

# Practical Social Network Analysis Method for Understanding the Sense of Community in SMEs

Author: Job Mulder  
University of Twente  
P.O. Box 217, 7500AE Enschede  
The Netherlands

## Abstract

This research explores the use of social network analysis to help small and medium-sized enterprises (SMEs) understand the sense of community within their organization. The study presents a network analysis method that SMEs can use to analyze their social network and gain insights into the relationships and connections between individuals and groups within the organization. A case study of a real organization is used to test the method, and the results demonstrate that it provides valuable insights for organizations and is appropriate for use by SMEs. The research findings suggest that the method can help SMEs improve their decision-making, communication, and employee satisfaction by implementing more effective strategies for building and maintaining a sense of community within the organization. Overall, this study highlights the importance of social network analysis for SMEs and provides a practical method for conducting such analysis.

## Graduation Committee members:

**Dr. R. Effing**

**Dr. S.A de Vries**

## Keywords

Sense of community, Social network analysis, small and medium-sized enterprises

## Table of content

1. Introduction.....	3
2. Theoretical background.....	4
2.1 Social Network Theories.....	4
2.2 Network roles .....	7
2.3 Social Network Analysis.....	8
2.4 Value of social network analysis for SMEs .....	10
2.5 Sense of community .....	10
2.6 Research design.....	12
3. Method.....	14
3.1 The Mulder method .....	14
Step 1: Why use SNA? .....	14
Step 2: Data collection.....	15
Step 3: Data analysis.....	16
Step 4: Data interpretation .....	17
4. Case study.....	18
Step 1: Why use SNA? .....	18
Step 2: Data collection .....	18
Step 3: Data Analysis .....	19
Centrality scores.....	19
Sense of community test.....	20
Network visualizations .....	23
Step 4: Data interpretation .....	27
5. Conclusion and future directions .....	29
Appendix A: SCI-2 test questions .....	32
References.....	38

## 1. Introduction

Today, we live with a tight labor market, in which every organization is searching for new employees (Kiss et al., 2022). Organizations have to deal with a larger amount of work for each employee, affecting the work environment. An organization can be seen as a community, as they often involve individuals with common goals, shared norms and values, that help each other (Nowell & Boyd, 2010). As an organization, you want a healthy work environment for your employees to increase job satisfaction, and enhance performance.

Community psychologists have been aware of the significance of the workplace as a community setting for quite some time (Pretty & McCarthy, 1991; Speer et al., 2013). In recent years, organizational experts have also been giving more consideration to building communities within organizational environments (Boyd & Nowell, 2017). One of the most notable contributions to this topic can be found in Mintzberg's (2009) research, which offers a framework for managers to examine forming communities in the workplace. As Mintzberg pointed out, successful organizations often have a strong sense of community.

A strong sense of community benefits organizations (Nowell & Boyd, 2010). This sense of community creates a feeling of belonging and connection among employees, allowing them to form relationships and interact with their coworkers (Nowell & Boyd, 2010). Furthermore, it can make employees feel like they have a voice in decisions impacting their work and that their needs and interests are being considered (Nowell & Boyd, 2010). A strong sense of community can help create a positive work environment and contribute to employee satisfaction.

But organizations, especially small and medium-sized enterprises (SMEs), often do not have the skills nor the capabilities to analyze this sense of community within their organization. There are different ways to analyze sense of community, the more traditional methods are surveys, focus groups or interviews. A method that is less traditional but gives a better understanding of the social structures and relationships within organizations is social network analysis (SNA). Research has shown that SNA can produce valuable insights for organizations (Tichy et al., 1979; Sözen et al., 2009; Nunes & Abreu, 2021). SNA is a quantitative analysis tool that uses various methodologies and tools for studying interactions, communications, and relationships. As a result, SNA is appropriate for the research and monitoring of online and offline interactions since it can automatically analyze interaction data, providing an aerial perspective of the group's social structure, interaction patterns, and mapping of all communications in the relational space (de Laat et al., 2017; Borgatti et al., 2009; Saqr & Alamro, 2019). SNA can analyze if the actual leaders are also the leaders within the social network, who have the most influence in the organization, or if the organization depends on certain people they did not expect. Information that you would like to know as an organization, especially top management. SNA allows researchers to identify key individuals or groups within an organization who may have disproportionate influence or power (Borgatti et al., 2013). Unfortunately for organizations, most of them are unaware of this existing technology and the according social theories. Theories that can be valuable in identifying influential people or organizations within their network. Granovetter's (1973) and Burt's (1992) theories are the most popular in the field area, explaining the importance of ties and positions in networks.

This research wants to focus on these possibilities of SNA and present a methodology for organizations on how to conduct SNA. By conducting SNA in organizations, they can identify key actors, understand communication patterns and information flow, and evaluate the effectiveness of organizational structures and processes. The methodology developed in this research could be used by organizations to gain insights into their networks and sense of community and use that to create strategies to improve their operations, communication, and decision-making. Furthermore, it will describe how to measure the sense of community within an organization and how SNA can be used to make assumptions and predictions. For instance, do people in certain network positions have a higher

or lower sense of community than others? Its goal is to educate organizations about the theories involved in the analysis and provide a case study that shows how SNA is implemented in a real organization.

