman and Thyra Grafström. At the intersection of influential regional nodes, philanthropists Henriette Coyet from Skåne, Ida Kristina Nilsson from Värmland and even the well-known author Selma Lagerlöf. Their influence as mediators is illustrated in Figure 7 with proportional intensity in the colour and size of their node.

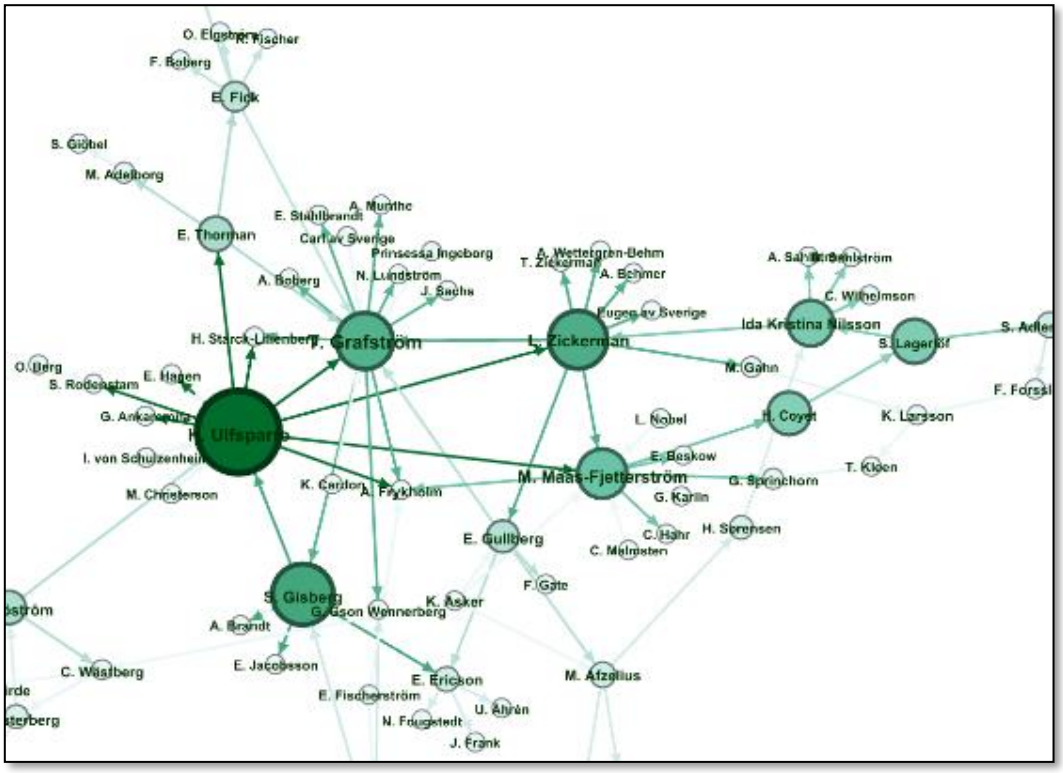


Figure 7 Betweenness Centrality, where the darkest node indicates largest centrality

With this graph it is possible to argue that betweenness centrality can be used to highlight and verify the formation of regional and central elites of women, suggested by Lundström and other authors. However, in addition, the analysis suggests the interesting fact that Hedvig Ulfsparre acted as mediator for the other mediators of regional and central elites.

There are other noteworthy regularities in the relationships of this structure. If one take in consideration that the number of connections in the Network of Contacts is 118 for 92 nodes, the density is rather loose. Outside of the densest area, a third part of the edges are clusters. These are pushed out and hanging by one node at a distance. The periphery of the largest clusters seems to have to do with a regional preference, that is a duty of education and preservation of heritage, as in the case of Ida Kristina Nilsson in Värmland, or as a niched focus on their production, as in the case of Agnes Branting with Licium and the religious textiles. Women of these nodes contributed to the movement with giving priority to their individual activity over their participation at the national level, strengthening their own social circle.

Network of Educational Institutions

This network is bimodal in the sense that it displays relations between two types of actors, unlike the Network of Contacts, where all nodes are of the same type. The Network of Educational Institutions encompasses, firstly, persons associated with the home handicrafts and textile art movement and, secondly, educational institutions found in the biographies in SKBL. To present this network I will follow the previously used format and I begin with describing the content of datasets, moving on to the visualization of the network based on the work-process in Gephi.

1. Network Overview Analysis

As in the case of the Network of Contacts, I initiate describing aspects of the datasets, including questions to consider when selecting data from the SKBL database, the components of the datasets and the resulting elements in the visualization after the process in Gephi. These descriptions are followed by a structure analysis, intended to explain the interaction of two large nodes dominating the network. The network includes all of the nodes from Network of Contacts plus educational institutions where the included persons studied or worked. With the following selection of datasets, I intend to investigate how their education relates to their social life and to their professional activity and what the structure can say about education as a factor of

influence. These questions are necessary to orient the social network analysis towards the answer to the main research questions of identifying narratives enabled by network analysis on collective interactions with educational institutions, as well as the encourage for content about social interactions between professionals and particular institutions.

From Set 1, (see p.16 Collection of Datasets) I collected individual names, attribute female or male, and id.

From Set 2, I collected contacts associated with a school institution, dates when the relation with the school took place and type of contact.

From Set 3, I collected names of school institutions, and id.

I used Force Atlas 2 of Gephi, the layout algorithm for visualization, with standard values and a repulsion by degree with strength of 3000.

In the Network of Educational Institutions there are two types of nodes: Persons and institutions. The same 108 members of the datasets (see p.17 Collection of Datasets) and 15 educational institutions are nodes. The edges or connections are 70, corresponding to relationships between persons and institutions, very few for the number of members.

In bimodal networks with two types of nodes all edges are defined directed.[55] The period includes years 1880– 1940. As Figure 8 illustrates, edges are coloured according to the date each node started a relationship. For example, Andrea Eneroth studied at Tekniska Skolan, also named Högre konstindustriella skolan (the Technical School, Konstfack today) and decades later, in 1930, worked at Handarbetets Vänner och Sy- och Vävskolan (Handicraft's Friends and Sewing School).

[55] For an explanation of Direct and Undirect edges please refer to the end of subject titled Collection of Datasets

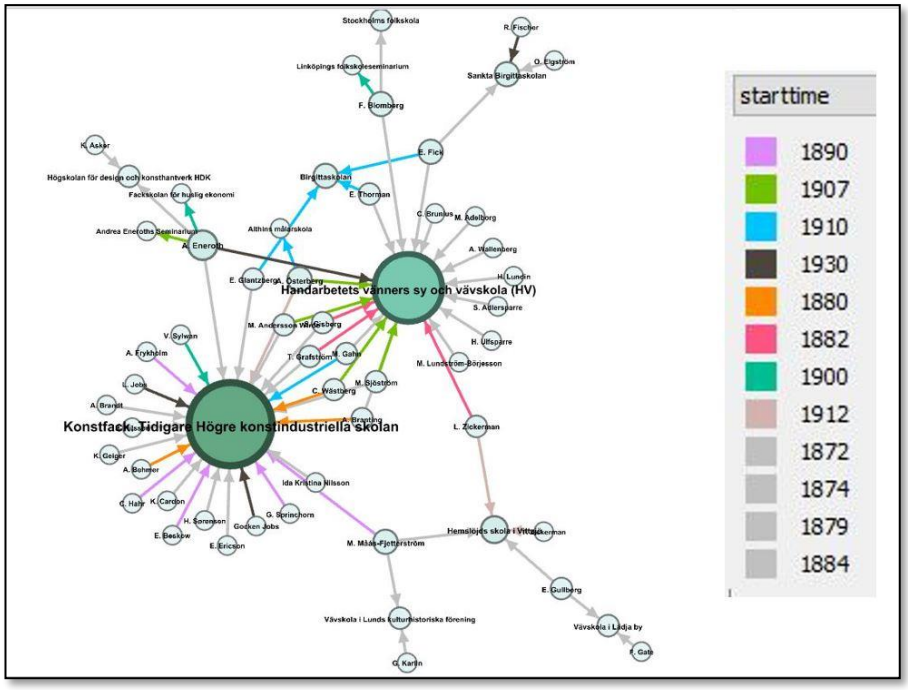


Figure 8 Edges coloured by date of initial relation with a school

However, Figure 8 only shows 55 percent of all the nodes – where are the other 43 members?

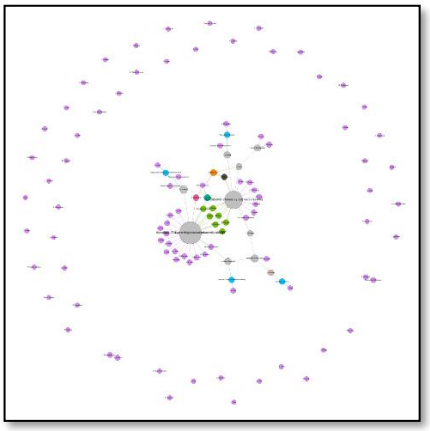


Figure 9 An aerial view of all elements in the Network of Educational Institutions

The simple answer is that almost half of the nodes in the graphical social network had no direct connection to a school. Their nodes are pushed apart to the periphery due to their weakness. The same occur to two nodes of institutions, Konstakademin and Brunnsvik folkhögskolan (The Academy of Arts, and the School of Superior Education in Brunnsvik), although both institutions were important international centres, they specialized in multiple disciplines,

meanwhile other schools with interconnections were fully dedicated to the handicrafts and industrial arts and were thus more connected amongst themselves. There also seems to be some patterns when it comes to nodes of persons at the periphery. With four exceptions, (see below), most men included in the network are situated in this group and they constitute 55 percent of all nodes in the periphery. Their relationships with other members of the network could probably have been professional, with interdisciplinary collaborations as architects, industrial artist, painters, and writers; and personal, as sponsors or relatives.

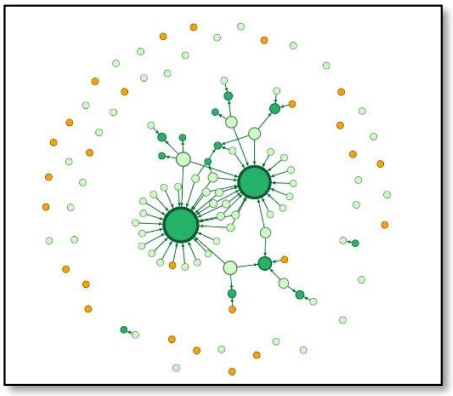


Figure 10 Male (light brown) and female (green) attributes, four nodes with male attribute are not in the periphery

After reviewing the biographies of the few female professionals in the periphery, I realized that their education, the development of their competences, occurred at home or abroad. That they are "pushed away" graphically from the two centres of institutional education, do not necessarily mean that they were uneducated or "amateur" professionals. Rather, it only means that the dataset does not include education at home as an institutional node. As a result, I cannot take education into consideration. In this respect, The Network of Educational Institutions reveals the need for re-thinking how education for women is valued and conceptualized in the context of SKBL. An unconscious bias thus became evident: The presupposition that "education" is solely provided by formal institutions, or by institutions in their home country.

