CEO Affiliation Networks: Social Clubs, Nonprofit Boards, and Universities

Will Macheel and Rohit Kandala

GitHub Project

## Introduction

What is the nature of chief executive officers' (CEOs) relationship with each other, as mediated by third-party, non-company organizations? Our paper aims to answer this question and other related inquiries by analyzing a historical, existing dataset and creating a new, modern network to examine as well. The paper starts by analyzing the data from Galaskiewicz's (1985) seminal study on chief executive officer membership in social clubs and organizations in the Twin Cities metropolitan area—St. Paul and Minneapolis. Next, we construct a new network data set from scratch on current Fortune 500 CEOs in the Twin Cities. Since we did not have the resources to survey social clubs and CEOs as Galaskiewicz did, we instead constructed a novel data set from publicly available data on CEO membership on non-profit boards and their alma maters for both undergraduate and graduate education, where applicable.

## Literature Review

Our paper builds on assignment number four for this class, in which we originally proposed this research idea. The literature review we conducted for that assignment is the basis for this paper, so we include that background in this section.

Galaskiewicz (1997) expands on his research on the local social networks of CEOs in the Twin Cities area (the Minneapolis and St. Paul metropolitan region in Minnesota), and how they relate to companies' charitable contributions. Galaskiewicz's original paper collected data from 1979-1981, while this more recent paper builds on those data with additional observations from

1987-1989. The author finds support for the institutional theory of corporate giving, in which CEOs experience social pressure from their peers to be more philanthropic with their companies' expenditures. The novel research question in this paper was whether corporate giving and its relationship to the social network of CEOs in the Twin Cities had fundamentally changed throughout the 1980s, as some of the local Fortune 500 companies suffered financial losses and experienced hostile takeover attempts.

To construct the social network, Galaskiewicz surveyed "prominent" citizens in the metro area on who were the philanthropic leaders that garnered the most corporate contributions. He interviewed these leaders, including on how closely they knew the officers and/or board members of the target companies in the study. Next, he reviewed the membership lists of local prestigious country clubs to determine which philanthropic leaders and CEOs belonged to the same groups. He next comes up with various network measures, such as the number of times a CEO (or their spouse) was on a cultural organization or other company board with a philanthropic leader, and also calculates eigenvector centrality for CEOs based on their proximity to philanthropic leaders. Using a panel regression analysis and controlling for other variables such as company employment and sales, he finds that proximity of CEOs to philanthropic leaders in local elite social networks does matter, and is positively associated with charitable giving by local companies.

Galaskiewicz et al. (1985) seeks to answer the question of how board members are selected for companies in a local metropolitan area. One theory for interlocking directorates is that they diversify away risk, allowing companies to pool resources in the face of adverse economic conditions. The other competing theory is more social in nature, that board members are selected based on their social capital. To test these hypotheses, the authors construct a dataset of 6,760 dyads between 116 publicly-owned firms in the Twin Cities area between 1978-1980. To do so, they created a binary adjacency matrix of these ties, using the Ninth Federal Reserve District's Corporate Report Factbook.

To test the economic theory, they relate market constraints (how much the tied companies affect each other's profits) to the frequency of their interlocking directorates. The authors find a null effect. The authors do find evidence that CEOs of large firms and that were part of the social elite had a greater frequency of ties with other companies based on interlocking directorates. Therefore, the authors conclude that there is an interaction effect between corporate size and social status on board membership, as measured by the frequency of dyads between companies.

Davis et al. (2003) examines how the social network structure of the "corporate elite" in the United States has evolved over time. Specifically, the paper investigates changes in the "small world" properties of this network, including measures of path length and clustering, between 1982 and 2001. The data used in the analysis consists of biographical information on the members of the boards of directors of the largest publicly traded U.S. corporations. This allows the researchers to construct a network representing interlocking directorates, where nodes are individual directors and ties indicate shared board memberships. The authors analyze this network data using techniques such as: path length, clustering coefficient, null model comparisons, and other centrality measures, and use it to assess the "small world" characteristics of the corporate elite network over the period. They also examine how these network properties vary based on factors like firm size, industry, and geographic location.

The findings indicate that the corporate elite network has become increasingly "small world" in nature, with shorter path lengths and higher levels of clustering over time. This suggests the American business community has become more tightly interconnected, which may have implications for the diffusion of information, resources, and practices among large corporations. Overall, the study provides insights into the evolving social structure of corporate power in the U.S.

Heemskerk (2011) attempts to characterize the social network structure of interlocking directorates of European corporations, and the extent to which board memberships cross borders within the European Union. The author defines the "corporate elite" as the directors of the continent's largest firms. They set the boundary of their network to include only the directors of the firms in the December 2005 FTSEurofirst 300 list. Heemskerk used annual reports to find the names of the firms' directors.

They create network graphs at a country level, with weighted ties between countries based on how many directors serve on at least two boards between two countries, which are the nodes. At the firm level, they find that the average distance between firm pairs is only around three ties. This relatively short path means that information can flow quickly between the European Union's largest firms. They also find that both regular industry and financial firms are similarly situated in terms of network centrality. Heemskerk also calculates the degree distribution of firms, showing that there are a select few with degree values of more than seven. These firms may serve as "hubs" in the interlocking directorate network.

Wasserman and Faust's textbook (1994) is foundational in SNA. While the UCIrvine page gives us significant information about the Galaskiewicz dataset, it does not tell us which companies the CEOs belong to and the social organizations they frequent. Galaskiewicz also collected this data originally through taping interviews.

This textbook also introduces an additional matrix titled a "co-membership" matrix between each of the 26 CEOs, and that helps inform not just how CEOs interact with the social organizations, but also how memberships affect other CEOs' participation in these clubs. There are additional metrics and matrices that this textbook includes that we could not find anywhere else.

Breiger (1974) examines the interdependent relationship between individuals and the social groups they belong to. The research question is how individuals and groups affiliate with each other, and is a landmark of understanding two-mode networks. Breiger uses empirical data on the group affiliations and social ties of a set of university faculty members. This allows him to investigate how an individual's structural position within a network reflects their group memberships, while also shaping the structure of those groups.

The research design involves mapping the overlapping group affiliations of the faculty members, as well as the patterns of interpersonal connections between them. Breiger then analyzes how these network structures demonstrate the reciprocal relationship between individuals and the groups they are embedded within. Overall, the study argues that individuals cannot be fully understood in isolation from the social groups they participate in, and vice versa. The duality of persons and groups is a fundamental feature of social life that has important implications for social theory and empirical research. By examining this duality, the article aims to provide a more holistic perspective on the interplay between individual and collective social dynamics.

**Research Questions**

Our research paper examines the nature of CEO and organizational social network structures as currently constructed in the Twin Cities metropolitan region. We build upon the seminal work by Galaskiewicz. We did not have the resources to construct a new version of Galaskiewicz's data set on Twin Cities CEO membership in social clubs, as those data tend to be private and require the survey methods Galaskiewicz used. Instead, we examine CEO affiliation networks along two new dimensions: non-profit boards and universities. These data are publicly available and allow for relative ease in data collection, while providing new insights into CEO affiliation networks in other important social arenas, non-profit organizations and educational institutions.

Our research questions include the following for both data sets:

- Which CEOs are most important in terms of different centrality measures (degree, betweenness, closeness, eigenvector)?
- Which organizations—social clubs, non-profit organizations, and universities are most important in terms of different centrality measures (degree, betweenness, closeness, eigenvector)?
- How do the overall structural characteristics of the original Galaskiewicz network on CEOs and social clubs in the Twin Cities metropolitan area in the later 1970s compare to our modern data set on CEOs, non-profit board membership, and educational institutions? We will answer this question by examining structural measures such as edge density and clustering coefficients.

We also formulated a research question unique to our original data set: To what extent are CEOs affiliated assortatively by whether or not they completed an MBA, as well as by their age, gender, and the market capitalization and industry category of their companies?

## Methodology

### *Data Collection*

The Galaskiewicz CEO data already comes preloaded in the University of California at Irvine social network data repository. We made no changes to these data and simply loaded it in R.

To construct our original data set, we first had to determine the bounds of our social network. We used a nominalist approach, as we did not capture all CEOs in the Twin Cities area in our data set. Instead, we defined our CEO network as the Fortune 500 CEOs in the metropolitan region. As a result of this nominalist approach, 16 CEOs or nodes are included in the network. For each CEO, we collected data on each non-profit organization board they are a member of and university they attended, for either their undergraduate education or graduate school. To collect these data points, we used publicly available data. We visited each CEO’s biographical page on their company websites, their LinkedIn profiles, and any other relevant web pages that came up during the online search process. This online search methodology returned 64 nonprofit organizations and 24 universities.

We also collected attribute data for each of the nonprofit organization and education institution vertices. For nonprofit organizations, these vertex attributes included their sector and geographic scale. The sector categories are comprised of Finance and Business, Health and Social Services, Arts and Culture, Education, Community Development and Housing, Social Services and Advocacy, and Professional and Educational Associations. As a result, there are seven categories. We also included the geographic scale at which the non-profit organizations operate. There are three categories for this variable, and they include Local, National, and International.