The research gap in this study is the lack of a consistent and repeatable methodology for SMEs to conduct SNA and measure the sense of community within their organizations. Previous research has focused on the knowledge-sharing process (Leon et al., 2017) or used a custom-adapted sense of community index (Dawson, 2008) to analyze social networks, but there is a need for a comprehensive method that SMEs can be understood and implemented in practice. This research aims to address this gap by providing a method for conducting SNA, measuring the sense of community, and demonstrating the practical usefulness of this method for organizations.

This research aims to describe a social network analysis method, measure the sense of community and present the practical usefulness of the method for organizations. This research tries to answer the following **research question**: What is an appropriate network analysis method for understanding the sense of community in SMEs?

In this context, "appropriate" means a network analysis method that is repeatable, provides valuable insights for SMEs, and can be easily understood and implemented in practice. Given the limited resources and expertise frequently available within SMEs, the method must be both repeatable and simple for SMEs to understand and implement in practice.

The research will have the following outline. First, the operationalization of the concepts will be provided in the theoretical background. This part explains the concepts and theories with the help of existing literature. After this part will come the method part where the design of the research will be explained and the method of this research will be provided. Then, the results of the research are provided and lastly, the discussion of the results and conclusion are presented.

## 2. Theoretical background

In this chapter, we will provide the foundation for the method outlined in chapter 3 by explaining the multiple concepts addressed in the research question through a review of relevant literature. The chapter begins by further exploring the social theories briefly mentioned in the previous chapter, followed by an explanation of social network roles within organizations. Additionally, we will elaborate on the sense of community introduced in the introduction and its application to organizations. The value of SNA for SMEs will be further explained, focusing on the effects of SNA on operations, communications and decision-making. Finally, the chapter concludes with guidelines for the method to be explained in chapter 3.

### 2.1 Social Network Theories

There are various kinds of networks, from distribution to social networks. The network this research is interested in is social networks (figure 1). A social network is defined as 'structures whose nodes represent entities embedded in the social context, and whose edges represent interaction, collaboration, or influence between entities' (Liben-Nowell & Kleinberg, 2007).

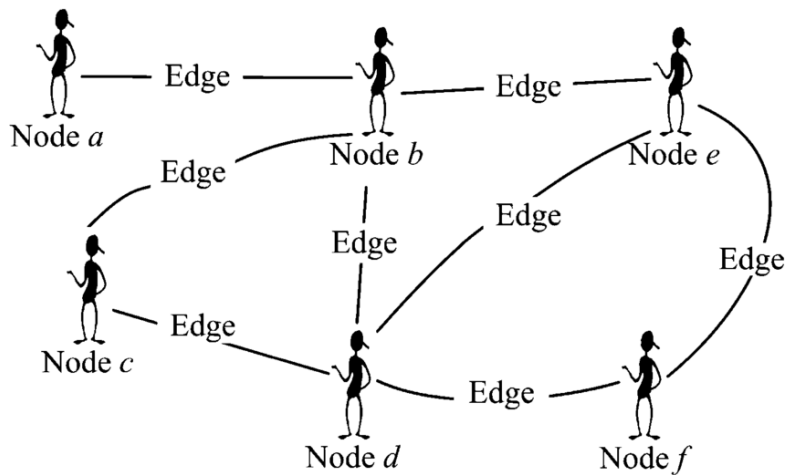


Figure 1: A Social Network (Reprinted from *Social networks on the Internet*, by Musial et al, (2012), *World Wide Web*, 16, 31-72.).

A node is the basic building block of any network, social or otherwise. Nodes may be found on several social media platforms. Examples of nodes include a user on Instagram, Facebook, Twitter, LinkedIn, TikTok, or YouTube. On social media, an edge is a symbolic connection between two nodes. Examples of edges include a follow relationship between two Instagram or Twitter users, a subscription on a YouTube channel, or friends on LinkedIn. In an organization, a node is an employee and the edge is the relationship between the two employees. The network, also called a sociogram, is a collection of interconnected groups of nodes. These social connections form social media networks when the area of interaction is a social media platform (Himmelboim, 2017), and form social networks when it is in an organization for instance.

In literature, there are two popular theories about social networks. The first is the weak ties theory (Granovetter, 1973) (Figure 2). In his seminal paper “The strength of Weak Ties,” Granovetter found out that people found new jobs more often via weak ties instead of strong ties. Weak ties are social relationships that require little commitment and are formed mostly by acquaintances or other loosely linked individuals, as opposed to relatives or close friends (strong ties) (Liu et al., 2017). He used an empirical study to test this. According to the study, a “forbidden triad” states that if A and B are connected, and A and C are connected, then B and C will also be related. This is especially true if the ties between two individuals are strong. Furthermore, he argues that certain ties can act as a bridge that connects social groups that otherwise would be disconnected but also argues that a strong tie cannot be a bridge. Bridging ties are social links that connect two network clusters that would otherwise be disconnected. Strong ties cannot be bridging ties because if someone is in a way linked to someone else, people around them will likewise be linked to them, making ties obsolete. Therefore, to have diffusion across networks, then weak ties are the most valuable. As a result, the number of connections has an insignificant effect on the strength of weak ties. Weak ties can access a larger, and more diverse, range of information sources. The empirical evidence Granovetter used came from a survey of job seekers. He asked who had found their job through contacts and how often they saw the person that had helped them. The results were that most of the people got their job from a weak tie (acquaintance), which proved the strength of weak ties in his study. Social media make it easier to maintain and extend social networks and can thereby change the structure and the content of an actor’s social network. Studies have shown that the use of social network sites (SNS) mainly increases contact with weaker ties (Ellison et al., 2007; Steinfield et al., 2008).