Education at home was especially important in the context of the handicraft's professionals of the textile movement. Mastering the techniques of handicraft were highly valued, many parents would encourage their daughters to devote hours to develop the necessary skills. It is assumed here that parents with economic possibilities, who saw good competences in their daughters supported formal education and even traveling abroad for case studies. The expertise women acquired in the field, either at home or at school become their working capital. Subsequently, handicrafts produced at home had a value based on the judgement of women experts in home handicrafts. Lundström described the duty of a handicrafts connoisseur as

follows: “De görande aktörerna fungerade ofta som en slags pedagoger vars uppgift var att leda hemslöjden in på rätta vägar. Här behövdes kunskap om material, tekniker, mönster och färger och inte minst kännedom om det ortstypiska”.[56]

The graphical network has two large central nodes or institutions, which draws attention to the contrast of its size with that of the other nodes. In bimodal structures, where most nodes are persons connected to a fewer number of institutions, nodes of institutions are of an exceptionally large size. In SKBL, Högre konstindustriella skolan and Handarbetets Vänner Sy- och Vävskolan are frequently referred to in the biographies of textile artists. As clearly seen in the Network of Educational Institutions, these two schools concentrated most of the education in handicrafts and textile art. This may partly explain why the Network of Contacts (see Attachment A) is centralized: Their network of contacts may have started at school time. I would argue, however, that Högre konstindustriella skolan had more amplitude than Handarbetets Vänner Sy- och Vävskolan, based on the disposition of its node members around both schools, and a close and abundant flow of communication between them.

One of the many changes that took place towards the end of the 19th century was a democratization process in many aspects of life: Economically, politically, and socially. Relevant to the field of the cultural endeavours was a more regionalized interest in heritage preservation and recovery, which played a part in the wider national process of reconfiguration of Swedish identity. Hence, it became urgent to study and restore the great value of heritage, and the opening of the school Handarbetets Vänner Sy- och Vävskola was particularly significant in this respect. As the interest in past Swedish culture grew, the Austrian art writer, visionary, and museologist Jakob von Falke, whose thoughts were important for the formation of the school Handarbetets Vänner Sy- och Vävskola, contributed to the shift in the value of home handicrafts from an economical, local enterprise to objects of historical and artistic interest.[57]

Handarbetets Vänner Sy- och Vävskolan was the first technical school of its time dominated by women. Several women in the Network of Educational Institutions united in this initiative and further developed their emancipatory ideas and their interest in the development of arts,

[56] Lundström, p. 154. “The active participants [in the movement] often acted as a kind of educator whose task was to lead the handicraft work in the right directions. Here, knowledge of materials, techniques, patterns, and colors was needed, and not least knowledge of the local features.”
[57] Lundström, p. 146.

technical skills, and crafts. Högre konstindustriella skolan also played an important role in the formation of professionals for the industry for several generations.

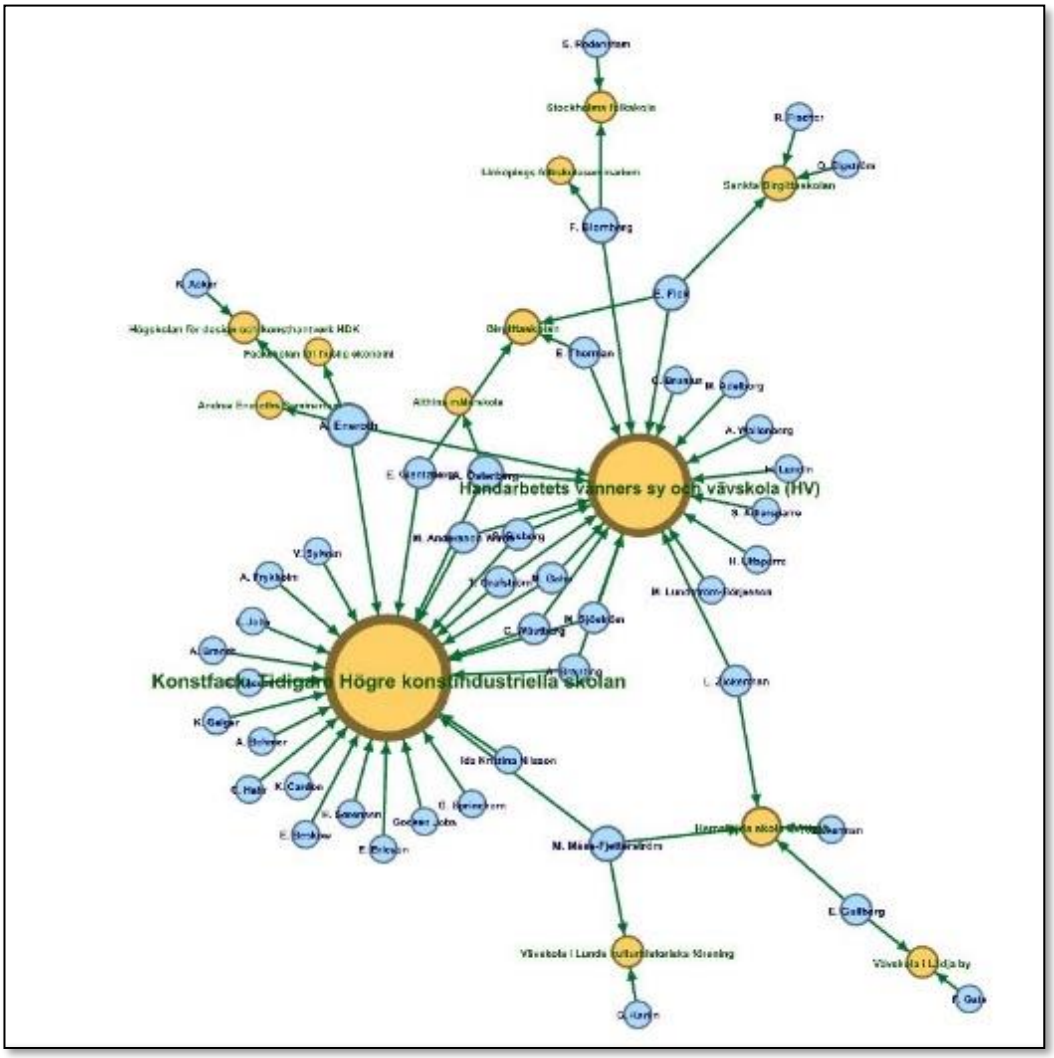


Figure 11 Nodes in yellow are institutions, members in blue

In Figure 11 two nodes representing schools – Högre konstindustriella skolan, known as Tekniska skolan and Handarbetets Vänner Sy- och Vävskolan – concentrate the greatest number of persons mapped-out. There are also a handful nodes that carry long edges (see Appendix B for the names) from node members to institutions, that represent prominent women who founded new schools: Andrea Eneroth, Fanny Blomberg, Lilli Zickerman, Emmy Fick, Elisabeth Glantzberg, Agda Österberg and Märta Måås-Fjetterström. The women's individual node goes out in one or two edges, spreading in opposite direction of the longest connection. This structure reveals how the technical education in design, fashion, handicraft, and textile production was extended through former students, towards regional and niche-oriented schools.

It also indicates the prominence of key actors in this endeavour, each with a degree of influence, with Märta Måås-Fjetterström at the top of the ranking. Other actors within the field of education appear to a lesser degree. Here, we should remember that the importance of the nodes is determined by the frequency of connections each person has with institutions (I chose not to set instructions in the application to establish connections between persons artificially).

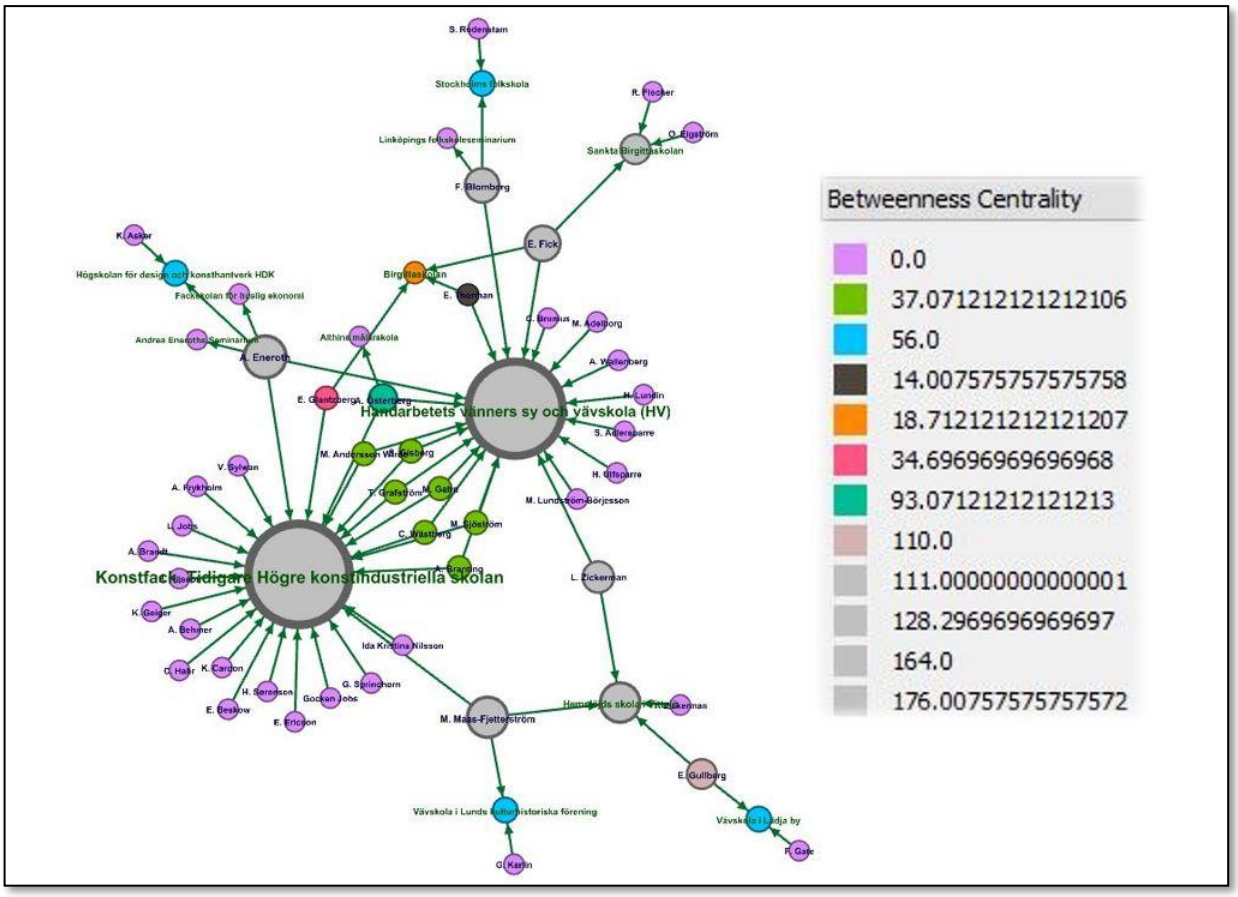


Figure 12 Betweenness Centrality with the highest ranked in grey to the lowest in light purple