For the CEOs, we created five different vertex attributes. The first is whether they completed a Master of Business Administration degree. Seen as a marker of preparedness for executive and general business management roles, whether or not a CEO attended and completed an MBA program will tell us about the institutional nature of MBAs as a supposed prerequisite for CEO positions. The MBA variable is binary, with CEOs coded as “1” if they completed an MBA program and “0” if they did not complete an MBA program. Age and gender vertex attributes are also included for the CEOs. Age was either explicitly mentioned during our online search, or was imputed based on the assumed age of 22 that the CEO received their bachelor’s degree. Gender was recorded as binary, male or female. The market capitalization for each company was also included as a vertex attribute, measured in billions of U.S. dollars.

Overall, our data collection means we have three networks: the Galaskiewicz data on CEOs and social clubs, our original data on CEOs and nonprofit organization boards, and our original data on CEOs and their past educational institutions. The two data sets we constructed have vertex attributes as we discussed above, while the Galaskiewicz data set does not have vertex attributes to analyze.

*Analysis*

We calculated multiple measures of centrality for each node in the two-mode and one-mode networks. These centrality measures included degree, closeness, betweenness, and eigenvector. All centrality measures were normalized to make for easier comparison across the four measures. Normalized degree centrality tells us the proportion of all other nodes that each node is connected to. Overall, degree centrality shows us how well connected each node is. Normalized betweenness centrality tells us the fraction of shortest paths in the whole network that each node lies on. CEOs that have relatively high levels of betweenness centrality may be mediators of information, as information might pass through them via social clubs, nonprofit organizations, or educational institutions. Normalized closeness centrality tells the average distance each node has to all the other nodes in the network. Last, normalized eigenvector centrality shows the degree to which each node is relatively important in the network, based on its relational position to the other nodes and those other nodes' own relative importance.

Since the Galaskiewicz data are weighted, we also binarized the one-mode matrices for CEOs and clubs to examine how unweighted connections affected the centrality measures. One-mode matrices were derived using matrix algebra.

Next, we calculated local clustering coefficients for each node in each network data set, along with global clustering coefficients. These values tell us the degree to which nodes are clustering in triads of three nodes, forming dense connections and smaller communities within the larger network. Similarly, we estimated maximal k-cores for each node to give us an indication of the largest core of nodes to which they are connected. Last, we calculated network-level edge density scores for each of the three networks.

**Results**

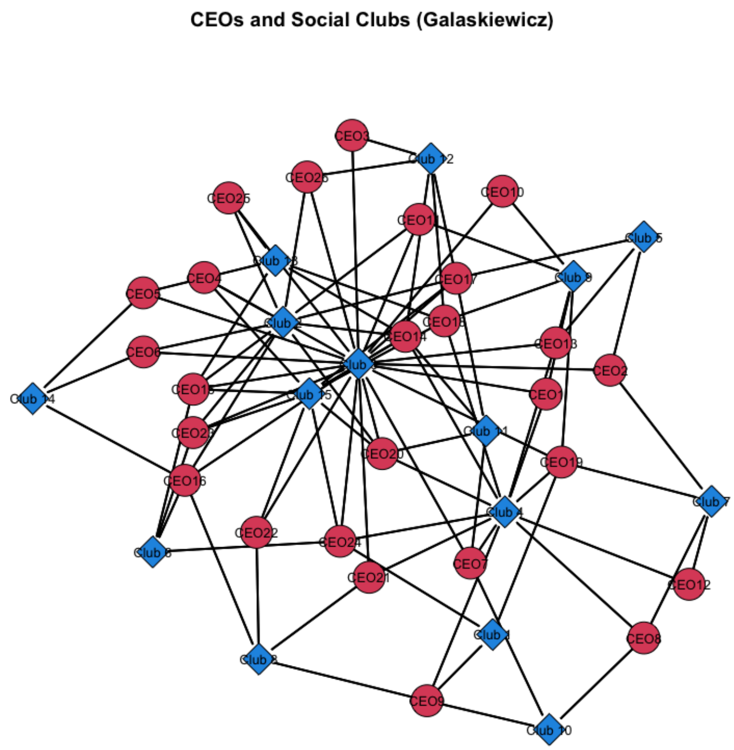
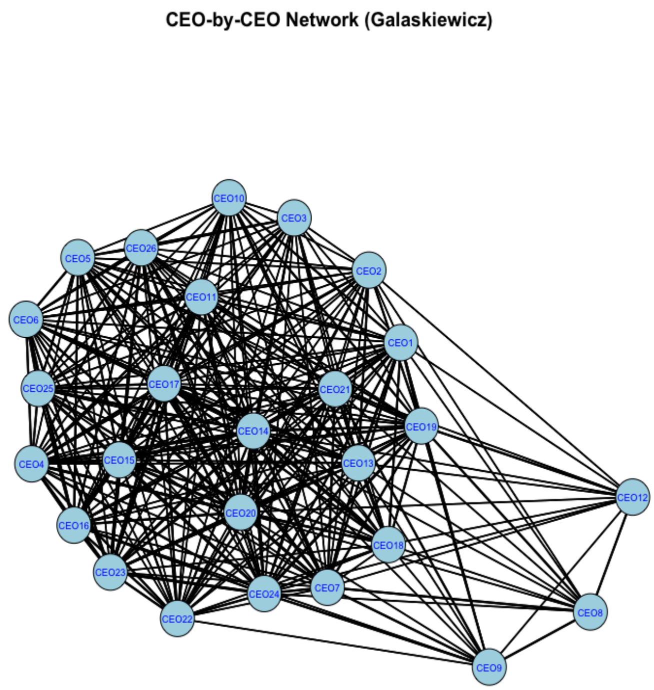



Figure 1. Two-Mode Network: Galaskiewicz Data on CEOs and Social Clubs

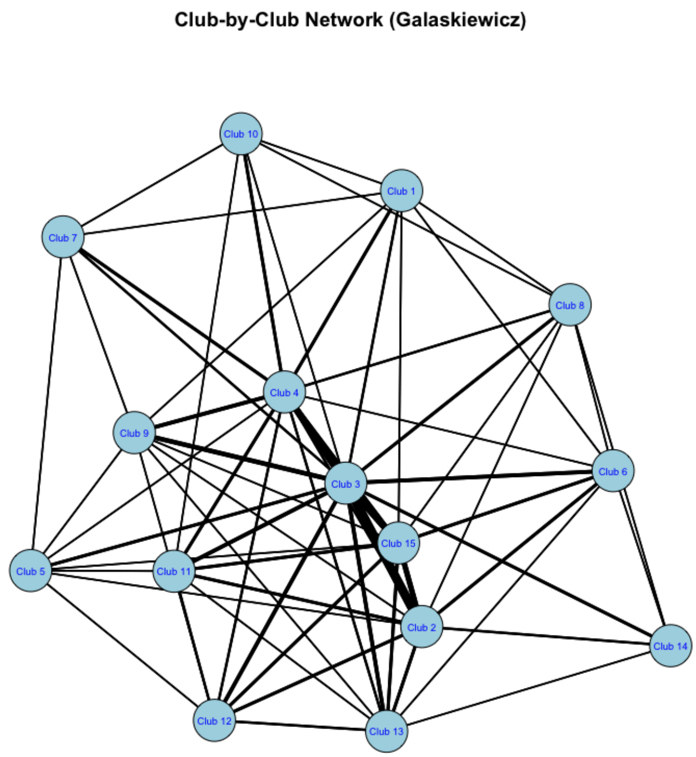
The above graph shows the two-mode affiliation network for CEOs and social clubs in the Galaskiewicz data set. CEO nodes are red and social club nodes are blue. Edges represent the membership of CEOs in the different social clubs. This is an undirected social network.

Figure 2. One-Mode CEO Network: Galaskiewicz Data on CEOs and Social Clubs



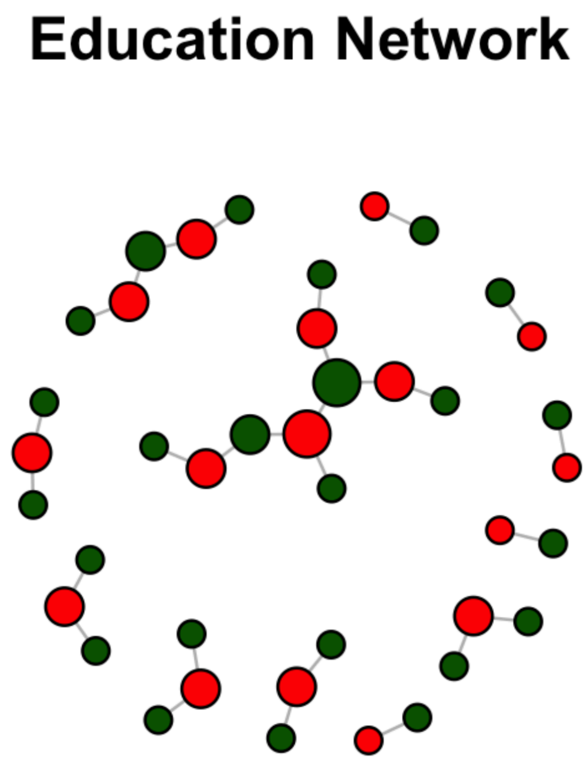

The above graph shows the one-mode affiliation network for CEOs in the Galaskiewicz data set. Edges between the CEOs represent membership in the same social club. This social network is undirected, and weighted, with edge weights serving as the number of clubs that each CEO pair both belong to.