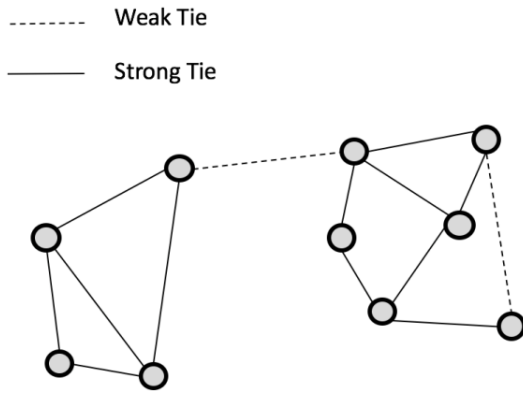


Figure 2: Weak and Strong Ties in a Social Network (Reprinted from *Economic Sociology: the Contributions of Mark Granovetter* | *Exploring Economics*. (n.d.). Retrieved October 6, 2022, from <https://www.exploring-economics.org/en/discover/economic-Sociology-the-mark-granovetter/>).

Granovetter his weak ties theory and hypothesis have been tested and supported by many studies (Weng et al., 2018).

Weak ties theory also plays a role in social media networks. In research from Zhao et al. (2010), weak ties play a subtle role in the diffusion of information on SNSs. They argued that weak ties play a role in bridging isolated communities and enhancing information diffusion across communities. Min and Wohn (2020) researched whether filter bubbles on Facebook get exposed to cross-cutting information. Their research showed that this was the case, and that cross-cutting information was more likely to come from weak ties instead of strong ties. Their research also concluded that people with more diversified ethnic and religious networks were more likely to be exposed to cross-cutting information. Other research by Donath and Boyd (2004) assumes that SNSs make it easier for individuals to shape and maintain weak ties since the technology is well-suited to keeping such relationships cheaply and simply maintained (Ellison et al., 2007). The tie strength is also responsible for what emotions travel more easily through a network. Fan et al. analysis found that tweets with anger traveled easier along weak ties than those with joy.

Studies by Carpenter et al. (1998) and Hansen (1999) have shown that organizations with more investments in weak ties or acquaintances improve their access to the government and help a project team search for useful knowledge in other subunits, but hinder the transfer of complex knowledge. Chell and Baines (2000) also found that owner-managers often use their trading contacts as sources of additional information and for purposes such as recruitment, and make little use of institutional networks. Additionally, a study by Xinmin Peng et al. (2008) argues that strong ties positively impact incremental innovation while weak ties positively impact radical innovation. The effectiveness of weak ties in fostering radical innovation is higher when the firm adopts a prospector orientation, while strong ties are more beneficial for incremental innovation for firms with a defender orientation.

The second popular social network theory is Burt's (1992) structural holes theory (Figure 3). A structural hole can be defined as a gap (missing relationship) between individuals in a person's network (Burt, 2004; Gamper, 2022; Labun & Wittek, 2014). Individuals on either side of the gap have different information flows and access. For example, information or other resources cannot be transferred through these holes. Due to their structural location within a network, actors who bridge such holes by connecting subgraphs can have advantages. As an example, an actor can generate non-redundant information from different subgraphs or merge knowledge from different social groups based on insight views into different subgraphs. Their role as brokers allows them to control the flow of information between subgraphs (Gamper, 2022). Therefore, there is "an opportunity to broker the flow of information between people, and control the projects that bring together people from opposite sides of the hole" (Burt, 2000). Structural holes theory is similar to Granovetter's (1973) theory about

weak ties, but Burt (1992) argues that the weakness of ties is not the main source of new information and benefits within a network, but the ‘chasm’ between groups is. “Bridge strength is an aside in the structural hole argument since information benefits are expected to travel over all bridges. Benefits vary between redundant and non-redundant ties” (Burt 1992:30).

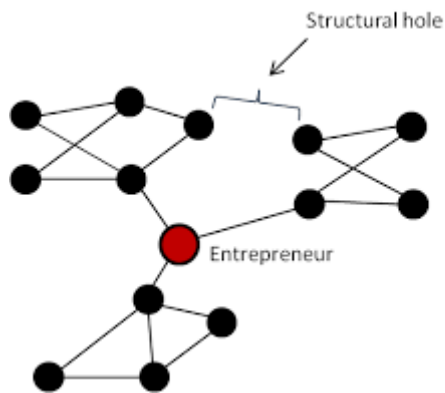


Figure 3: Structural Holes in a Social Network (Reprinted from *Down the Rabbit Hole: How Structural Holes in Entrepreneurs' Social Networks Impact Early Venture Growth*, by Mackenzie et al, 2014, *Technology Innovation Management Review*, 4(9): 19-27.).

An organization bridges a structural hole when it has connections to two separate organizations that have no connections to each other (Krijkamp et al., 2021). There are two ways in which organizations can reap benefits from spanning these structural holes. The first and most widely studied way is the structural advantage that comes with being positioned between disconnected organizations. This provides organizations with access to a wider range of information that is more diverse and delivered faster, compared to organizations that span fewer structural holes (Krijkamp et al., 2021). Soda et al., (2018) describe this as the "vision" benefit of structural holes, where brokerage positions offer opportunities for knowledge and information. The second-way organizations can benefit from spanning structural holes is through active exploitation of their strategic network position (Obstfeld et al., 2014). Although spanning structural holes alone provides advantages, organizations that play their alters against each other while leveraging their informational advantage can further increase their performance. This requires organizations to be aware of their competitive edge and take steps to utilize it (Krijkamp et al., 2021).