2. Individual Nodes Analysis

I will now turn to the issue of the visual presence of individual nodes and its edges. Based on previous research, I will reflect on the significance of the educational centres with particular attention to the two larger educational institutions (Högre konstindustriella skolan and Handarbetets Vänner Sy- och Vävskolan). I will also discuss how some of the dynamics between pioneers were affected by their antagonistic ideas on aesthetic values, which were presumably influenced by their educational background.

Network visualizations are tools for conveying network information in dense ways and they provide possibilities for observing structural features of networks.[58] The first observation that the Network of Educational Institutions pointed to was how much integration these two schools enjoyed, and how they, to some extent, acted together as joint mechanism. In a way, one can imagine both nodes as circles and their small nodes as the gear of a moving machinery. Most contacts that received formal technical education came from these schools or from study centres where they were teaching. This raises further questions: What made these schools collaborate so well? Were there implicit or explicit agreements between members of the home handicrafts and textile art movement?

Most of these women involved worked, to some extent or another, together, studied at the same schools, or partnered in handicraft stores. Some of them, like Emy Fick, were preoccupied with preparing students to their life as housewives. Initiatives of handicrafts production also had specific markets and its particular consumers. The creation of associations dedicated to the handicrafts drew many women together and some were employed by associations due to their technical and artistical abilities. However, these relationships were not exempt from ideological conflicts, which is demonstrated by the case of two historical figures: Märta Måås-Fjetterström's work and production for six years, employed by the Malmö House Region's Handicrafts Association's Warehouse and Henriette Coyet, philanthropist and member of the board. In the Network of Educational Institutions Märta Måås-Fjetterström plays an important role in education. From her derives two edges towards more schools. Henriette Coyet is in the periphery due to the fact that her biographical post in SKBL does not make specific references to formal education or collaboration with an educational institution, as she received private instruction. However, Coyet published several historical compendia on textile from Skåne, at the south of Sweden. Research have shown that differences between Måås-Fjetterström and Coyet and their disputes on aesthetical preferences, eventually forced Märta Måås-Fjetterström to separate from the association. In Lundström's account, the conflict is attributed to their different views on nationalism, one understood as the duty to preserve heritage by activating it with the incorporation of modern artistic forms, the other more concerned with preserving heritage for its traditional value by rescuing stylistic patterns attached to the tradition of this craft. According to Lundström the conflict culminated at an exhibition award to the association where work was recognized by its aesthetics but not necessarily by its heritage value "Det fanns

[58] Brandes, et. al.

visserligen inom denna mycket av värde, såväl tekniskt som konstnärligt sett; den hade bara ett fel – att den inte var skånsk".[59] I would argue that the conflict illustrates how their aesthetic values and Måås-Fjetterström and Coyet's understanding of heritage preservation derived strongly from their education. Aristocrats, governing elites, and philanthropist leading the movement, as Coyet, were privileged with private education at home, while those educated at Högre konstindustriella skolan, as Måås-Fjetterström, tended to show artistic ambitions and the desire to insert in the traditional expression, techniques and influences from international trends.

3. Sub-Groups Analysis

I am going to discuss how groups add to the expansion of the movement through education, by describing disposition of nodes. In Figure 12, nodes coloured in grey represent the most frequent paths, through whom, persons reach others. For example, smaller schools (in light blue) are in contact with the largest schools through them. Marked in green are persons that facilitate the flow between the largest schools. This visualization of so-called Betweenness Centrality seems to indicate how integral the communicators (in green) most likely were to the textile community.

Pioneers of the handicraft movement had different perspectives on what their cultural duties were, which largely caused a polarization with individuals who did not share the same understanding of what was "best for the country". For all these social actors, though, it was important to highlight the richness of regional diversity and originality, and also to protect the authenticity of the works that people around the country produced in their homes. At the same time, a growing professionalization gradually replaced the techniques as well as the appreciation of handicrafts as cultural objects of artistic value. Nevertheless, both modes of thought could coexist. According to Maria Carlgren the conflict is illustrated by the disagreements between founders of Birgitta schools. Carlgren argues that various value-laden conflicts between Emy Fick and Elisabeth Glantzberg were rooted in their different social and educational backgrounds. Their competences and experience were also different:

> Glantzberg var genom sitt intresse för allmoge en del av världen för "den högre bondekulturens hantverksestetik". Fick kan, med sina estetiska preferenser och sina

[59] Lundström, p. 151. "Admittedly, there was a lot of value in this, both technically and artistically; it had only one fault – that it was not Scanian".

> studier hos Worth, sägas ligga närmare "den högre sömnadsmodevärlden". De hade alltså olika värderingar/habitus i sitt samarbete.[60]

Such breaks in social interactions are hard to incorporate in the datasets in a computable way for the application. However, in the definition of the type of relationship between nodes (for example, "friend"), I added the type "opponent" with the hope of finding an alternative in future analysis to convey visually, such aspects of social relationships.

Persons with prominent positions in the network analysis are, however, easier to observe as they share several characteristics. Such persons received education and some even worked in one of the schools of the Network of Educational Institutions. Most of them grew up in a bourgeois family and became professional entrepreneurs. That is the case of women such as: Lilli Zickerman and Agnes Branting, who were daughters of pharmacists and managed, respectively, the store of the Förening för Svensk Hemslöjd (the Association of Handicrafts) downtown in Stockholm and AB Licium of church textiles. Märta Måås-Fjetterström and Ida Kristina Nilsson who were daughters of a rural dean and an agriculture and forestry entrepreneur respectively, developed their own regional firms. Sofia Gisberg, Elsa Gullberg and Emy Fick were daughters of wholesales men. Gisberg was a designer consult to multiple companies and Gullberg and Fick combined business with educational programs with their firms. Maja Sjöström, daughter of a crown county governor became one of the most talented textile artists of her times. Estrid Ericsson, daughter of a hotel owner, successfully contributed to developing Svensk Tenn AB. Some years after these first pioneers, Annie Frykholm, daughter of a marine engineer developed her own firm, and Märta Afzelius, daughter of a lawyer and politician developed a carrier as a design consultant. [61]

[60] Carlgren, p.89. "Glantzberg was part of the world for 'the craft aesthetics of the higher peasant culture' through her interest in the peasantry. Fick, with her aesthetic preferences and her studies at Worth, can be said to be closer to 'the higher sewing fashion world'. They thus had different values/habitus in their collaboration".
[61] "Svenskt kvinnobiografiskt lexikon", *Göteborgs Universitet*, https://skbl.se/sv, 2020-06-02.

Summary of Results

While the network analysis in many ways confirms previous results based on more traditional historical methods, it also generates somewhat different results. Here I will discuss some of the more interesting results, following similar structure to the previous chapter, from an overview to closer perspectives.

Expansion of the Movement

Early in the collection of datasets I identified a number of contacts that either had studied or worked mainly in two schools, Handarbetets Vänner Sy- och Vävskolan and Högre konstindustriella skolan. Consequently, I expected to find two large nodes even before visualizing the Network of Educational Institutions. However, what I did not expect to identify in the visual result was the limited number of persons as targeted nodes of these two schools. The position and direction of relationships for these persons indicate their function as mediators for and centres in clusters of new schools, thus implicitly indicating their contribution to the expansion of educational activities connected to the home handicrafts and textile art movement.

The two largest nodes in the Network of Educational Institutions, Handarbetets Vänner Sy- och Vävskola and Högre konstindustriella skola are of different size. The node of Högre konstindustriella skolan is larger than the Handarbetets Vänner Sy- och Vävskola's node. This can be interpreted as that Högre konstindustriella skolan had more relevance in the movement than it has been credited with. Pioneers as Thyra Grafström, Märta Måås Fjetterström and Lilli Zickerman, with the largest node sizes in the Network of Contacts, all studied at Högre konstindustriella skolan and later collaborated with Handarbetets Vänner Sy- och Vävskolan as professionals. This prominence of Högre konstindustriella skolan in roles of education is not specifically stated in biographical articles in SKBL. However, this data is revealed by adding the number of persons who have studied there. The Network of Educational Institutions visually indicates that both schools had a well-functioning collaboration, by showing multiple links between both institutions with the mediation of nodes of persons.

The social interactions between professionals of home handicrafts and manufacture of textiles were concentrated in a few well-connected women, as stated in previous research.[62] Subgroups and regional elites are visually present and organized around a focal node with a leader mediating the connection with various elites. That is, for example, the case of Hedvig

[62] Carlgren; Lundström; Svensson &Walden; Österberg & Carlsson Wetterberg.

Ulfsparre, who is visually present as an active mediator between central and regional groups. Furthermore, the visualizations highlight individuals in the neighbourhood of well-connected persons. Their names are seldom mentioned in research of the movement but their closeness to the largest nodes in the network suggest that they served an important function as communicators. In the Network of Educational Institutions, the activity is concentrated in two centres in Stockholm, Högre konstindustriella skolan and Handarbetets vänner Sy- och vävskolan, from which female professionals and trade activities came to dominate the field of textile production. The pioneers of the movement were well-connected, presumably in part, due to relations developed at school, and fulfilled a bridging function with other sub-groups.