Figure 3. One-Mode Club Network: Galaskiewicz Data on CEOs and Social Clubs



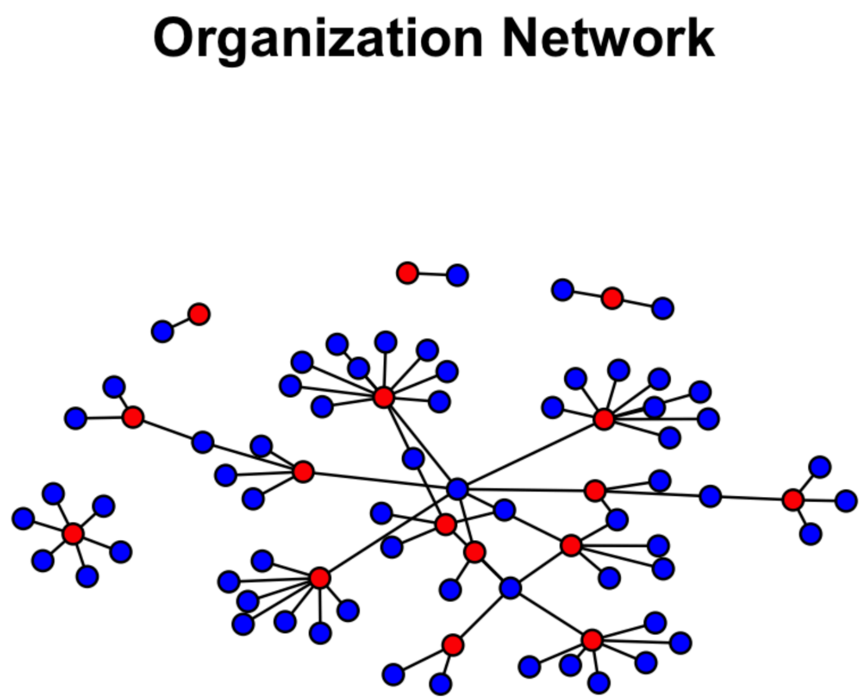

The above graph shows the one-mode affiliation network for clubs in the Galaskiewicz data set. CEO nodes are red and social club nodes are blue. Edges between the clubs represent shared membership from the same CEOs. This social network is undirected and weighted, with edge weights serving as the number of same CEOs having membership in both social clubs within a pair.

Figure 4. Two-Mode Network: Modern CEOs and Universities




This is a visualization of CEOs (in red) and the universities they’re affiliated with (in green). The size of these nodes differ with the degree of the nodes; larger nodes have a higher degree and smaller nodes have a lower degree.

Figure 5. Two-Mode Network: Modern CEOs and Non-Profit Organizations




This is a visualization of CEOs (in red) and the organizations they're affiliated with (in blue). As opposed to fig. 4, the vertex nodes are constant and generally this is a well-connected network.

Table 1. Two-Mode Centrality Measures: Galaskiewicz CEOs

| | Degree | Eigenvector | Betweenness | Closeness |
|---|---|---|---|---|
| CEO1 | 0.075 | 0.264 | 0.012 | 0.449 |
| CEO2 | 0.075 | 0.189 | 0.027 | 0.430 |
| CEO3 | 0.050 | 0.191 | 0.004 | 0.412 |
| CEO4 | 0.075 | 0.317 | 0.004 | 0.421 |
| CEO5 | 0.075 | 0.209 | 0.018 | 0.421 |
| CEO6 | 0.075 | 0.259 | 0.015 | 0.412 |
| CEO7 | 0.100 | 0.277 | 0.047 | 0.460 |
| CEO8 | 0.075 | 0.103 | 0.012 | 0.342 |
| CEO9 | 0.100 | 0.127 | 0.023 | 0.360 |
| CEO10 | 0.050 | 0.189 | 0.004 | 0.412 |
| CEO11 | 0.075 | 0.277 | 0.009 | 0.421 |
| CEO12 | 0.050 | 0.091 | 0.004 | 0.336 |
| CEO13 | 0.100 | 0.285 | 0.030 | 0.460 |
| CEO14 | 0.175 | 0.506 | 0.064 | 0.494 |
| CEO15 | 0.125 | 0.387 | 0.023 | 0.440 |
| CEO16 | 0.125 | 0.313 | 0.046 | 0.440 |
| CEO17 | 0.150 | 0.413 | 0.044 | 0.449 |
| CEO18 | 0.125 | 0.264 | 0.032 | 0.440 |
| CEO19 | 0.125 | 0.298 | 0.057 | 0.471 |
| CEO20 | 0.125 | 0.430 | 0.031 | 0.471 |
| CEO21 | 0.075 | 0.250 | 0.018 | 0.449 |
| CEO22 | 0.075 | 0.250 | 0.014 | 0.430 |
| CEO23 | 0.100 | 0.349 | 0.013 | 0.430 |
| CEO24 | 0.125 | 0.354 | 0.049 | 0.471 |
| CEO25 | 0.075 | 0.279 | 0.007 | 0.421 |
| CEO26 | 0.075 | 0.279 | 0.008 | 0.421 |

Table 2. Two-Mode Centrality Measures: Modern CEOs (Organization Network)

| | Degree | Eigenvector | Betweenness | Closeness | Coreness |
|---|---|---|---|---|---|
| andrewwitty | 0.076 | 0.000 | 0.005 | 1.000 | 1 |
| briancornell | 0.089 | 0.180 | 0.120 | 0.243 | 1 |
| jayddebertin | 0.038 | 0.033 | 0.041 | 0.198 | 1 |
| coriebarry | 0.038 | 0.397 | 0.101 | 0.339 | 2 |
| williammbrown | 0.101 | 0.521 | 0.139 | 0.310 | 1 |
| andrewcecere | 0.076 | 0.551 | 0.163 | 0.349 | 2 |
| davebozeman | 0.114 | 0.604 | 0.157 | 0.312 | 1 |
| bethford | 0.063 | 0.371 | 0.137 | 0.310 | 1 |
| jeffharmening | 0.063 | 0.237 | 0.078 | 0.258 | 2 |
| bobfrenzel | 0.013 | 0.000 | 0.000 | 1.000 | 1 |
| jamescracchiolo | 0.051 | 0.388 | 0.123 | 0.310 | 2 |
| christophebeck | 0.038 | 0.121 | 0.041 | 0.236 | 1 |
| jimsnee | 0.013 | 0.000 | 0.000 | 1.000 | 1 |
| teresajrasmussen | 0.051 | 0.038 | 0.061 | 0.201 | 1 |
| michaeltspeetzen | 0.025 | 0.000 | 0.000 | 1.000 | 1 |
| geoffmartha | 0.139 | 0.944 | 0.201 | 0.332 | 2 |

Table 3. Two-Mode Centrality Measures: Modern CEOs (University Network)

| | Degree | Eigenvector | Betweenness | Closeness | Coreness |
|---|---|---|---|---|---|
| andrewwitty | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| briancornell | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| jayddebertin | 0.051 | 0.000 | 0.004 | 0.571 | 1 |
| coriebarry | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| williammbrown | 0.051 | 0.000 | 0.001 | 1.000 | 1 |
| andrewcecere | 0.051 | 0.367 | 0.011 | 0.321 | 1 |
| davebozeman | 0.051 | 0.000 | 0.001 | 1.000 | 1 |
| bethford | 0.051 | 0.000 | 0.001 | 1.000 | 1 |
| jeffharmening | 0.051 | 0.594 | 0.011 | 0.375 | 1 |
| bobfrenzel | 0.051 | 0.000 | 0.001 | 1.000 | 1 |
| jamescracchiolo | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| christophebeck | 0.051 | 0.594 | 0.011 | 0.375 | 1 |
| jimsnee | 0.077 | 0.961 | 0.031 | 0.500 | 1 |
| teresajrasmussen | 0.051 | 0.000 | 0.004 | 0.571 | 1 |
| michaeltspeetzen | 0.051 | 0.000 | 0.001 | 1.000 | 1 |
| geoffmartha | 0.026 | 0.000 | 0.000 | 1.000 | 1 |

Table 1, Table 2, and Table 3 show the different centrality measures—degree, eigenvector, betweenness, and closeness—for each of the CEO nodes, both in the Galaskiewicz data set and in our own networks that we constructed. In the Galaskiewicz network, the highest normalized degree centrality belongs to CEO #14, with a score of 0.175. That CEO also has the highest centrality measures for eigenvector, betweenness, and closeness centrality. Two CEOs are tied for the lowest degree centrality, CEO #10 and CEO #12, with a degree centrality measure of 0.050. CEO #12 has the lowest eigenvector centrality measure of 0.091, lower than CEO #10 which was also tied for the lowest degree centrality measure, but which instead has a slightly higher eigenvector centrality of 0.189. Multiple CEOs in the Galaskiewicz data set are tied for the lowest betweenness score of 0.004: CEO #3, #4, #10, and #12.