## 2.2 Network roles

Within a social network, there are different kinds of roles a node/actor can have. These informal roles they have in the network can be different from the roles they have within the organization. Mapping these network roles out can give organizations a better view of whom important players are in the network and who are bottlenecks (Nolker & Zhou, 2005). Cross et al., (2003) analyzed more than fifty large organizations and identified four roles in informal networks: central connector, boundary spanner, information broker, and peripheral specialist. The research suggests that if executives within an organization focus on these four key players, the effectiveness of the organizational informal network can be enhanced.

Central connectors are the people who link most people with one another in an informal network. They often have the most connections and are most of the time not the formal leaders of an organization or department (Cross et al., 2003). They are aware of who can provide information or knowledge that the entire network can rely on to complete tasks. For organizations, the central connectors are significantly important, they are the go-to person for information and help solve questions of colleagues. Cross et al., (2003) saw that these efforts of central connectors were seen by colleagues but often not rewarded by management and focused more on work that was important for top management. Therefore, it is important that management should recognize these central connectors



for their important role in the network and should reward them. Central connectors can also act as bottlenecks, as they can withhold information or they are busy and cannot communicate fast enough, which makes others cannot do their work (Cross et al., 2003).

Boundary spanners function as a bridge to connect one part of the organization to another part of the organization, or to other organizations with similar networks. They frequently consult with and advise people from a variety of departments and organizations, regardless of their personal affiliations (Cross et al., 2003). Boundary spanners are linked to the central connectors of other informal networks and are similar to the bridge actor in Burt's (1992) structural holes theory. They play an important role in situations where different kinds of knowledge and expertise are shared. For instance, new product development (Cross et al., 2003). Research from Cross et al., (2003), found the importance of boundary spanners. They mapped a consumer-products company's R&D department and discovered that just four of the 36 researchers in the group maintained connections with academics in their disciplines. These four boundary spanners were the only sources of information for the whole team, and if any of them were to quit or be promoted out of R&D, the entire group's productivity would have suffered.

Information brokers are the people who communicate with different subgroups and hold the informal network together. The network as a whole would break into smaller, less effective segments if they did not interact between subgroups (Cross et al., 2003). They are similar to boundary spanners, only they do it within the organization. Because they hold the authority of a central connector without necessarily having as many direct connections as central connectors do, information brokers are important to the functioning of the informal network (Cross et al., 2003).

Peripheral specialists are the people who provide expertise to anyone in an informal network (Cross et al., 2003). These people perform a crucial role in the network by acting as experts, despite the fact that they work on the periphery. When necessary, they communicate their specialized information or technical expertise to the other group members (Cross et al., 2003).

### 2.3 Social Network Analysis

Social network analysis (SNA) is a quantitative analysis tool that uses various methodologies and tools for studying interactions, communications, and relationships. As a result, SNA is appropriate for the research and monitoring of online and offline interactions since it can automatically analyze interaction data, providing an aerial perspective of the group's social structure, interaction patterns, and mapping of all communications in the relational space (de Laat et al., 2017; Borgatti et al., 2009; Saqr & Alamro, 2019).

The data used in SNA can come from many sources. It can include primary data, such as surveys, where respondents often were asked to provide information on their relationships. Surveys frequently ask about respondents' level of connection to others (frequency of contact), the nature of such exchanges, and the value the respondent places on them. Besides primary data, SNA can also include secondary data sources. Examples of such secondary data sources are social media data (followers, comments, likes, etc.) (Johnson & Chew, 2021).

SNA has two types of analyses, namely a visual analysis and a mathematical analysis. These types of analyses will now be explained.

First the visual analysis of SNA. SNA visualization portrays relationships between actors in social networks through graphs known as sociograms; the sociogram illustrates nodes (actors) as points and edges (relationships) as arrows derived from the source of the interaction and pointing to the target of the interaction (Borgatti et al., 2009). SNA may help depict social interactions and identify who the major players in the target group are and who the isolated actors are, as well as which individuals/groups have dense interactions, and which have sparse interactions and are less relevant (Saqr & Alamro, 2019). Colors in these sociograms denote distinct types of players or nodes on the



network. The node sizes represent the degree of connectivity. The placement and grouping of nodes in network maps depict the network structure, which includes isolated actors, central actors, bridging actors, and any sub-groupings (Johnson & Chew, 2021).

The SNA mathematical analysis measures network parameters at the individual and group levels. SNA mathematical analysis employs graph theory techniques to compute metrics describing nodes, connections, or the network. Such as the distance between the network's actors, the number of contacts with other actors (degree), or the number of times it bridged links across communities (Saqr & Alamro, 2019). These metrics are useful for measuring interactions, rating nodes, or establishing linkages. The most used measures in social network analyses are centrality scores (Table 1). These scores are determined at the actor level and are measurements of a node's location or relevance in the social network (Saqr & Alamro, 2019). Degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality are the four most frequently used centrality measures (Friemel, 2017).