I previously noted that social actors educated at home calls for a contextual analysis for which there is unfortunately not sufficient information in SKBL. Therefore, they are not shown in the Network of Educational Institutions since their nodes are located at the periphery of the network. However, in SKBL there are a few well documented biographies of contributors to the movement, such as Henriette Coyet, who, due to her status and publications, got included.

In sum, the overall structure of both networks, Network of Contacts as well as Network of Educational Institutions, to a significant extent conforms what has been written on the social organization of the movement.[63] However, it should also be pointed out that the number of network connections is relatively low compared with the volume of data used in social network analysis, and this affect the scope of this analysis. Since the number of ties is loose, and so, the statistical analysis limited, the value of these results is mostly on the visual analysis.

Visual Highlighting of Social Actors

Perhaps most interesting is the fact that the Network of Contacts includes a number of persons whose contribution to the movement have not been discussed in the same extension as its more well-known members. These persons' neighbouring positions and sizes visually indicates that they may have had greater relevance for the movement. Information about them in general, do not reflect the extent of their contribution, in the same way as the Network of Contacts, which summarizes their contributions, collaborations and personal relationships. That is particularly the case of Annie Frykholm, Elsa Gullberg and Alice Lund, whose contributions to the home handicrafts and textile art movement can be identified and highlighted through the use of software tools for social network analysis and digital databases, such as SKBL.

[63] Carlgren; Geijer; Ivanov; Lundström; Svensson & Waldén; Österberg & Carlsson Wetterberg.

The Network of Contacts also suggests an assigned place in space that depicts social closeness and how communication could have flown between specific actors in a network of almost 100 persons. Names often highlighted in earlier studies of the movement also appear in the Network of Contacts, but unlike previous studies, the network also indicates several other adjacent women and men. Thus, one can say that the exploration in Gephi allows us to bring forward a whole community and to build synergies in the social and educational circles of individuals. From an overall perspective, Thyra Grafström is the person with the highest number of connections in this community. This can be explained by her early education and professional activity related to the two largest educational centres, as well as the impact of her efforts as business developer, with her own firm and by leading the textile department at NK in Stockholm.

The structure of the Network of Contacts also highlights seven persons that were connected to all the other members of the network. These seven nodes are close to the center and also more connected than those in the periphery, who seem to be more independent. This visual result should be understood in relation to their geographic disposition, where central nodes are collaborating in educational centers in Stockholm and distant nodes collaborating in regional centres out in the countryside.[64] Names mentioned in research of the first phases of the home handicrafts and textile are movement also are in the Network of Contacts: Sofia Gisberg, Maja Sjöström, Agnes Branting, Ida Kristina Nilsson, Sofia Widén, Märta Afzelius and Emy Fick.[65] Based on their position in the Network of Contacts and their references in research, one can perhaps say that these socially active actors drew other individuals into the movement, through their work as artists, technicians, or mentors.

As mentioned above, the position of nodes in space at the Network of Contacts indicates that Annie Frykholm is probably more important to the movement than what has been recognized previously. Her presence at the centre of the largest nodes in the Network of Contacts at least indicates that she was holding close relationships with the leading figures, while the scarce references to her in previous research discusses her as a talented artist.[66]

The structure of the Network of Educational Institutions brings forward persons that stood out for their contribution to the field of education: Andrea Eneroth, Fanny Blomberg, Elisabeth Glantzberg and Agda Österberg. Their importance is probably best explained by their affiliation

[64] See first figure in Appendix A for a visual reference.
[65] Lundström, Svensson & Waldén, Geijer; Österberg & Carlsson Wetterberg.
[66] Österberg & Carlsson Wetterberg.

to educational centres. In the graph below, the size of their nodes are not as big as the ones of the women of the elite, but they nevertheless highlights the role played by the schools these women founded, known for their educational contribution to the movement.

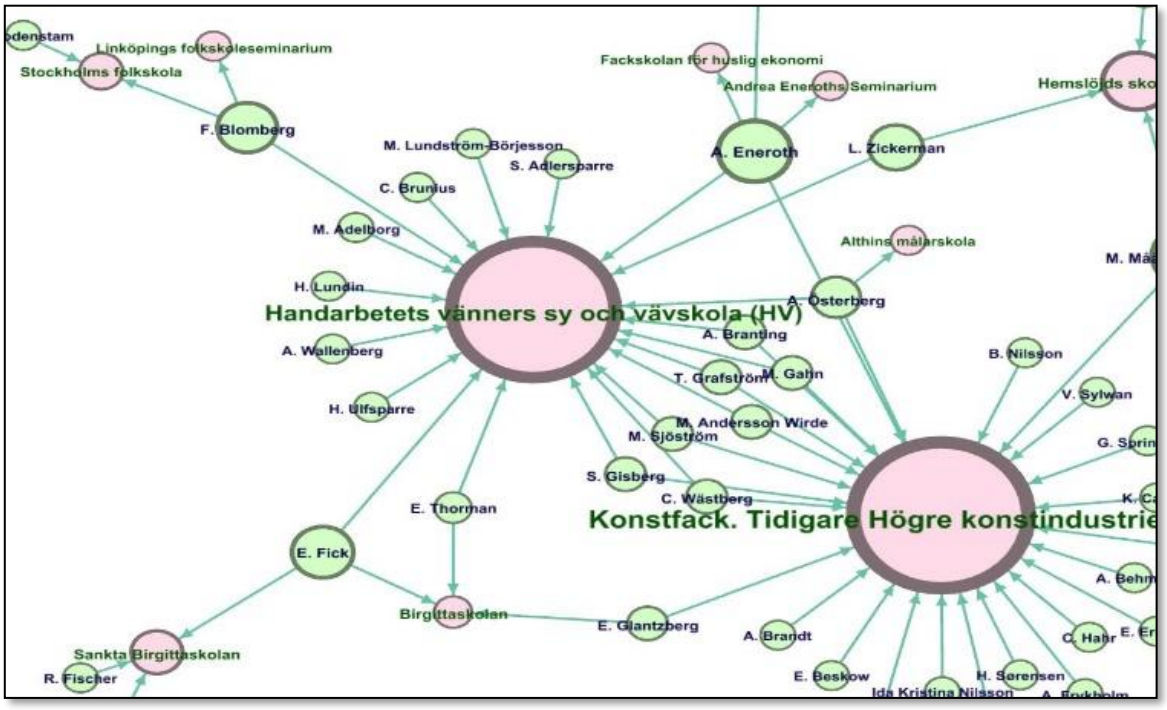


Figure 13 Members of the network, founders of educational centers

The network analysis not only confirms the indisputable contributions of Märta Måås-Fjetterström to the movement as an artist and as entrepreneur, but also her importance as an educator. Researchers have often stressed how the leading figures in the movement played multiple roles, including philanthropists and journalists, but specially as educators. Lundström describe the task of leading handicraft work by transfering their knowledge of the local ancient features to new generations.[67] However, the work of Märta Måås-Fjetterström is mostly discussed in relation to her production, design, and artistic abilities. There are some mentions to her participation in different schools and descriptions of her dedication to educating new generations of textile artist: "MMF var också skyldig att årligen utbilda fem frielever under tre

[67] Lundström, p. 154.

månader. Flera av dem stannade sedan kvar som ordinarie väverskor och de uppgick så småningom till 20 personer".[68]

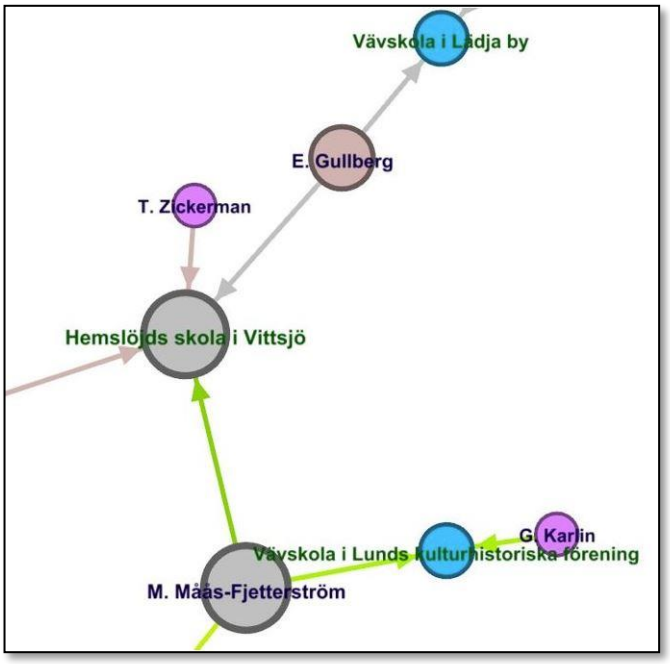


Figure 14 Märta Måås Fjetterström's node and her school connections

While there are members who stand out for their dedication to pedagogical work, Märta Måås-Fjetterström also seems to have been both prolific and influential. The closer examination of her in Figure 14, indicates that her node generated new regional schools in Lund, Vittsjö and Lädja.

Pioneer's Common Features

Visualizations of the Network of Educational Institutions suggest that there were women that served a function as connections between Högre konstindustriella skolan and Handarbetets Vänner.Sy- och Vävskolan. Their nodes correspond to, basically, the same women that made up the leading elite of the movement. Apart from Hedvig Ulfsparre, who was a nurse before she became a philanthropist, twelve of the highlighted persons – who are listed in the sub-group analysis of the Network of Educational Institutions in the previous chapter – does not only share an educational background or work at these educational institutions but also a bourgeois origin,

[68] Svensson & Walden, p. 92. "MMF had also the responsibility to train five free students annually for three months. Several of them then remained as ordinary weavers and they eventually increased to 20 people".

as daughters of male professionals in socially distinguished positions. Another shared characteristic of these women was their abilities in business development and success in marketing and sales. More on their shared features are their leadership in their social and professional circles and their ability to expand their professional interest to new generations. The advantage of visualizations here is the identification of these social patterns as a result of computed data.

Perhaps the most significant contribution of this thesis is the highlighting of lesser known individuals and of Högre konstindustriella skolan, as relevant contributors to the movement. In the current format of SKBL, persons with a central position in the Network of Contacts do not have biographical posts and are referred only across different biographies. Taking in consideration that the aim of SKBL is to become a more or less complete database of female biographies, it is interesting to find clues for new biographies in its own data. 40 percent of all nodes or members of the Network of Contacts have a specific biography in SKBL. If the biographies of the remaining 60 percent are gradually incorporated into the database, more relationships could probably be generated between members of the network, increasing its density and therefore the effectiveness of the method.