Examining Table 2 (setting aside Table 3 for brevity of the discussion), we are able to see which modern CEOs are most important in terms of their different centrality measures. Geoff Martha has the highest degree centrality of 0.139, the highest eigenvector centrality of 0.944, and the highest betweenness centrality with 0.201. Four CEOs—Andrew Witty, Bob Frenzel, Jim Snee, Michael T. Speetzen—have the highest normalized closeness centrality of one.

Additional centrality measures for the binarized and non-binarized versions of the Galaskiewicz CEO and club one-mode networks are included in the Appendix.

Comparing the edge densities across the networks, we see some clear differences. For the Galaskiewicz data, the two-mode CEO-by-club network density is 0.120, while the two-mode CEO-by-organization network density in our original data is only 0.025. The one-mode CEO-by-CEO network density in the Galaskiewicz data is 0.874, while the CEO-by-CEO network density in our original data is only 0.292. The one-mode club-by-club network density in the Galaskiewicz data is 0.629, while the CEO-by-CEO network density in our original data is only 0.105.

Table 4. Local Clustering Coefficients: Galaskiewicz CEOs (Binarized)

| Node | Coefficient |
|---|---|
| CEO1 | 0.863 |
| CEO2 | 0.897 |
| CEO3 | 0.987 |
| CEO4 | 0.987 |
| CEO5 | 0.987 |
| CEO6 | 1.000 |
| CEO7 | 0.863 |
| CEO8 | 0.970 |
| CEO9 | 0.936 |
| CEO10 | 0.987 |
| CEO11 | 0.987 |
| CEO12 | 0.970 |
| CEO13 | 0.863 |
| CEO14 | 0.863 |
| CEO15 | 0.987 |
| CEO16 | 0.948 |
| CEO17 | 0.987 |
| CEO18 | 0.861 |
| CEO19 | 0.863 |
| CEO20 | 0.863 |
| CEO21 | 0.863 |
| CEO22 | 0.941 |
| CEO23 | 0.987 |
| CEO24 | 0.863 |
| CEO25 | 0.987 |
| CEO26 | 0.987 |

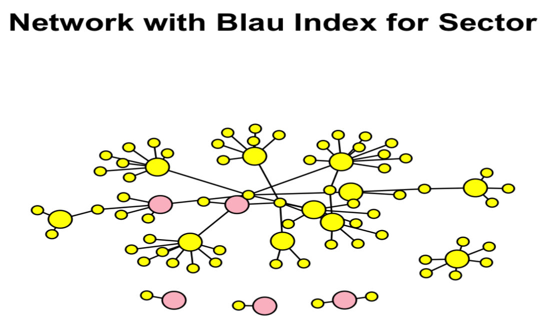
Examining the above tables, we see a range of local clustering coefficients for the CEOs in the Galaskiewicz network. In the Galaskiewicz data, the CEO with the highest clustering coefficient is CEO #6, with a coefficient of 1, meaning every node it is connected to, in unison, constitutes cliques. The CEOs with the lowest clustering coefficient in the Galaskiewicz data is CEO #18 with a clustering coefficient of 0.861.

Table 5. Maximal k-Cores: Galaskiewicz CEOs (Binarized)

| | Cores |
|---|---|
| CEO1 | 21 |
| CEO2 | 21 |
| CEO3 | 21 |
| CEO4 | 21 |
| CEO5 | 21 |
| CEO6 | 21 |
| CEO7 | 21 |
| CEO8 | 12 |
| CEO9 | 12 |
| CEO10 | 21 |
| CEO11 | 21 |
| CEO12 | 12 |
| CEO13 | 21 |
| CEO14 | 21 |
| CEO15 | 21 |
| CEO16 | 21 |
| CEO17 | 21 |
| CEO18 | 19 |
| CEO19 | 21 |
| CEO20 | 21 |
| CEO21 | 21 |
| CEO22 | 21 |
| CEO23 | 21 |
| CEO24 | 21 |
| CEO25 | 21 |
| CEO26 | 21 |

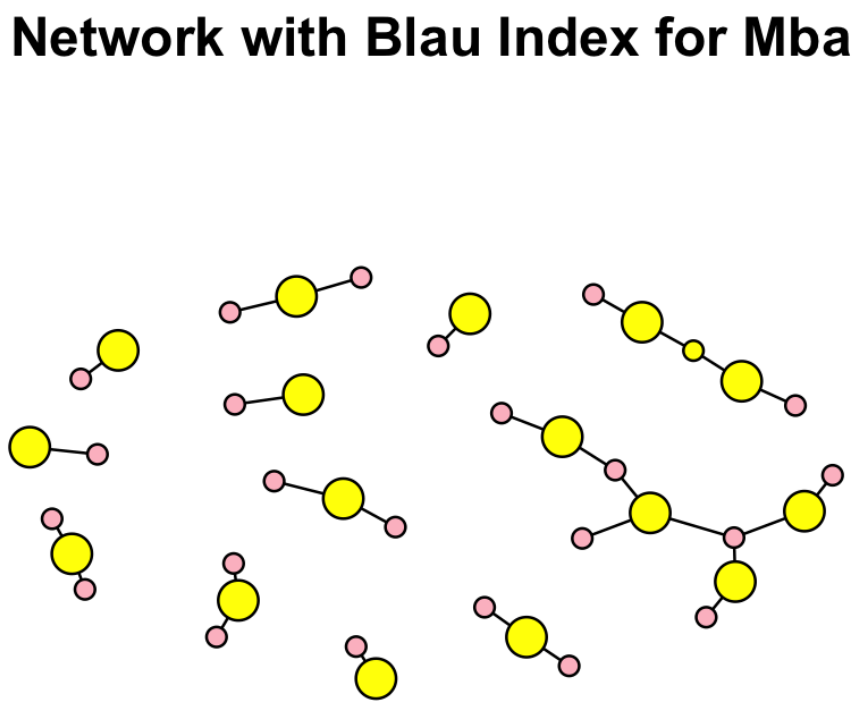
The above table shows that the maximal k-cores for the Galaskiewicz CEOs are mostly similar, and that most CEOs in the network are well-connected and have relatively large subgraphs. Three CEOs in particular, CEOs #8, #9 and #12, do not seem to be well-connected according to their maximal k-core of 12. Given that the modern CEO affiliation networks (non-profit organization boards and educational institutions) are sparsely connected, the low maximal k-cores are intuitive for each CEO node in each of these networks—they range from one to two (tables 2 and 3).

Figure 6. Modern CEO Affiliation Network with Blau Index for Nonprofit Sector Organizations




The above figure is a data visualization of a Blau Index that shows the homophily between CEOs and the organizations they are part of; in particular, the sector that the organization is part of. The larger nodes are the CEOs and the smaller nodes are the organizations; moreover, the nodes in yellow have a high Blau Index (greater than 0.5) while the nodes in pink have a low Blau Index. This figure demonstrates that this network has low homophily as most nodes are colored yellow, regardless of whether they are CEO or organizational nodes.

Figure 7. Modern CEO Affiliation Network with Blau Index for University MBA Programs




The above figure is a data visualization of a Blau Index that shows the homophily between CEOs and whether they have received an MBA at the University they've attended. Similar to Fig. 4, the larger nodes are the CEOs and the smaller nodes are the universities; moreover, the nodes in yellow have a high Blau Index (greater than 0.5) while the nodes in pink have a low Blau Index. When juxtaposed with universities, this network shows low homophily, and in general CEOs are diverse in their background.

## Discussion

The results are clear that the Galaskiewicz data set on CEOs and social clubs was more densely connected than our original data sets on CEOs, nonprofit organization boards, and educational institutions. This difference may be due in part to the nature of CEOs' relationships with these different institutions—social clubs, universities, and nonprofit organization boards. CEOs may derive more value from being in the same social club, where they can privately share information about best business practices. On the other hand, CEOs may derive value from not being on the same nonprofit boards, as there is prestige associated with being a leader of a nonprofit organization that other local business leaders are not a part of. The low density of the CEO network for universities relative to social clubs also makes sense—CEOs attend a variety of universities around the country for their undergraduate education and/or graduate school before coming to the Twin Cities metropolitan area, a regional center for Fortune 500 companies.

## Conclusion

This paper analyzes three different CEO affiliation networks, an older data set looking at CEO memberships in social clubs, and two original data sets on CEO affiliations with nonprofit organization boards and educational institutions. Our study employs various social network analysis measures to examine the relative importance of CEOs in each network as determined by their respective affiliations. We also visualize two-mode and one-mode versions of these networks to show these connections. The Galaskiewicz data on CEO affiliations with social clubs from a few decades ago generates a much denser network than the two modern networks we constructed. Part of this difference may be due to the nature of the affiliations themselves. In the modern day, CEOs are more geographically mobile educationally, as they attend institutions around the country before settling in the Twin Cities area to become Fortune 500 CEOs. Additionally, the digital nature of networks means that CEOs may more readily access nonprofit board memberships around the country, and even, the world.

**Sources**

Breiger, Ronald L. "The duality of persons and groups." Social forces 53, no. 2 (1974): 181-190.

Davis, Gerald F., Mina Yoo, and Wayne E. Baker. "The small world of the American corporate elite, 1982-2001." Strategic organization 1, no. 3 (2003): 301-326.