Degree centrality counts the number of relationships an actor has and is divided into two parts, that describe the number of incoming connections (in-degree), and the number of outgoing connections (out-degree) (Zhu et al., 2010; Friemel, 2017). In an undirected network such as LinkedIn, the degree is the number of ties to other nodes. Organizations value knowing which of their members have a high degree of centrality because these members are more likely to successfully distribute information throughout their networks. Moving members with a high degree of centrality out of their networks is often undesirable since it disrupts knowledge movement (Zhu et al., 2010).

Closeness centrality allows you to see how an actor is embedded in the network and tells you more than only the amount of connections an actor has. The distance between an actor and all other actors in the network is reflected by closeness centrality (Friemel, 2017). Nodes with a high closeness centrality score are easily reachable by all the other actors. Closeness centrality emphasizes actors' ability to easily distribute their resources to all network members. Employees that have a high level of closeness centrality encourage using and sharing explicit knowledge (Leon et al., 2017).

Betweenness centrality measures how much an actor connects two other unconnected actors in the network and explains how powerful an actor is in a network (Zhu et al., 2010). Actors with high betweenness centrality are viewed as information gatekeepers, bridging other actors and regulating the flow of information (Friemel, 2017). When an organization has to transfer a member out of a network, they use betweenness centrality to evaluate which member would be the least damaging to remove from that network (Zhu et al., 2010).

The last centrality measure is the eigenvector centrality. The eigenvector centrality measures that a node is important/central if it is connected to important/central nodes (Friemel, 2017). This includes that having a connection with a popular LinkedIn user gives you more influence than having connections with many new LinkedIn users with few connections (Riddell et al., 2017).

Table 1: Centrality measures

<b>Centrality measure</b>	<b>Explanation</b>
Degree centrality	How many relationships does an actor have?
Closeness centrality	How fast can this actor get information to others in the network?
Betweenness centrality	How many times is this actor between two other actors in the network?
Eigenvector centrality	How well is the actor connected to other well connected actors in the network?

Social network analysis typically focuses on an actor's social capital, making the assumption that individuals with better access to other network members are more significant or influential (Putnam, 1995). However, if the nodes are humans, they could have varied skills, and it might be difficult to replace actors who have certain skills (Sparrow, 1991). They could thus be more significant to the network than what is apparent from centrality measurements alone (Block, 2022).

Other network metrics include the path across the network, and the density of the network (Arif, 2015). The strength of the relationships is critical in determining the relationship behavior among the nodes. A specific link between two nodes might be highly important to the overall network. As a result, not only can nodes be evaluated in terms of proximity, but links can also be measured in terms of how they connect nodes within the network (Saqr & Alamro, 2019). Furthermore, while doing network analysis, the properties of the complete network should be calculated (Arif, 2015; Saqr & Alamro, 2019; Johnson & Chew, 2021).

#### 2.4 Value of social network analysis for SMEs

SNA can be beneficial for organizations because it allows them to understand and analyze the structure of their social networks, including the relationships and patterns of communication among individuals and groups within the organization (Borgatti et al., 2013). One of the main advantages of using SNA in organizational research is its ability to provide a comprehensive and objective view of the social structure within a group (Borgatti et al., 2013). By mapping out the relationships and interactions between individuals, SNA can reveal patterns and trends that may not be immediately apparent through other methods (Wasserman & Faust, 1994). This can be particularly useful for organizations that are seeking to understand how different groups within the organization are connected and how information and resources flow between them (Borgatti et al., 2013).

Another possibility of SNA is that it allows researchers to identify key individuals or groups within an organization who may have a disproportionate amount of influence or power (Borgatti et al., 2013). These individuals or groups often referred to as "central actors," can play a critical role in shaping the direction and decision-making processes within the organization (Wasserman & Faust, 1994). By identifying and studying these central actors, organizations can better understand how power and influence are exercised within the group and how this may impact the group's goals and objectives (Borgatti et al., 2013).

SNA has also been used to study how organizations adapt and change over time (Wasserman & Faust, 1994). By tracking changes in the social structure and relationships within a group, researchers can gain insight into how an organization responds to external pressures and how it changes in response to internal dynamics (Borgatti et al., 2013). In addition to its usefulness in understanding the social structure and dynamics of an organization, SNA has also been applied to a range of practical problems facing organizations (Borgatti et al., 2013). For example, to optimize the flow of information within an organization (Wasserman & Faust, 1994), to improve communication and collaboration between team members (Borgatti et al., 2013), and to understand the implementation and diffusion of social innovations (Kolleck, 2013).

#### 2.5 Sense of community

McMillan and Chavis (1986) define "sense of community" as a feeling of belonging and connection among individuals within a particular social setting. They argue that a sense of community is characterized by the presence of four elements: membership, influence, fulfillment of needs, and a shared emotional connection. In their view, a sense of community is not just about being physically present in a particular location, but also includes the subjective experiences of individuals and the relationships they form within that setting. The four elements are explained in Table 2.

Table 2: Sense of community elements

Element	Explanation
Membership	Measures the degree to which an individual perceives themselves as a member of the community and feels a sense of belonging. It includes items that assess the perceived level of social interaction and connectedness within the community (McMillan & Chavis 1986).
Influence	Measures the extent to which an individual feels that they have a voice in the community and can influence decision-making processes. It includes items that assess the perceived level of influence and power within the community (McMillan & Chavis 1986).
Integration and fulfillment of needs	Measures the degree to which an individual's needs and interests are being fulfilled within the community. It includes items that assess the perceived level of support and satisfaction with the community (McMillan & Chavis 1986).
Shared emotional connection	Measures the extent to which an individual feels emotionally connected to the community. It includes items that assess the perceived level of emotional attachment to the community and the level of shared values and beliefs (McMillan & Chavis 1986).