Conclusions

The results summarized in the previous chapter are findings from a qualitative analysis of network visualizations displayed in the prototype. The visualized networks are a result of a quantitative process. Previous to the quantitative analysis in Gephi, there is a process of building tables from datasets. The selection of data and data collection are probably the most critical parts of the process. These definitions determine the potential of network analysis. Ideally the collection of names as well as the construction of pairs of relationships between persons, should be automatic. That is probably one of the future steps to improve this method, not only for the time and effort that building of tables consumes but for the clarity of the criteria applied to select persons and for being able to create a higher volume of data to process in Gephi.

A uniform criterion of selection was applied, in which persons with other professions than handicrafts and textile art got included, based on referenced professional collaboration, intellectual authority influence or their closeness for their role as social actors, in biographies of SKBL. Even though the margin of error the manual work implies, with the quantitative processing of tables in Gephi, it is possible to suggest degree of connection for each of the persons and with the rest of the network. These suggestions are providing immediate visual clues as how each node is positioned in the overall structure, how the nodes relate to subgroups and how each node connect with and through others. These clues can serve as starting points for further investigation, to establish the nature of their adherence to the movement or their social relationship. A possible development of this prototype into a project would benefit from a deeper understanding of software tools as Gephi and a closer access to SKBL databases.

For the sake of my research questions, the use of a network with nodes of the same type was good enough to build a visual network of contacts. However, a bimodal network, such as the network of Educational Institutions, with more variables, provided more information, due to the combination of two types of nodes. That is, persons and institutions, edges of persons that didn´t have a relation with a person but had a relation to an institution, bringing forward pioneers that, according to the analysis, were significant to the movement but lived abroad for long periods, or their contribution was not related to the social circles of women of the movement.

Additionally, two types of networks provide more elements of comparison between their structures. The layout of a bimodal network seem to provide more visual clues such as mechanisms of movement between largest nodes. For example, in this particular bimodal

structure, most central nodes are persons connected to a fewer number of institutions. The nodes of two institutions are of an exceptionally large size, pointing out how much integration these two schools enjoyed, and how they, to some extent, acted together as joint mechanism. While in the Network of Contacts the layout shows that all persons crucial to the movement have in common its own Ego Network. An Ego Network is a disposition of nodes in the form of a star, around a focal node called "ego". The nodes around the "ego node" are called "alters". These *ego networks* provide a further reference on the role and importance that persons had in the Network of Contacts, since people being alters it is established that their relationship had an influence on people with ego nodes, and whose contribution depends on their relationship with a person with ego node; who, in turn, had a more active and predominant role in the movement.

Moreover, other concepts from network social analysis support the understanding of the visualizations. When applying *repulsion by degree* in the network of educational institutions and as a consequence, a good portion of the nodes were pulled out to the periphery, I realized that, with few exceptions, those nodes at the centre were also at the centre of the network of contacts. If both networks are considered scenarios, even with their different characteristics, the spatial coincidence in presence and position of main social actors confirms a central hierarchy between the members of the movement.

In summary, although data collection is susceptible to interpretation and human errors, the application of simulations of the social forces that takes place in Gephi, together with the automatic generation of scenarios, provides visual clues in the structures of the networks that help us to interpret some characteristics of relationships between people and the role they play in the community.

For the study of the home handicrafts and textile art movement it is intended with the prototype to provided information useful as points of departure for historic research. The prototype suggests how important institutional education could have been to the movement, but it also provides clues on the relevance of education at home. This method has the potential to investigate influence of persons educated at home. Another subject included in the datasets that can be analysed in the future, is the participation of members of the Network of Contacts in artistic and industrial exhibitions, which constitutes material in tables for building new bimodal networks. The social character of this activity could provide insights on the extent of their professional life and their collaboration with other professionals in projects.

The prototype together with its narratives have conveyed some of the benefits of using a mixed methods approach to alternative ways of presenting and re-working SKBL databases. Through quantitative processes concrete data is reorganized and associated to visually convey structures of relationships among persons. Qualitative processes in the form of narratives, open the possibility for interpretation with the intention to capture the complexities of social interactions and its impact in historical movements. The application of this method can be enriched with more complex searches in the SKBL database and increased volumes of data. For me personally, the experience of the development of the prototype can be useful in deeper statistical analysis, producing more material for narratives.

References

Alvarez, Maria Guadalupe, *Experiencing Play with Digital Heritage through Mobile AR Technology*, Master Degree Project, Skövde: University of Skövde, 2016

Bastian, Mathieu, Heymann, Sebastien & Jacomy, Mathieu, "*Gephi: An Open Source Software for Exploring and Manipulating Networks",* Paris, France: *Association for the Advancement of Artificial Intelligence*, 2009

Bolíbar, Mireia, "Macro, meso, micro: broadening the 'social' of social network analysis with a mixed methods approach", *Quality and Quantity* 2016:vol.50 issue 5, pp. 2217–2236

Brandes, Ulrik, Kenis, Patrick, Raab, Jörg, Schneider, Volker, & Wagner, Dorothea, "Exploration into the Visualization of Policy Networks", *Journal of Theoretical Politics*, 1999:vol.1 issue 1, pp.75–106

Caiani, Manuela, "Social Network Analysis", *Methodological Practices in Social Movement Research*, red. Donatella della Porta, Oxford University Press, 2014, pp. 368–397

Carlgren, Maria, *Birgittaskolorna. Modeateljéer och sömnadsskolor mellan tradition och förnyelse*, Phd Dissertation, Göteborg, Stockholm: Makadam Förlag, 2016

Coker, Cait, & Ozment, Kate, "Digital Enumerative Bibliography as Preservation of Feminist Labor" *Digital Humanities Quarterly*, 2019:13, nr 3, https://www.digitalhumanities.org/dhq/vol/13/3/000428/000428.html#

Della Porta, Donatella, "Social Movement Studies and Methodological Pluralism. An Introduction", *Methodological Practices in Social Movement Research*, red. Donatella Della Porta, Oxford University Press, 2014, pp. 368–397

Drucker, Johanna, *Graphesis. Visual Forms of Knowledge Production*, Cambridge, Massachusetts, and London, England:Harvard University Press, 2014

Franzosi, Roberto, "Text Genres, Narrative, and Story Grammars" *Quantitative Applications in the Social Sciences: Quantitative Narrative Analysis*, Thousand Oaks, CA: SAGE Publications, 2010

Franzosi, Roberto, Sudhahar, Saatviga, De Fazio, Gianluca & Nello Cristianini "Network analysis of narrative content in large corpora" *Natural Language Engineering*, 2013:21 (1), Cambridge University Press, pp. 81–112

Freeman, Linton C., *The Development of Social Network Analysis. A study in the Sociology of Science*, Vancouver: Empirical Press, 2004

Gabasova, Evelina. "The Star Wars Social Network", 2015-12-15, http://evelinag.com/blog/2015/12-15-star-wars-social-network/index.html#how

Geijer, Agnes, *Ur textilkonstens historia*, Slovenia: Tidens förlag, 3rd. Edition, 1994

Hillerström, Lena, "'Insigt och flit' Kvinnliga elever vid Tekniska skolan i Stockholm 1850 - 1925", *Rummet vidgas. Kvinnor på väg ut i offentligheten 1880–1940*, reds. Eva Österberg & Christina Carlsson Wetterberg, Stockholm: Atlantis, 2002, pp.310 - 344

Ivanov, Gunnela, *Vackrare vardagsvara – design för alla?: Gregor Paulsson och Svenska Slöjdföreningen 1915–1925*, Phd Dissertation, Umeå: Umeå Universitet, 2004

Jacomy, Mathieu, Venturini, Tomassi, Heymann, Sebastien & Bastian, Mathieu,"ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software", *PLoS ONE* 9, 2014:6, https://doi.org/10.1371/journal.pone.0098679

Jenkins, Nicholas, Meeks, Elijah & Murray, Scott, *Kindred Britain*, 2013. http://kindred.stanford.edu/#, [retrieved 2020-05-27]

Jockers, Matthiew L., *Macroanalysis. Digital Methods and Literary History*, Urbana, Chicago and Springfield: University of Illinois Press, 2013

Koenitz, Hartmut, et. al., "Towards a Specific Theory of Interactive Digital Narrative", *Interactive Digital Narrative: History, Theory and Practice*, NY: Routledge, 2015, p. 98ff

Kress, Gunther, *Multimodality a social semiotic approach to contemporary communication*, Hoboboken: Taylor and Francis, 2009

Larkin, Jill, & Simon, Hebert, "Why a Diagram Is (Sometimes) Worth Ten Thousand Words", *Cognitive Science*, 1987: 11, pp. 65–100

Luke, Douglas A., Amar Dhand, & Bobby J. Carothers, "Social Network Analysis", *System Science and Population Health*, eds. Abbdulrahman M. El-Sayed & Sandro Galea, 2017:Oxford University Press, pp. 114–123

Lundström, Catarina. *Fruars makt och omakt. Kön, klass och kulturarv 1900-1940, PhD Dissertation*, Umeå: Institutionen för historiska studier, Umeå Universitet, 2005

Meeks, Elijah. "More Networks in the Humanities or Did books have DNA?", 2011:Stanford University Libraries, https://dhs.stanford.edu/visualization/more-networks/

Moretti, Franco, "Network Theory. Plot analysis", *Literary Lab. Pamphlet 2*, 2011-05-01, https://litlab.stanford.edu/LiteraryLabPamphlet2.pdf

Murray, Scott, *Designing Kindred Britain*, 2013, San Fco, CA. USA.: Stanford University. http://kindred.stanford.edu/notes.html?section=designing#ug_title0

Newman, Mark, E.J., "The Structure and Function of Complex Networks", *SIAM Review Society for Industrial and Applied Mathematics*, 2003:45, nr 2, pp.167–256

Pauwels, Luc, "A Multimodal Framework for Analyzing Websites", *Journal of Computer-Mediated Communication*, 2012:17, nr 3, pp.247–265

Posner, Miriam, "Social Network Analysis Glossary", *Beyond the Digitized Slide Library*, 2015:UCLA, https://github.com/miriamposner/network_analysis_workshop/blob/master/social-network-glossary.md [retrieved 2020-04-26]

Sjöberg, Maria, "SKBL 2.0 är på väg", *Humtank*, 2020-01-22, http://humtank.se/skbl-2-0-ar-pa-vag/, [retrieved 2020-06-02]

Sjöberg, Maria, ‟Om behovet av Svenskt kvinnobiografiskt lexikon”, *Skandia: Tidsskrift för Historisk Forskning*, 2019: band 85(2), pp.99–112