Galaskiewicz, Joseph. *Social Organization of an Urban Grants Economy: A Study of Business Philanthropy and Nonprofit Organizations*. 1985. Harcourt Brace Jovanovich Publishers.

Galaskiewicz, Joseph. “An Urban Grants Economy Revisited: Corporate Charitable Contributions in the Twin Cities, 1979-81, 1987-89.” Administrative Science Quarterly 42, no. 3 (1997): 445–71.

Galaskiewicz, Joseph, Stanley Wasserman, Barbara Rauschenbach, Wolfgang Bielefeld, and Patti Mullaney. "The influence of corporate power, social status, and market position on corporate interlocks in a regional network." Social Forces 64, no. 2 (1985): 403-431.

Heemskerk, Eelke M. "The social field of the European corporate elite: a network analysis of interlocking directorates among Europe's largest corporate boards." Global networks 11, no. 4 (2011): 440-460.

Wasserman, Stanley, and Katherine Faust. "Social network analysis: Methods and applications." (1994).

## Appendix

Table 6. Two-Mode Centrality Measures: Galaskiewicz Clubs

| | Degree | Eigenvector | Betweenness | Closeness |
|---|---|---|---|---|
| Club 1 | 0.075 | 0.119 | 0.007 | 0.357 |
| Club 2 | 0.275 | 0.580 | 0.067 | 0.444 |
| Club 3 | 0.550 | 1.000 | 0.480 | 0.645 |
| Club 4 | 0.300 | 0.495 | 0.179 | 0.476 |
| Club 5 | 0.075 | 0.135 | 0.005 | 0.357 |
| Club 6 | 0.100 | 0.214 | 0.007 | 0.364 |
| Club 7 | 0.100 | 0.104 | 0.016 | 0.351 |
| Club 8 | 0.100 | 0.143 | 0.017 | 0.364 |
| Club 9 | 0.150 | 0.240 | 0.022 | 0.385 |
| Club 10 | 0.075 | 0.077 | 0.007 | 0.345 |
| Club 11 | 0.100 | 0.248 | 0.007 | 0.364 |
| Club 12 | 0.125 | 0.252 | 0.014 | 0.370 |
| Club 13 | 0.125 | 0.251 | 0.016 | 0.377 |
| Club 14 | 0.075 | 0.119 | 0.003 | 0.328 |
| Club 15 | 0.225 | 0.498 | 0.048 | 0.426 |

Table 7. One-Mode Centrality Measures: Galaskiewicz CEOs (Non-Binarized)

| | Degree | Eigenvector | Betweenness | Closeness |
|---|---|---|---|---|
| CEO1 | 1.48 | 0.579 | 0.009 | 1.000 |
| CEO2 | 1.04 | 0.414 | 0.006 | 0.926 |
| CEO3 | 1.00 | 0.427 | 0.000 | 0.893 |
| CEO4 | 1.56 | 0.689 | 0.000 | 0.893 |
| CEO5 | 1.08 | 0.457 | 0.000 | 0.893 |
| CEO6 | 1.32 | 0.567 | 0.000 | 0.862 |
| CEO7 | 1.48 | 0.589 | 0.013 | 1.000 |
| CEO8 | 0.64 | 0.225 | 0.000 | 0.658 |
| CEO9 | 0.72 | 0.270 | 0.001 | 0.676 |
| CEO10 | 1.04 | 0.426 | 0.000 | 0.893 |
| CEO11 | 1.44 | 0.608 | 0.000 | 0.893 |
| CEO12 | 0.56 | 0.203 | 0.000 | 0.658 |
| CEO13 | 1.56 | 0.609 | 0.010 | 1.000 |
| CEO14 | 2.44 | 1.000 | 0.020 | 1.000 |
| CEO15 | 1.84 | 0.803 | 0.001 | 0.893 |
| CEO16 | 1.56 | 0.654 | 0.004 | 0.893 |
| CEO17 | 1.92 | 0.835 | 0.001 | 0.893 |
| CEO18 | 1.28 | 0.545 | 0.007 | 0.893 |
| CEO19 | 1.68 | 0.624 | 0.018 | 1.000 |
| CEO20 | 2.12 | 0.890 | 0.016 | 1.000 |
| CEO21 | 1.40 | 0.546 | 0.011 | 1.000 |
| CEO22 | 1.28 | 0.546 | 0.003 | 0.926 |
| CEO23 | 1.68 | 0.742 | 0.000 | 0.893 |
| CEO24 | 1.80 | 0.735 | 0.014 | 1.000 |
| CEO25 | 1.40 | 0.608 | 0.000 | 0.893 |
| CEO26 | 1.40 | 0.608 | 0.000 | 0.893 |

Table 8. One-Mode Centrality Measures: Galaskiewicz Clubs (Non-Binarized)

| | Degree | Eigenvector | Betweenness | Closeness |
|---|---|---|---|---|
| Club 1 | 0.786 | 0.197 | 0.005 | 0.700 |
| Club 2 | 2.571 | 0.751 | 0.030 | 0.824 |
| Club 3 | 4.429 | 1.000 | 0.234 | 1.000 |
| Club 4 | 2.714 | 0.641 | 0.098 | 0.933 |
| Club 5 | 0.714 | 0.216 | 0.002 | 0.700 |
| Club 6 | 1.071 | 0.338 | 0.004 | 0.700 |
| Club 7 | 0.643 | 0.163 | 0.003 | 0.636 |
| Club 8 | 0.786 | 0.223 | 0.008 | 0.700 |
| Club 9 | 1.143 | 0.351 | 0.005 | 0.737 |
| Club 10 | 0.571 | 0.132 | 0.002 | 0.636 |
| Club 11 | 1.286 | 0.399 | 0.008 | 0.700 |
| Club 12 | 1.286 | 0.399 | 0.001 | 0.700 |
| Club 13 | 1.286 | 0.396 | 0.005 | 0.737 |
| Club 14 | 0.571 | 0.185 | 0.000 | 0.609 |
| Club 15 | 2.429 | 0.698 | 0.023 | 0.824 |

Table 9. One-Mode Centrality Measures: Galaskiewicz CEOs (Binarized)

| | Degree | Eigenvector | Betweenness | Closeness |
|---|---|---|---|---|
| CEO1 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO2 | 0.92 | 0.940 | 0.009 | 0.926 |
| CEO3 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO4 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO5 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO6 | 0.84 | 0.899 | 0.000 | 0.862 |
| CEO7 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO8 | 0.48 | 0.482 | 0.000 | 0.658 |
| CEO9 | 0.52 | 0.522 | 0.001 | 0.676 |
| CEO10 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO11 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO12 | 0.48 | 0.482 | 0.000 | 0.658 |
| CEO13 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO14 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO15 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO16 | 0.88 | 0.921 | 0.004 | 0.893 |
| CEO17 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO18 | 0.88 | 0.882 | 0.010 | 0.893 |
| CEO19 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO20 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO21 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO22 | 0.92 | 0.959 | 0.004 | 0.926 |
| CEO23 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO24 | 1.00 | 1.000 | 0.013 | 1.000 |
| CEO25 | 0.88 | 0.937 | 0.001 | 0.893 |
| CEO26 | 0.88 | 0.937 | 0.001 | 0.893 |

Table 10. One-Mode Centrality Measures: Galaskiewicz Clubs (Binarized)

| | Degree | Eigenvector | Betweenness | Closeness |
|---|---|---|---|---|
| Club 1 | 0.571 | 0.614 | 0.020 | 0.700 |
| Club 2 | 0.786 | 0.851 | 0.045 | 0.824 |
| Club 3 | 1.000 | 1.000 | 0.118 | 1.000 |
| Club 4 | 0.929 | 0.961 | 0.077 | 0.933 |
| Club 5 | 0.571 | 0.665 | 0.012 | 0.700 |
| Club 6 | 0.571 | 0.645 | 0.014 | 0.700 |
| Club 7 | 0.429 | 0.472 | 0.008 | 0.636 |
| Club 8 | 0.571 | 0.620 | 0.023 | 0.700 |
| Club 9 | 0.643 | 0.730 | 0.022 | 0.737 |
| Club 10 | 0.429 | 0.462 | 0.010 | 0.636 |
| Club 11 | 0.571 | 0.664 | 0.017 | 0.700 |
| Club 12 | 0.571 | 0.690 | 0.003 | 0.700 |
| Club 13 | 0.643 | 0.727 | 0.023 | 0.737 |
| Club 14 | 0.357 | 0.410 | 0.002 | 0.609 |
| Club 15 | 0.786 | 0.871 | 0.036 | 0.824 |

Table 11. Local Clustering Coefficients: Galaskiewicz Clubs (Binarized)

| Node | Coefficient |
|---|---|
| Club 1 | 0.714 |
| Club 2 | 0.691 |
| Club 3 | 0.571 |
| Club 4 | 0.615 |
| Club 5 | 0.821 |
| Club 6 | 0.786 |
| Club 7 | 0.800 |
| Club 8 | 0.714 |
| Club 9 | 0.750 |
| Club 10 | 0.733 |
| Club 11 | 0.786 |
| Club 12 | 0.929 |
| Club 13 | 0.750 |
| Club 14 | 0.900 |
| Club 15 | 0.709 |