As mentioned earlier in the introduction, a strong sense of community has benefits for an organization. According to Mintzberg (2009), a strong sense of community within an organization is associated with greater employee engagement and positive outcomes for the organization. The paper discusses the importance of managers creating a sense of purpose and identity to develop an organization. Mehta and Krishnan (1999) discuss that when employees feel a stronger sense of community within the workplace, they are more likely to identify with the organization, develop positive working relationships, experience higher levels of productivity, and feel more satisfied with their jobs. Hughey et al. (1999) also suggest that a strong sense of community is associated with positive outcomes for both individuals and the organization as a whole. N. Boyd et al. (2017) investigate the extent to which sense of community, sense of community responsibility, and public service motivation predict employee well-being and engagement in public service organizations. They find that a strong sense of community and community responsibility are significant predictors of both employee well-being and engagement. The role of leaders in an organization is important in promoting a strong sense of community in the organization. According to Klein and D'Aunno (1986), leaders and supervisors can play an important role in shaping the group by defining its purpose and identity, influencing employees' loyalty and respect for the organization, and providing opportunities for active involvement in the group or organization. House (1983) suggests that supervisors can indirectly promote a sense of community among employees by modeling supportive and participative behavior. By doing so, supervisors may encourage employees to interact with each other in similar ways, leading to a net increase in the sense of community for all members of the organization.

## 2.6 Research design

This research aims to develop an appropriate network analysis method for understanding the sense of community in SMEs. The research will be design research for an information system, which is a method developed by Hevner et al (2004). ‘The design-science paradigm seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts’ (Hevner et al., 2004). While Hevner's design science approach is one way of conducting this type of research, an alternative approach is offered by Peffers et al. (2007) design science, which also emphasizes the development of practical artifacts. The goal of design science research is utility, which in this research is an information system that can be used as a method. The implementation of the research can be seen in Figure 4.

First, a relevance for creating an artifact is being developed due to an identified business need in the environment (Hevner et al., 2004). The knowledge base serves as the raw materials from which and through which information systems research is carried out (Hevner et al., 2004). The foundations and techniques make up the knowledge base. Prior information systems research and findings from reference disciplines offer the basic theories, frameworks, instruments, structures, models, and methodologies required in the research study's development/build phase (Hevner et al., 2004). Methodologies serve as guides for the justification/evaluation process. Rigor is accomplished by the proper application of established foundations and methodologies and applicable knowledge (Hevner et al., 2004). The artifact is assessed and refined by testing and experimenting until a viable artifact is developed (Hevner et al., 2004).

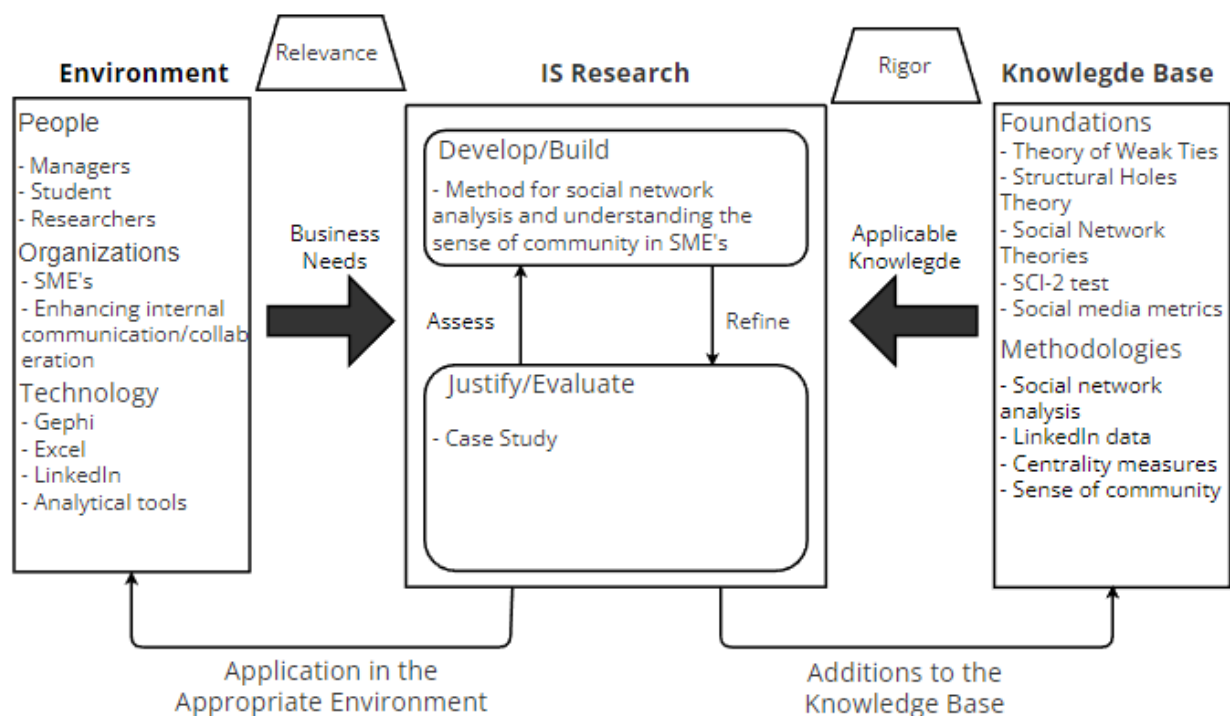


Figure 4: Information Systems Research framework (Adapted from Hevner, Alan & R, Alan & March, Salvatore & T, Salvatore & Park, & Park, Jinsoo & Ram, & Sudha., (2004). Design Science in Information Systems Research. Management Information Systems Quarterly. 28. 75-.).