‟Svenskt kvinnobiografiskt lexikon”, *Göteborgs Universitet*, n.d. https://skbl.se/en, [retrieved 2020-06-02]

Svensson, Birgitta, & Waldén, Louise, ‟Att hävda det textila.”, *Den feminina textilen. Makt och mönster*, reds. Birgitta Svensson & Louise Waldén, Stockholm: Nordiska Museet, 2005, pp. 7–28

Tahmasebi, Nina, ‟Ett litet sidospår. Maskininlärning.”, Video-lecture, *Studiecirkelträff 2. Språkbanken Text*, University of Gothenburg, 2019

Weingart, Scott B., ‟Demystifying Networks, Part I & Part II.” *Journal of Digital Humanities* Winter 2011:vol.1, nr.1, no pagination, http://journalofdigitalhumanities.org/1-1/demystifying-networks-by-scott-weingart/

Österberg, Eva, Carlsson Wetterberg, Christina, *Rummet vidgas. Kvinnor på väg ut i offentligheten 1880–1940*, reds. Eva Östberg & Christina Carlsson Wetterberg, Stockholm: Atlantis, 2002

[unsign.], “Network”, *Online Etymology Dictionary*, 2001-2020, https://www.etymonline.com/word/network, [retrieved 17-04-2020]

Appendix

Appendix A. Social Network of Contacts

Nodes defined as *Directed* and Nodes defined *Undirected*

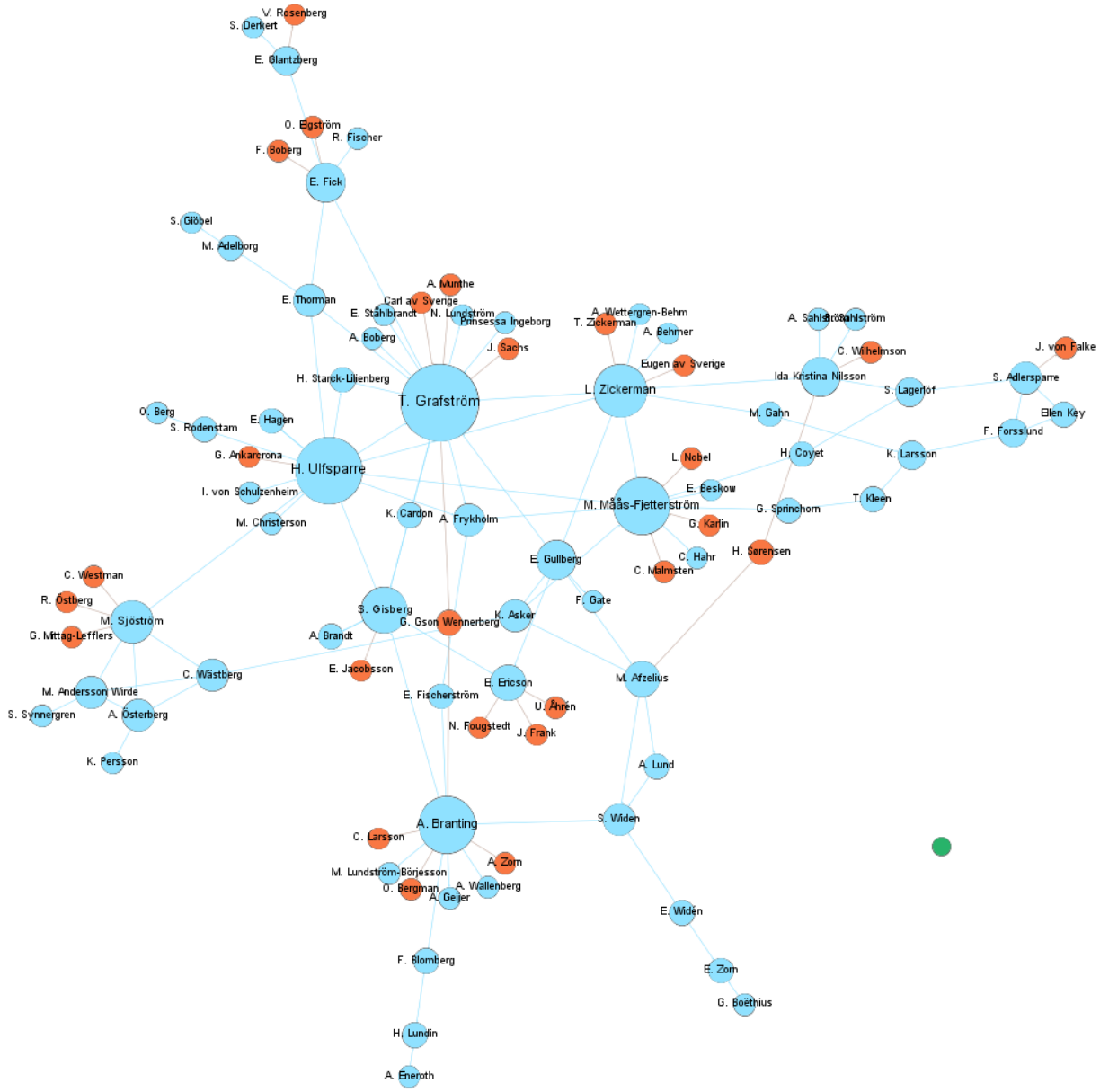


Fig. 1 Network with Directed Nodes

Comparison

The layout of both structures is similar with the Force Atlas algorithm process.

Differences are appreciated in the reports for Average Path Length, where the Directed Network has an average edge overview of 4, 485 and the Undirect Network is of 4, 008.