Table 12. Maximal k-Cores: Galaskiewicz Clubs (Binarized)

| | Cores |
|---|---|
| Club 1 | 6 |
| Club 2 | 7 |
| Club 3 | 7 |
| Club 4 | 7 |
| Club 5 | 7 |
| Club 6 | 6 |
| Club 7 | 6 |
| Club 8 | 6 |
| Club 9 | 7 |
| Club 10 | 6 |
| Club 11 | 7 |
| Club 12 | 7 |
| Club 13 | 7 |
| Club 14 | 5 |
| Club 15 | 7 |

Table 13. Two-Mode Centrality Measures for Universities in the CEO Network

| | Degree | Eigenvector | Betweenness | Closeness | Coreness |
|---|---|---|---|---|---|
| universityofnottingham | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| ucla | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| universityofnorthdakotagrandforks | 0.051 | 0.000 | 0.005 | 0.667 | 1 |
| uwmadison | 0.026 | 0.000 | 0.000 | 0.400 | 1 |
| collegeofstbenedict | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| villanovauniversity | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| universityofpennsylvania | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| universityofstthomas | 0.051 | 0.618 | 0.019 | 0.409 | 1 |
| universityofminnesota | 0.026 | 0.171 | 0.000 | 0.250 | 1 |
| bradleyuniversity | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| milwaukeeschoolofengineering | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| iowastateuniversity | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| columbiauniversity | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| depauwuniversity | 0.026 | 0.276 | 0.000 | 0.281 | 1 |
| harvarduniversity | 0.077 | 1.000 | 0.032 | 0.500 | 1 |
| georgiatech | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| universityofchicago | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| newyorkuniversity | 0.026 | 0.000 | 0.000 | 1.000 | 1 |
| swissfederalinstituteoftechnologylausanne | 0.026 | 0.276 | 0.000 | 0.281 | 1 |
| newmexicostateuniversity | 0.026 | 0.447 | 0.000 | 0.346 | 1 |
| minnesotastateuniversitymoorhead | 0.026 | 0.000 | 0.000 | 0.400 | 1 |
| arizonastateuniversity | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| purdueuniversity | 0.026 | 0.000 | 0.000 | 0.667 | 1 |
| pennstateuniversity | 0.026 | 0.000 | 0.000 | 1.000 | 1 |

Table 14. One-Mode Centrality Measures for Modern CEOs in the Organization Network

| | Degree | Eigenvector | Betweenness | Closeness | Coreness |
|---|---|---|---|---|---|
| andrewwitty | 0.000 | 0.000 | 0.000 | NaN | 0 |
| briancornell | 0.533 | 0.380 | 0.000 | 0.550 | 8 |
| jayddebertin | 0.133 | 0.090 | 0.000 | 0.440 | 2 |
| coriebarry | 1.333 | 0.916 | 0.075 | 0.846 | 12 |
| williammbrown | 0.800 | 0.647 | 0.000 | 0.688 | 12 |
| andrewcecere | 1.467 | 1.000 | 0.092 | 0.846 | 12 |
| davebozeman | 0.800 | 0.647 | 0.000 | 0.688 | 12 |
| bethford | 0.933 | 0.658 | 0.095 | 0.733 | 12 |
| jeffharmening | 0.667 | 0.465 | 0.006 | 0.579 | 8 |
| bobfrenzel | 0.000 | 0.000 | 0.000 | NaN | 0 |
| jamescracchiolo | 1.067 | 0.781 | 0.095 | 0.733 | 12 |
| christophebeck | 0.533 | 0.380 | 0.000 | 0.550 | 8 |
| jimsnee | 0.000 | 0.000 | 0.000 | NaN | 0 |
| teresajrasmussen | 0.133 | 0.107 | 0.000 | 0.440 | 2 |
| michaeltspeetzen | 0.000 | 0.000 | 0.000 | NaN | 0 |
| geoffmartha | 0.933 | 0.703 | 0.017 | 0.733 | 12 |

Figure 8. Modern CEO-Organization Affiliation Network with Blau Index for Age

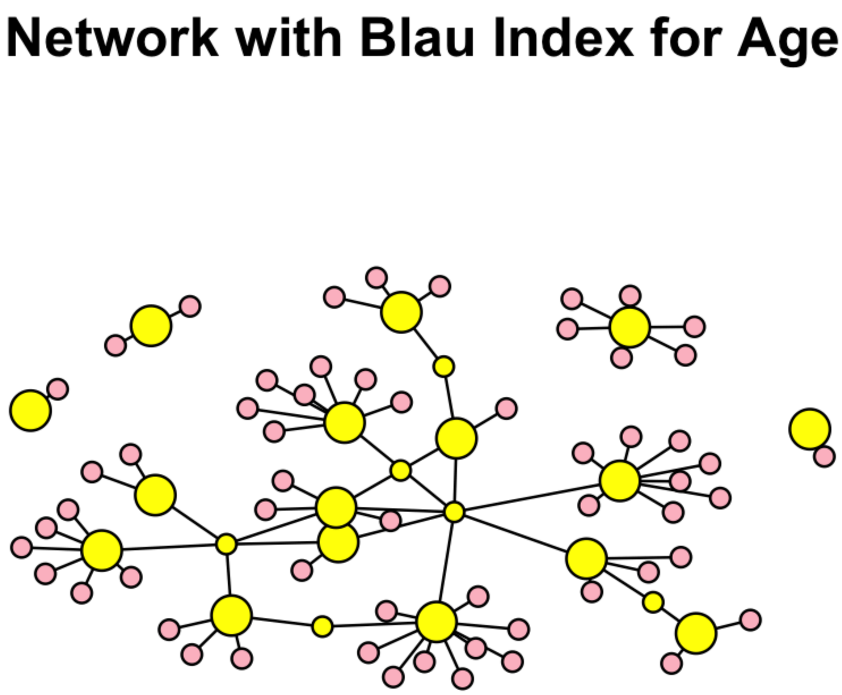


Figure 9. Modern CEO-Organization Affiliation Network with Blau Index for Gender

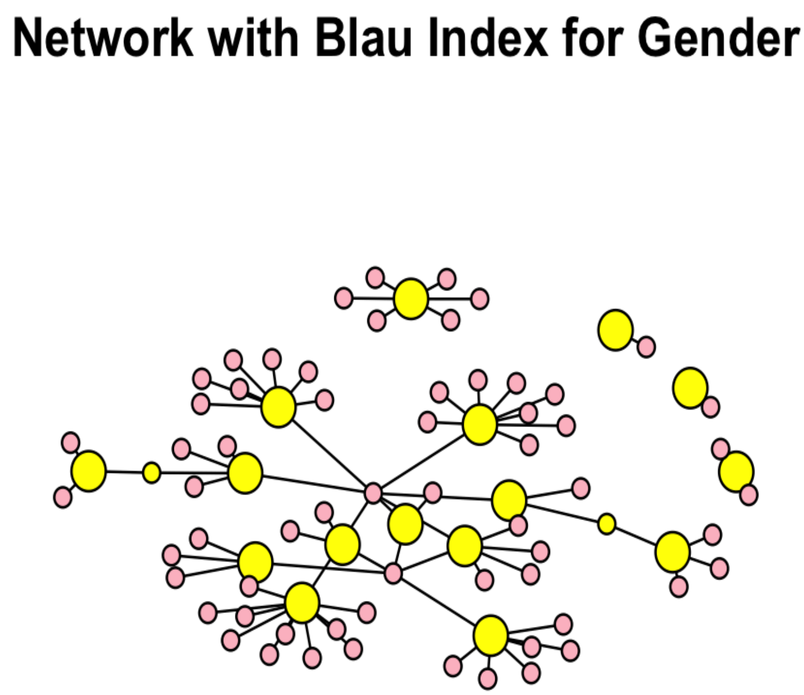


Figure 10. Modern CEO-Organization Affiliation Network with Blau Index for Company Sector

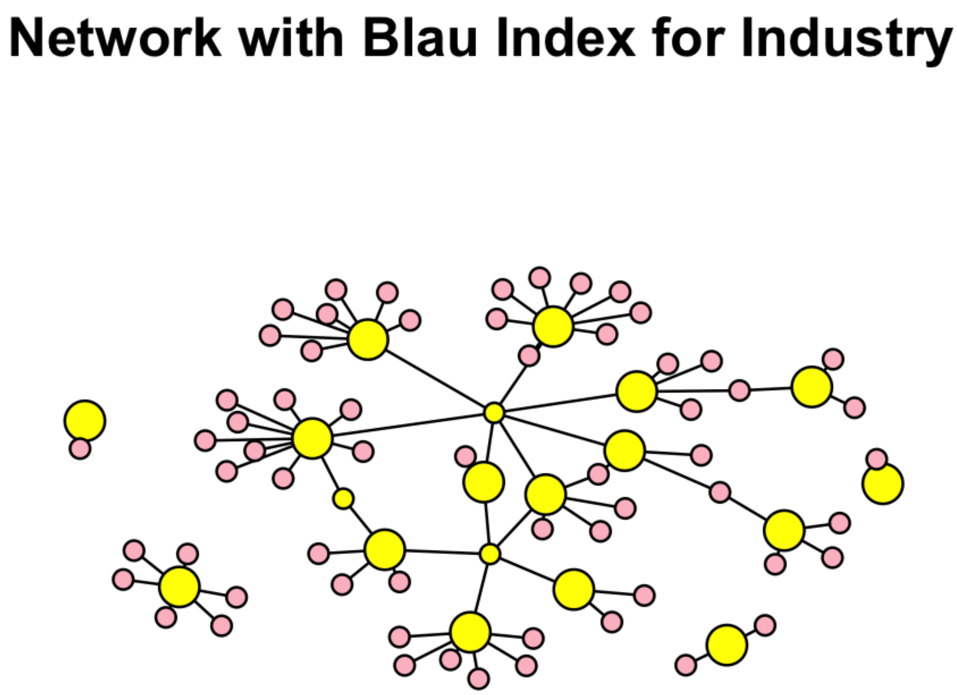


Figure 11. Modern CEO-Organization Affiliation Network with Blau Index for Organization Geographic Scale