In this research, the business needs that the artifact is being developed for is the gap in knowledge about the practical use of network analysis methods for SMEs and how a sense of community within an organization can be assessed by using the technique. This method will be used as a guideline for organizations to analyze their social network and identify new insights. The applicable knowledge will come from the theories and literature that are mentioned in the theoretical background. These studies offer the basic theories, frameworks, instruments, structures, models, and methodologies required in

the research study's development/build phase. The designed method will contribute to the existing literature and theories and will be explained in the theoretical contribution section. The practical contribution will also be explained separately. This artifact will be justified and evaluated via a case study, in which data is gathered from LinkedIn and the computer program Gephi will be used to create social networks out of the data. 'Gephi is the leading visualization and exploration software for all kinds of graphs and networks'<sup>1</sup>.

Hevner developed 7 guidelines (Table 3) that design research should comply with.

*Table 3: Guidelines For Design-Science Research (Adapted from Hevner, Alan & R, Alan & March, Salvatore & T, Salvatore & Park, & Park, Jinsoo & Ram, & Sudha, (2004). Design Science in Information Systems Research. Management Information Systems Quarterly. 28. 75-.).*

<b>Guideline</b>	<b>Description</b>
Guideline 1: Design as an Artifact	Design science research must produce a viable artifact in the form of a model, a construct, a technique, or an instantiation.
Guideline 2: Problem Relevance	Design-science research aims to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	A design artifact's utility, quality, and efficiency must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be successfully communicated to both technical and managerial audiences.

Now, we will explain how these guidelines are implemented in this research. The first guideline Hevner proposes is to design as an artifact. This research will produce a viable artifact in the form of a method. The method will tackle the problem that SMEs are often unaware of the possibilities of network analysis methods. This is a problem because SMEs may be missing out on valuable insights and opportunities. Network analysis methods can be used to analyze relationships and connections within a network, such as a group of businesses or a social network (guideline 2). The artifact will be evaluated via case study testing, where one organization will be evaluated via the method (guideline 3). The research contribution of this design research will be the designed artifact, the artifact will be useful for many organizations (guideline 4). Creating rigorous research is important and often neglected when new phenomena are researched. This research will create rigor by collecting appropriate data, using proper analysis techniques, fair representations of the results, good reflections, and thoughtful thinking and planning (guideline 5). The design research will use the following available means to reach the desired end; LinkedIn data, analysis tools, research papers, supervisors, company feedback, and an SCI-2 test (guideline 6). Lastly, this research will present to managerial

<sup>1</sup> <https://gephi.org/>

audiences the importance and effectiveness of the artifact. The artifact will be presented to the organization, which may also present it to its customers. The technology-oriented audiences will be provided with a description of the construction of the artifact and how it is used in practice in the form of this paper (guideline 7).

### 3. Method

In this chapter, we will describe the Mulder method, which was introduced in the previous chapter and named after the author of this paper. The previous chapter has provided the foundation of the Mulder method, by discussing the theories that are involved and explaining the purpose of the design science research. This chapter describes how the Mulder method can be implemented and what the possibilities are of the method.

#### 3.1 The Mulder method

In order to understand the process of social network analysis, and in order to see the role of sense of community the Mulder method was developed (see Figure 5), consisting out of four steps, where each step entails a set of actions. The case study that this research is conducting focuses on the sense of community in organizations. The method that this research describes can be implemented for analyzing all different kinds of things in an organization and not only for the sense of community. For instance, organizations can use the method to measure the impact of personal leadership or social capital in an organization.