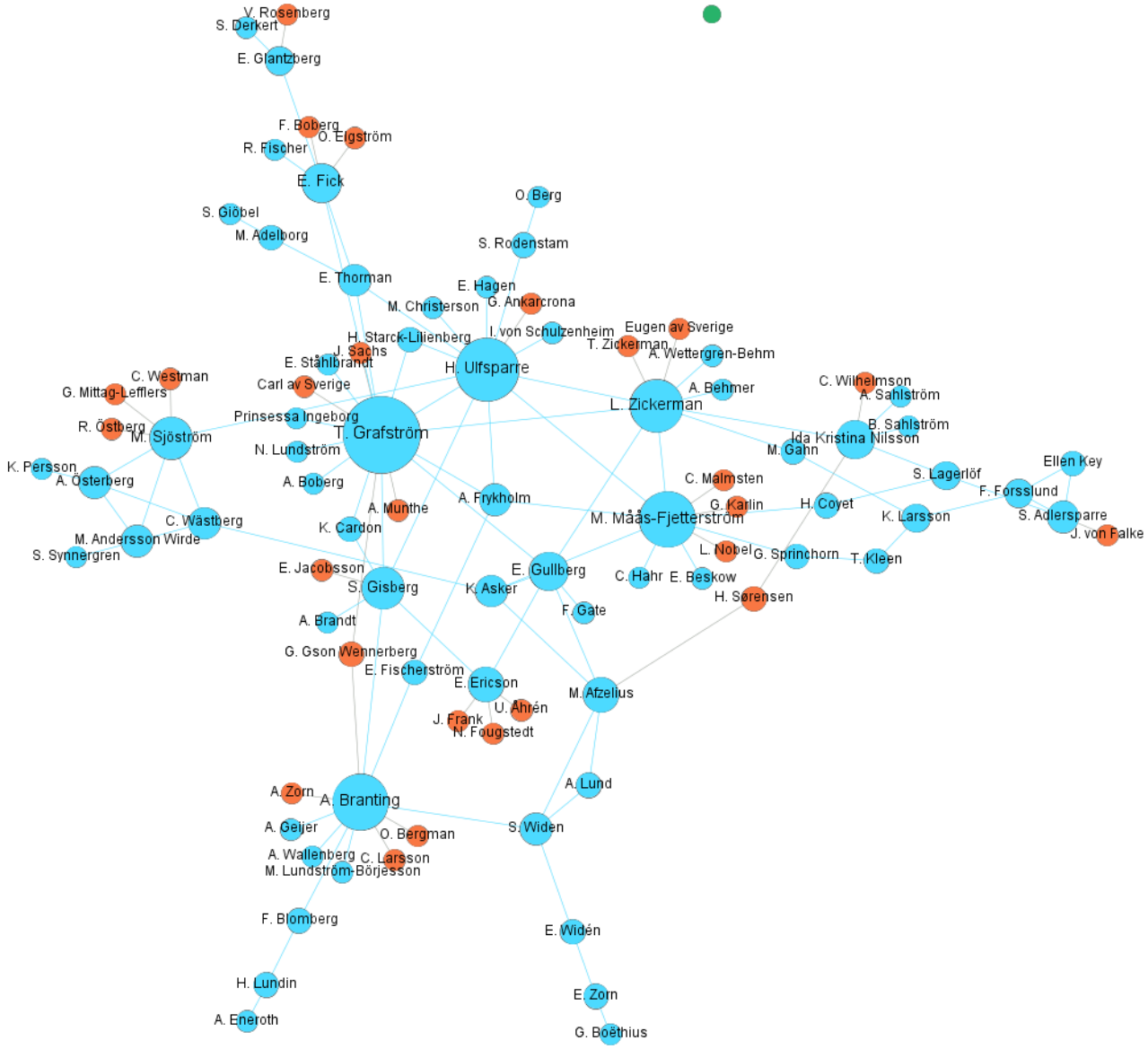
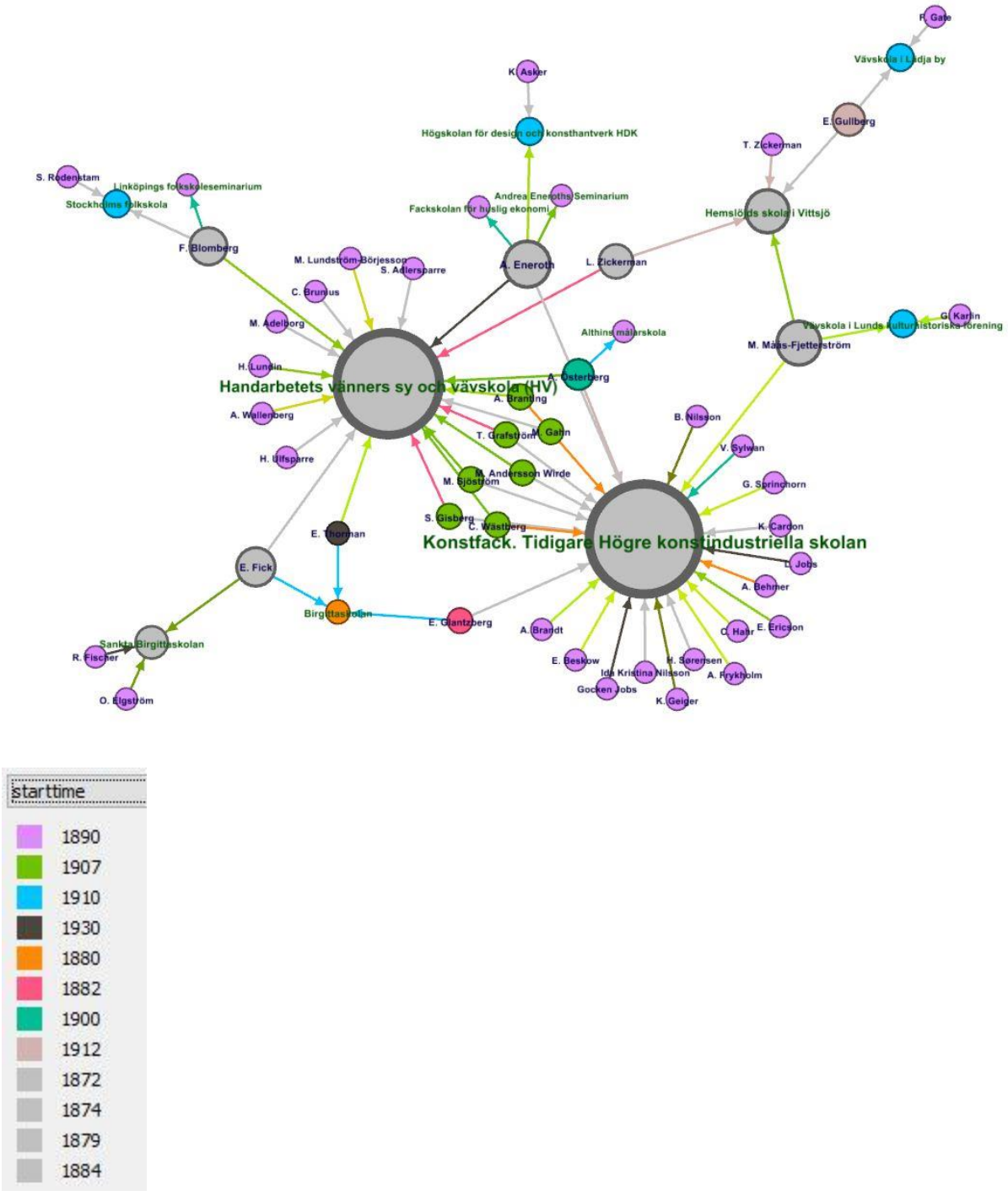
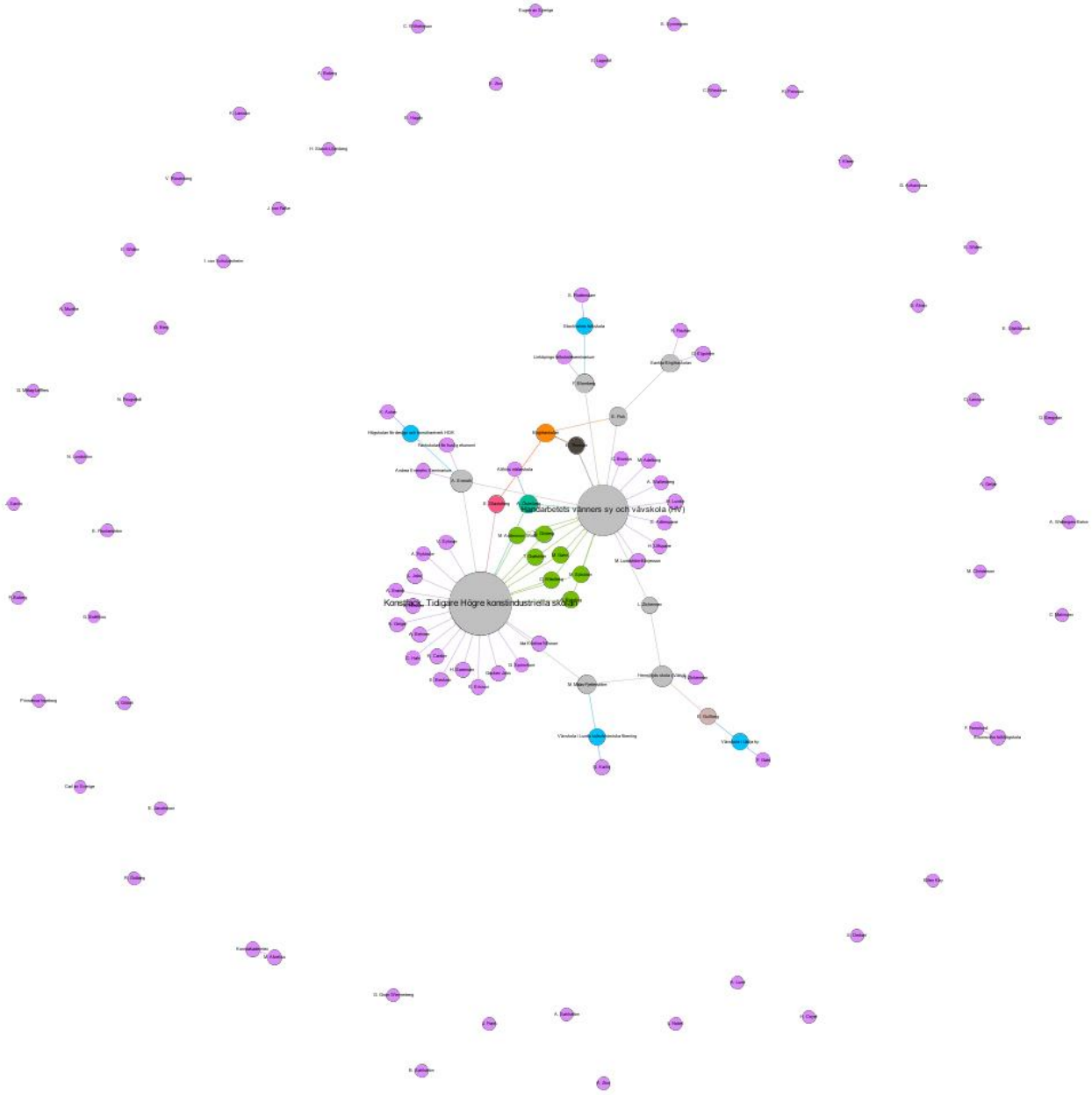


Fig. 2 Network with Undirected Nodes

Appendix B. Network of Educational Institutions

The following are several layouts of the same network. Each illustration shows exploration's results.





This illustration shows a layout of the network as displayed with a gravity value of 15.0. That is a standard value. By increasing the gravity, the nodes of the periphery get closer to the centre, but due to their weakness it is recommendable to remove them. I considered important to observe that in the totality of the network, they represent almost half of it.

Appendix C. Datasets

Network of Contacts - Nodes

ID	Label	Cat	Attribute
B1	L. Zickerman	Member	1
B2	A. Behmer	Member	1
B3	Eugen av Sverige	Member	2
B4	A. Wettergren-Behm	Member	1
B5	E. Gullberg	Member	1
B6	M. Måås-Fjetterström	Member	1
B7	M. Gahn	Member	1
B8	T. Zickerman	Member	2
B9	M. Afzelius	Member	1
B10	E. Ericson	Member	1
B11	S. Gisberg	Member	1
B12	N. Fougstedt	Member	2
B13	J. Frank	Member	2
B14	F. Gate	Member	1
B15	T. Grafström	Member	1
B16	K. Cardon	Member	1
B17	H. Ulfsparre	Member	1
B18	J. Sachs	Member	2
B19	A. Boberg	Member	1
B20	N. Lundström	Member	1
B21	G. Gson Wennerberg	Member	2
B22	A. Frykholm	Member	1
B24	H. Starck-Lilienberg	Member	1
B25	A. Munthe	Member	2
B26	Carl av Sverige	Member	2
B27	Prinsessa Ingeborg	Member	1

B28	E. Ståhlbrandt	Member	1
B29	E. Beskow	Member	1
B30	G. Sprinchorn	Member	1
B31	C. Hahr	Member	1
B32	G. Karlin	Member	2
B33	H. Coyet	Member	1
B34	H. Sørensen	Member	2
B35	C. Malmsten	Member	2
B36	L. Nobel	Member	2
B37	K. Larsson	Member	1
B38	A. Lund	Member	1
B39	S. Widen	Member	1
B40	E. Fischerström	Member	1
B41	A. Branting	Member	1
B42	A. Wallenberg	Member	1
B43	M. Lundström-Börjesson	Member	1
B44	C. Larsson	Member	2
B45	A. Zorn	Member	2
B46	O. Bergman	Member	2
B47	A. Geijer	Member	1
B48	U. Åhrén	Member	2
B49	M. Sjöström	Member	1
B50	I. von Schulzenheim	Member	1
B51	S. Rodenstam	Member	1
B52	E. Thorman	Member	1
B53	G. Ankarcrona	Member	2
B54	E. Hagen	Member	1
B55	M. Adelborg	Member	1
B56	S. Giöbel	Member	1
B57	E. Fick	Member	1
B58	E. Glantzberg	Member	1

B61	F. Boberg	Member	2
B62	R. Fischer	Member	1
B63	O. Elgström	Member	2
B64	S. Derkert	Member	1
B65	V. Rosenberg	Member	2
B66	A. Österberg	Member	1
B67	C. Wästberg	Member	1
B68	K. Persson	Member	1
B69	R. Östberg	Member	2
B70	C. Westman	Member	2
B71	G. Mittag-Lefflers	Member	2
B72	M. Andersson Wirde	Member	1
B73	S. Synnergren	Member	1
B74	A. Brandt	Member	1
B75	E. Jacobsson	Member	2
B76	T. Kleen	Member	1
B77	S. Lagerlöf	Member	1
B80	Ida Kristina Nilsson	Member	1
B81	C. Wilhelmson	Member	2
B82	A. Sahlström	Member	1
B83	B. Sahlström	Member	1
B87	E. Widén	Member	1
B88	E. Zorn	Member	1
B89	O. Berg	Member	1
B106	M. Christerson	Member	1
B107	G. Boëthius	Member	1
B109	K. Asker	Member	1
B110	H. Lundin	Member	1
B111	A. Eneroth	Member	1
B112	F. Blomberg	Member	1
B113	S. Adlersparre	Member	1