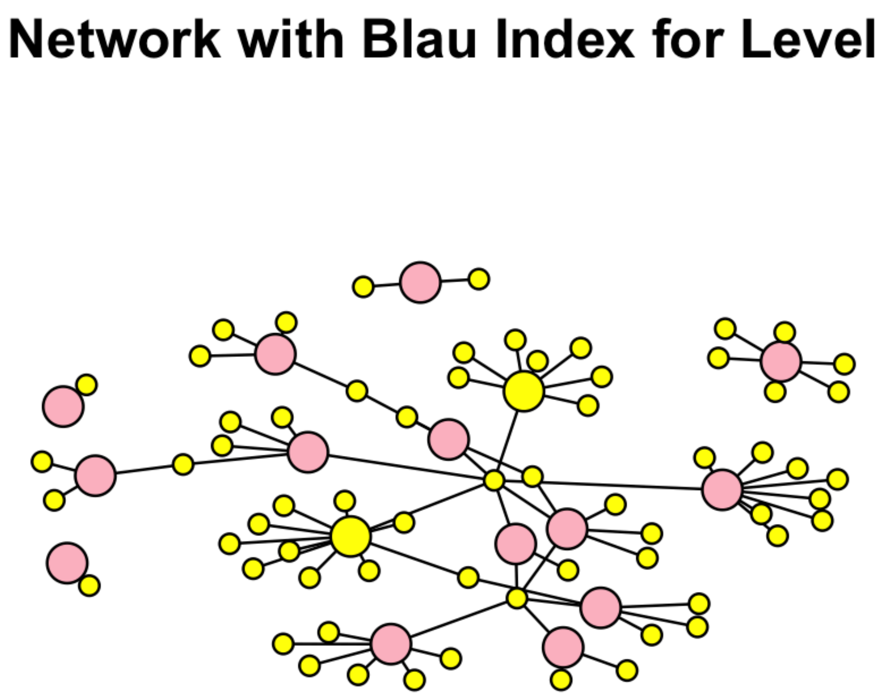


Figure 12. Modern CEO-Organization Affiliation Network with Blau Index for Organization Market Capitalization