B114	Ellen Key	Member	1
B115	F. Forsslund	Member	1
B116	J. von Falke	Member	2

Network of Contacts – Edges

Source	Target	Type
B1	B2	direct
B1	B3	direct
B1	B4	direct
B1	B5	direct
B1	B5	direct
B1	B6	direct
B1	B7	direct
B1	B8	direct
B1	B7	direct
B5	B9	direct
B11	B10	direct
B11	B10	direct
B5	B10	direct
B10	B12	direct
B10	B13	direct
B5	B14	direct
B16	B15	direct
B16	B11	direct
B15	B11	direct
B17	B15	direct
B15	B18	direct
B15	B19	direct
B15	B20	direct
B15	B21	direct
B15	B22	direct

B1	B15	direct
B1	B15	direct
B26	B15	direct
B27	B15	direct
B15	B19	direct
B15	B22	direct
B15	B25	direct
B5	B15	direct
B15	B24	direct
B15	B28	direct
B6	B22	direct
B6	B29	direct
B6	B30	direct
B6	B31	direct
B32	B6	direct
B32	B6	direct
B6	B33	direct
B9	B34	direct
B35	B6	direct
B36	B6	direct
B7	B37	direct
B9	B38	direct
B5	B9	direct
B5	B9	direct
B9	B39	direct
B38	B39	direct
B38	B39	direct
B40	B22	direct
B40	B41	direct
B41	B42	direct
B41	B43	direct

B41	B44	direct
B41	B11	direct
B41	B39	direct
B41	B45	direct
B41	B46	direct
B41	B21	direct
B41	B47	direct
B10	B48	direct
B49	B17	direct
B50	B17	direct
B17	B24	direct
B17	B22	direct
B17	B51	direct
B17	B52	direct
B17	B53	direct
B54	B17	direct
B17	B54	direct
B17	B6	direct
B55	B56	direct
B52	B57	direct
B52	B15	direct
B57	B15	direct
B57	B58	direct
B57	B58	direct
B57	B61	direct
B57	B62	direct
B57	B63	direct
B57	B63	direct
B58	B64	direct
B58	B65	direct
B67	B66	direct

B66	B49	direct
B66	B68	direct
B49	B69	direct
B49	B70	direct
B71	B49	direct
B49	B67	direct
B49	B70	direct
B72	B49	direct
B72	B67	direct
B72	B66	direct
B72	B73	direct
B74	B11	direct
B11	B75	direct
B11	B74	direct
B11	B17	direct
B30	B76	direct
B33	B77	direct
B37	B76	direct
B78	B79	direct
B80	B81	direct
B80	B1	direct
B80	B82	direct
B77	B80	direct
B80	B83	direct
B80	B82	direct
B80	B83	direct
B34	B80	direct
B85	B86	direct
B87	B39	direct
B87	B88	direct
B89	B51	direct

B94	B98	direct
B97	B94	direct
B97	B98	direct
B101	B104	direct
B101	B104	direct
B101	B104	direct
B106	B17	direct
B107	B88	direct
B17	B1	direct
B109	B5	direct
B109	B9	direct
B109	B67	direct
B109	B6	direct
B111	B110	direct
B112	B110	direct
B112	B41	direct
B77	B113	direct
B113	B114	direct
B115	B114	direct
B115	B37	direct
B113	B115	direct
B113	B114	direct
B113	B116	direct
B52	B55	direct

Network of Educational Institutions – Nodes

(Same file as nodes in Network of Contacts and the following nodes)

ID	Label	Cat	lat	lon	City
I3	Hemslöjds skola i Vittsjö	Institution	56.34366	13.66081	Vittsjö
I4	Handarbetets vänners sy och vävskola (HV)	Institution	59.33258	18.0649	Stockholm
I5	Konstfack. Tidigare Högre konstindustriella skolan	Institution	59.29972	17.99416	Stockholm
I11	Vävskola i Lädja by	Institution	57.111577	14.680382	Växjö
I18	Vävskola i Lunds kulturhistoriska förening	Institution	55.704984	13.191550	Lund
I21	Konstakademien	Institution	59.328452	18.064018	Stockholm
I34	Birgittaskolan	Institution	59.33258	18.0649	Stockholm
I35	Sankta Birgittaskolan	Institution	59.33258	18.0649	Stockholm
I36	Althins målarskola	Institution	59.33258	18.0649	Stockholm
I163	Högskolan för design och konsthantverk HDK	Institution	57.746286	11.986021	Göteborg
I170	Fackskolan för huslig ekonomi	Institution	59.856223	17.638541	Uppsala
I171	Andrea Eneroths Seminarium	Institution	59.336932	18.053496	Stockholm
I172	Linköpings folkskoleseminarium	Institution	58.415436	15.621444	Linköping
I173	Stockholms folkskola	Institution	59.33258	18.0649	Stockholm
I175	Brunnsviks folkhögskola	Institution	60.505922	15.427820	Brunnsvik

Network of Educational Institutions – Edges

Source	Target	Label	StartTime	EndTime	Type
B1	I3	kollega	1908	1913	direct
B1	I3	kollega	1913	1919	direct
B1	I3	lärare	1912		direct
B1	I4	elev	1882	1886	direct
B11	I5	mentor	1913	1918	direct
B5	I11	kollega	1951		direct
B16	I5	mentor	1875	1911	direct
B16	I5	mentor	1879	1883	direct
B15	I4	kollega	1882	1888	direct
B6	I5	skolklassvän	1890	1895	direct
B6	I5	skolklassvän	1890	1895	direct
B6	I5	skolklassvän	1890	1895	direct
B6	I5	skolklassvän	1890	1895	direct
B32	I18	chef	1902	1913	direct
B9	I21	elev	1911	1914	direct

B2	I5	elev	1880	1886	direct
B7	I5	elev	1910	1915	direct
B41	I5	deltagare	1880	1884	direct
B41	I4	arbetare	1885	1891	direct
B41	I4	ledare	1891	1904	direct
B42	I4	styrelsemedlem	1884	1904	direct
B43	I4	styrelsemedlem	1884	1904	direct
B49	I5	elev	1886	1893	direct
B49	I4	arbetare	1893	1920	direct
B55	I4	arbetare	1899	1907	direct
B52	I34	vän	1910	1935	direct
B57	I4	elev	1895	1908	direct
B57	I34	partner	1910	1914	direct
B58	I5	elev	1920	1930	direct
B57	I35	sammarbetare	1930	1940	direct
B57	I35	sammarbetare	1929	1931	direct
B66	I36	elev	1910	1912	direct
B66	I5	elev	1912	1914	direct
B67	I4	mentor	1914		direct
B66	I4	kollega	1914	1915	direct
B66	I4	arbetare	1916	1926	direct
B49	I4	kollega	1903	1920	direct
B72	I5	elev	1897	1903	direct
B72	I4	arbetare	1907	1929	direct
B72	I4	kollega	1907	1929	direct
B72	I4	kollega	1907	1929	direct
B72	I4	kollega	1907	1929	direct
B74	I5	mentor	1879	1883	direct
B11	I5	elev	1879	1886	direct
B11	I5	lärare	1887		direct
B11	I5	efterträdare	1904	1925	direct

B11	I4	kollega	1874	1910	direct
B34	I5	mentor	1872	1878	direct
B85	I5	elev	1900	1905	direct
B93	I5	mentor	1938	1940	direct
B101	I5	skolklassvän	1930	1935	direct
B109	I163	student	1912	1918	direct
B109	I163	mönsterritare	1922	1930	direct
B109	I163	föreståndare	1930	1935	direct
B109	I163	lärare	1935	1957	direct
B110	I4	mentor	1913	1920	direct
B111	I4	efterträdare	1930	1961	direct
B111	I5	elev	1893	1894	direct
B111	I163	student	1891	1893	direct
B111	I170	lärare	1900	1907	direct
B111	I171	lärare	1907	1930	direct
B112	I172	lärare	1900	1904	direct
B112	I173	slöjdinspektris	1905	1922	direct
B112	I4	föreståndare	1905	1922	direct
B112	I4	efterträdare	1915	1922	direct
B113	I4	grundare	1874	1887	direct
B115	I175	lärare	1906	1937	direct
B67	I5	student	1880	1890	direct
B67	I4	anställd	1904	1910	direct
B67	I4	föreståndare	1911	1933	direct
B51	I173	statensinstruktor	1922	1935	direct
B52	I4	forskare	1904	1924	direct
B118	I4	student	1898	1899	direct
B7	I4	lärare	1932	1934	direct
B5	I3	kollega	1908	1913	direct
B6	I3	kollega	1913	1919	direct
B8	I3	lärare	1912		direct

B10	I5	mentor	1913	1918	direct
B14	I11	kollega	1951		direct
B15	I5	mentor	1875	1911	direct
B11	I5	mentor	1879	1883	direct
B11	I4	kollega	1882	1888	direct
B22	I5	skolklassvän	1890	1895	direct
B29	I5	skolklassvän	1890	1895	direct
B30	I5	skolklassvän	1890	1895	direct
B31	I5	skolklassvän	1890	1895	direct
B6	I18	chef	1902	1913	direct
B58	I34	partner	1910	1914	direct
B62	I35	sammarbetare	1930	1940	direct
B63	I35	sammarbetare	1929	1931	direct
B66	I4	mentor	1914		direct
B49	I4	kollega	1914	1915	direct
B67	I4	kollega	1903	1920	direct
B49	I4	kollega	1907	1929	direct
B67	I4	kollega	1907	1929	direct
B66	I4	kollega	1907	1929	direct
B11	I5	mentor	1879	1883	direct
B74	I5	efterträdare	1904	1925	direct
B17	I4	kollega	1874	1910	direct
B80	I5	mentor	1872	1878	direct
B94	I5	mentor	1938	1940	direct
B104	I5	skolklassvän	1930	1935	direct
B110	I4	efterträdare	1930	1961	direct
B110	I4	efterträdare	1915	1922	direct

Appendix D. Instructions to Access the Prototype

The prototype is available in two project files of the network analysis application Gephi. Therefore, it is necessary to download Gephi from the Internet to a desktop. The application license is free and built in an open environment at https://gephi.org/users/download/

Files are accessible in version 0.9.2. of Gephi. These files were created in the spring 2020. The files are:

- NetworkContacts.gephi
- NetworkEducationalInstitutions.gephi

When the project is open, navigation through the network is directly available with the cursor. For more use of application features, a quick reference guide can be found at https://gephi.org/users/quick-start/