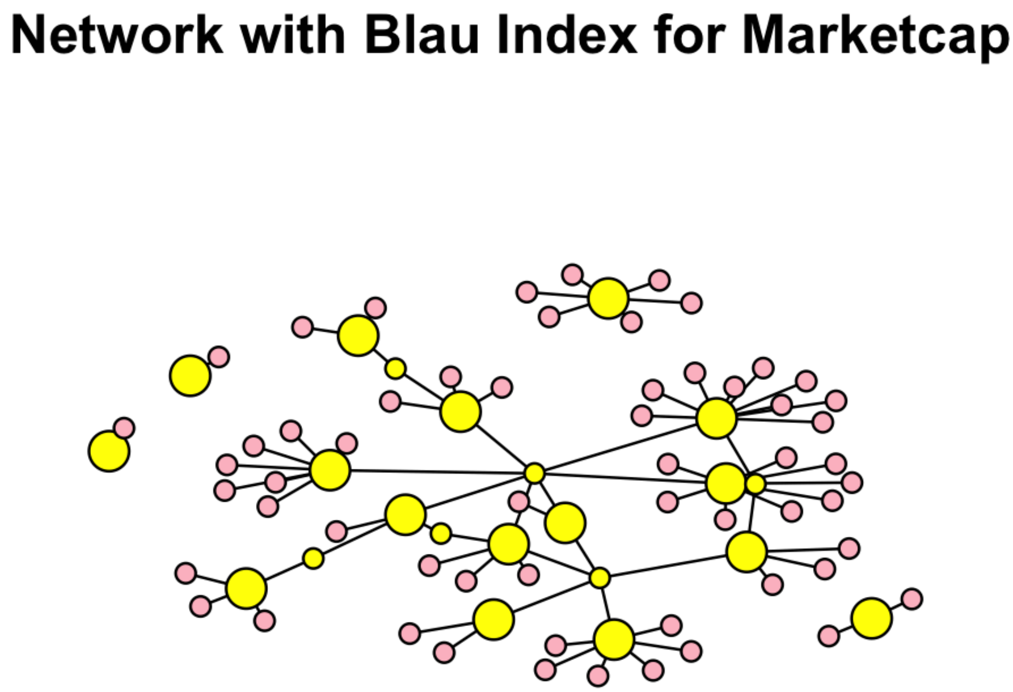


Figure 13. Modern CEO-University Affiliation Network with Blau Index for Age

**Network with Blau Index for Age**

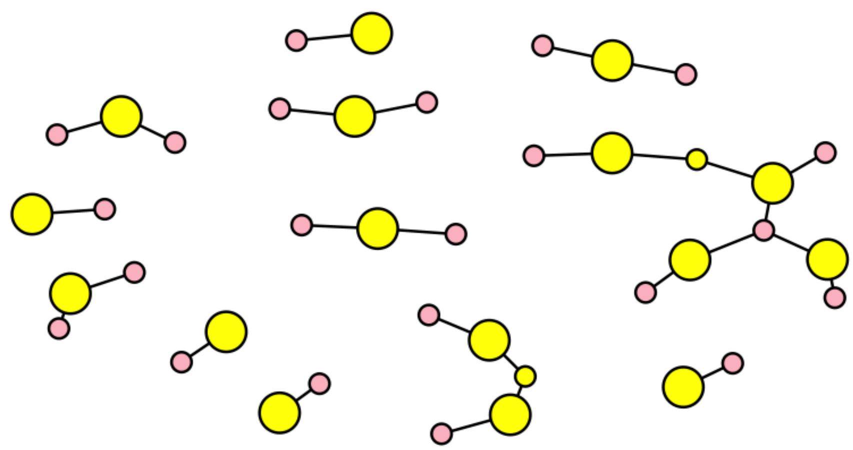


Figure 14. Modern CEO-University Affiliation Network with Blau Index for Company

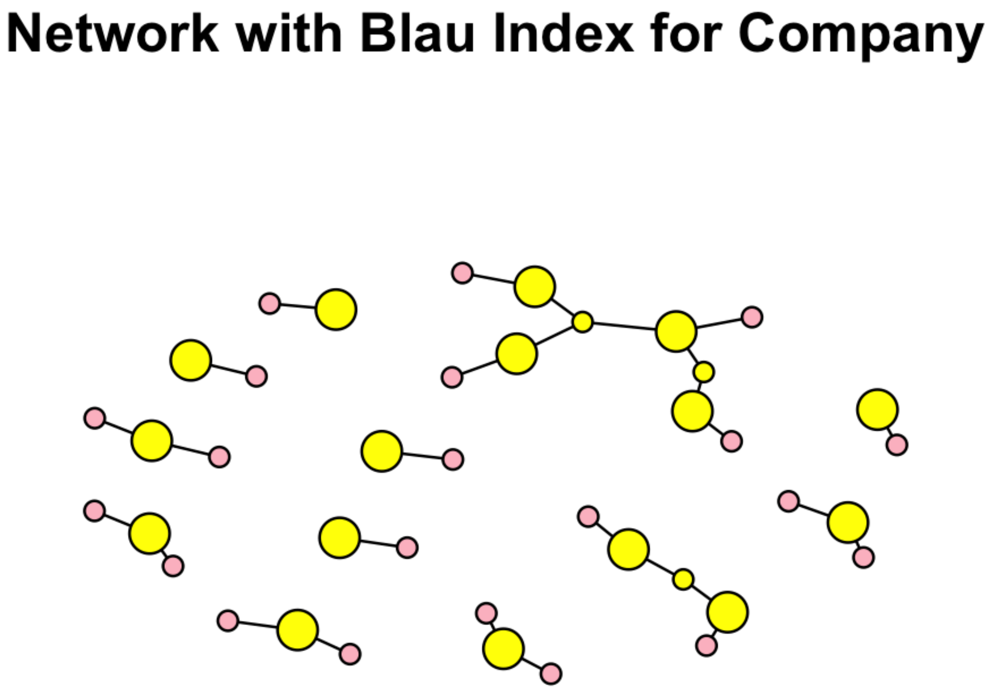


Figure 15. Modern CEO-University Affiliation Network with Blau Index for Gender

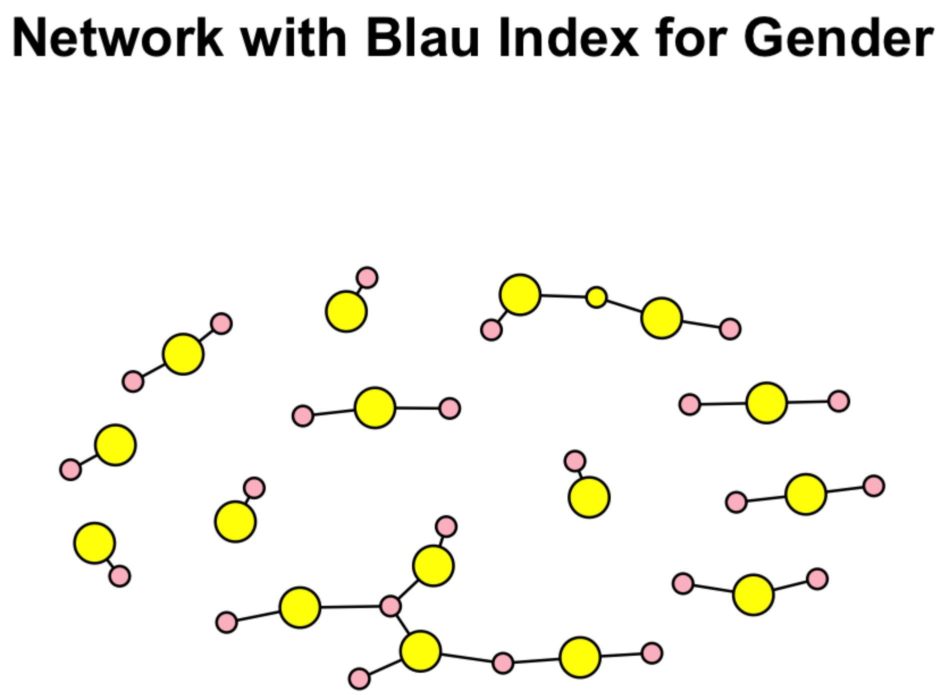


Figure 16. Modern CEO-University Affiliation Network with Blau Index for Industry

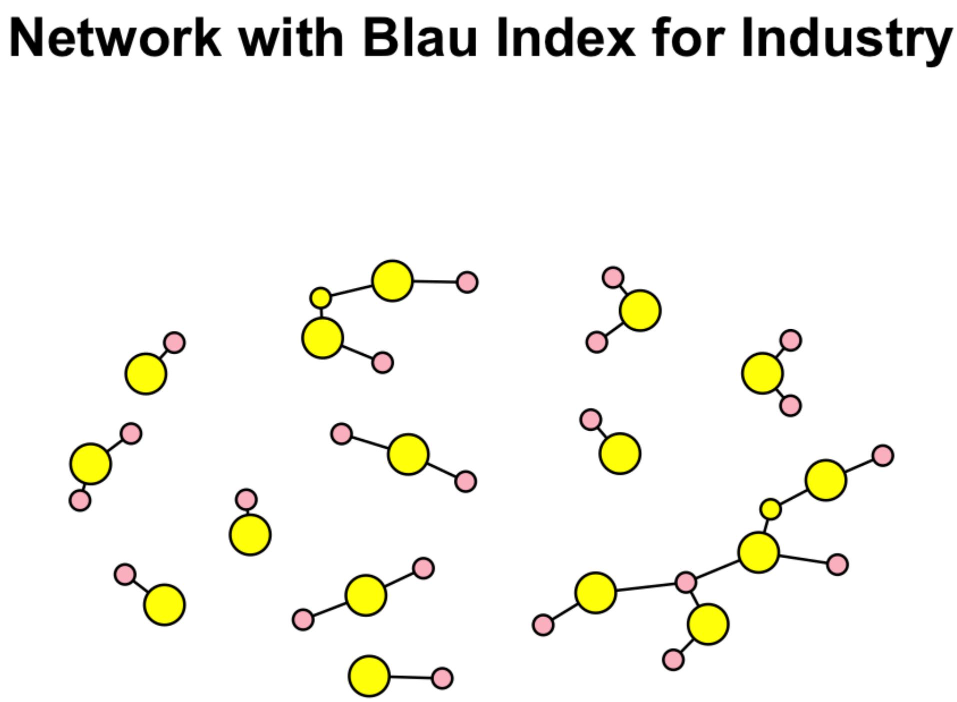


Figure 17. Modern CEO-University Affiliation Network with Blau Index for Market Capitalization

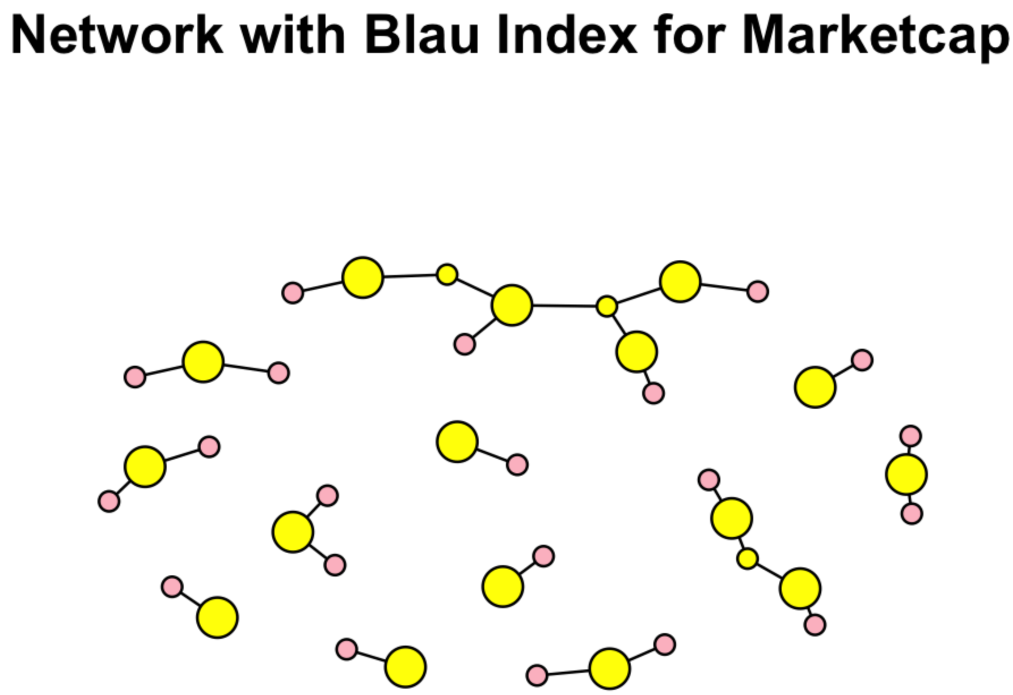


Figure 18. Modern CEO-University Affiliation Network with Blau Index for University Region

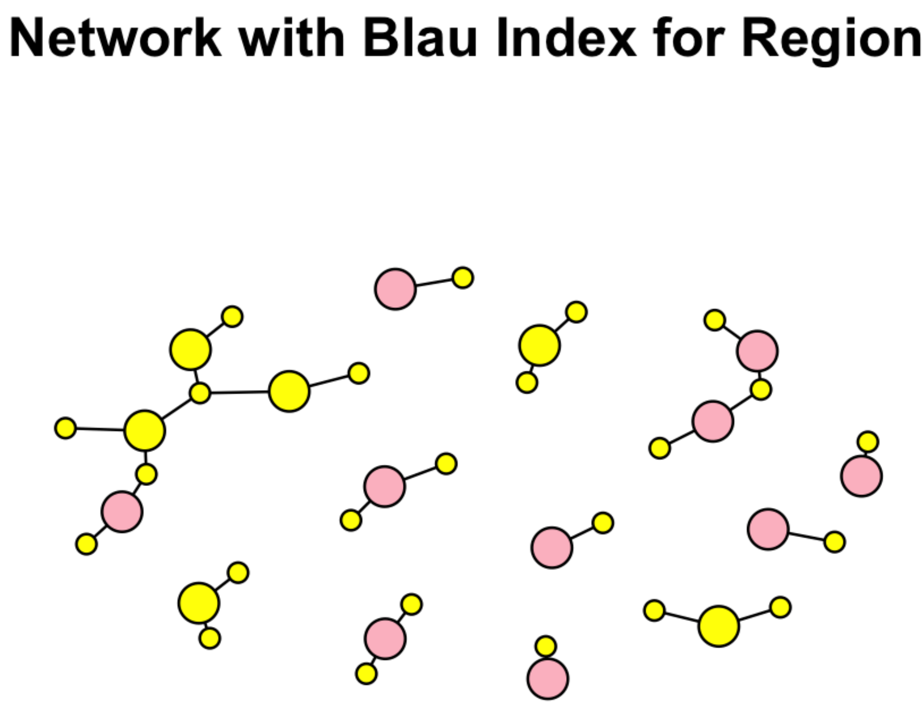


Figure 19. Modern CEO-University Affiliation Network with Blau Index for University Ranking (Top 20 or Not)