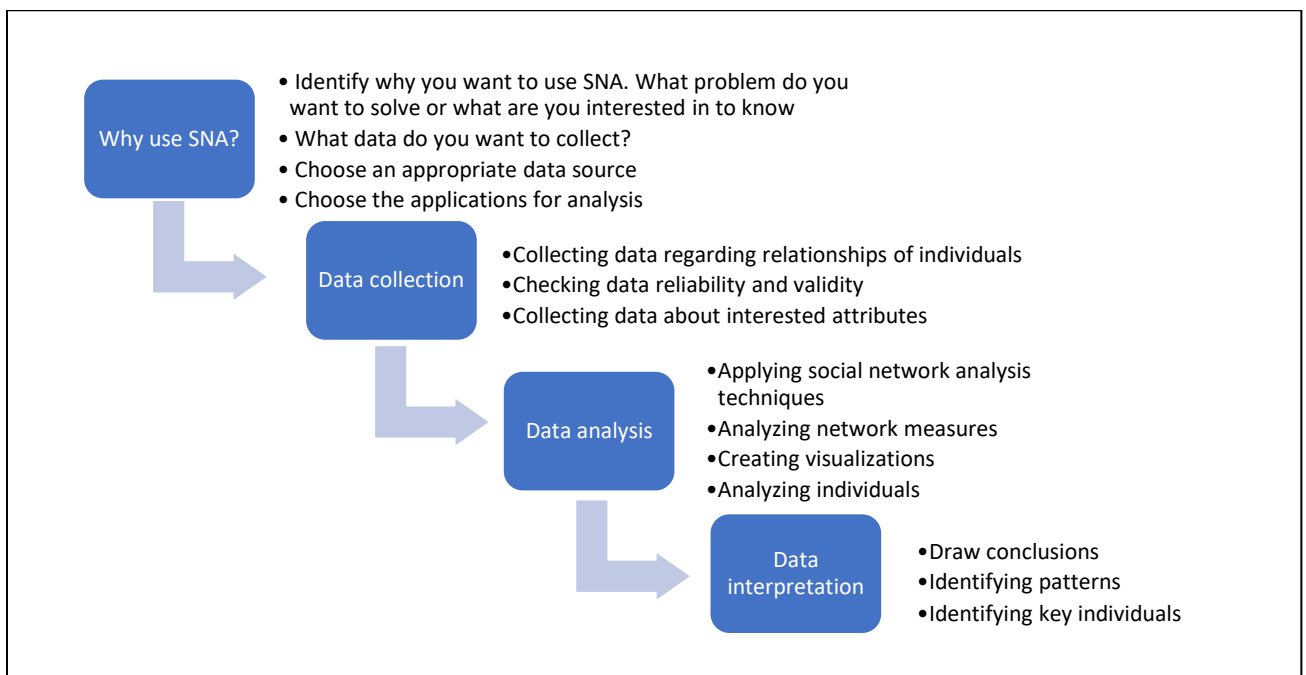


Figure 5: The Mulder method.

#### Step 1: Why use SNA?

The first step is identifying the research question or problem that the SNA is intended to address. This involves defining the specific objective or purpose of the SNA and the population or context in which it will be conducted. Some examples of research questions that SNA might be used to address include:

- How does information flow within a particular community or organization?
- Who are the key influencers or decision-makers in a particular network?
- How does the structure of a network impact the spread of innovations or behaviors?



- What is the impact of an intervention or policy on the relationships within a network?

Defining the research question or problem will help guide the development of the study design and ensure that the results of the SNA are relevant and meaningful. It is important to be as specific and clear as possible about the research question, as this will help to ensure that the SNA is specific and helpful. In order to accurately analyze a social network, it is essential to select a reliable data source that can provide information about the relationships between individuals. If the data source is not an appropriate representation of this, then the reliability of the analysis may be compromised. Lastly, an application should be chosen to visualize and analyze the data. In this paper, the program Gephi is used. Gephi is an open-source application that can visually and mathematically analyze social networks through a graphical user interface. It can import a range of formats as well as export analysis data in an easy-to-use format for analysis.

### Step 2: Data collection

This step involves identifying the specific individuals or organizations that will be included in the analysis and determining the nature and strength of the relationships between them. This may involve surveying individuals or organizations, observing interactions, or extracting data from existing sources such as social media platforms.

It is important to consider the representativeness of the sample and the potential biases that may be introduced through the data collection process (Scott, 2000). For example, if the sample is not representative of the larger population, the results of the SNA may not be generalizable (Borgatti et al., 2013). Similarly, if the data collection process is prone to bias, such as by only collecting data from individuals who are more likely to respond, the results may not accurately reflect the relationships within the network (Knoke & Yang, 2008).

Once the data has been collected, it is important to clean and prepare the data for analysis (Borgatti et al., 2013). This may involve checking for errors, missing values, or inconsistencies, and ensuring that the data is in a usable format (Scott, 2000).

Data about specific attributes the researcher is interested in should be collected in this step. This research is interested in sense of community in SMEs and this data is collected via a test. Some examples of other personal attributes that might be collected and analyzed as part of an SNA include:

- Demographic characteristics such as age, gender, race, education level, and occupation. These attributes may be relevant for understanding how social networks are structured and how individuals are connected to one another.
- Attitudes, values, and beliefs. These attributes may be relevant for understanding how individuals' perspectives and motivations influence their interactions and relationships with others.
- Personality traits. These attributes may be relevant for understanding how individuals' characteristics and behaviors affect their interactions and relationships with others.
- Skills and abilities. These attributes may be relevant for understanding how individuals' capabilities and expertise influence their interactions and relationships with others.

It is important to consider the specific research question or problem that the SNA is intended to address when deciding which personal attributes to collect and analyze. Additionally, it is important to consider the feasibility and ethical implications of collecting and analyzing personal attribute data.

The SCI-2 instrument, developed by Chavis et al. (2008), is used to assess the sense of community. It consists of 24 statements, rated on a Likert scale, that evaluate an individual's feelings of belonging, influence, reinforcement, and shared emotional connection (four subscales). The questionnaire will be



conducted on employees of Marotura. The total score, which ranges from 0 to 72, provides an overall measure of an individual's sense of community. A score of 36 or higher is considered positive, while a score below 36 is considered negative. The test will be presented to the employees.

### Step 3: Data analysis

Analyze the data to generate a network map or visual representation of the relationships between individuals or organizations. This step involves applying statistical techniques and software tools to transform the collected data into a usable form for analysis.

In this step of the social network analysis process, various centrality measures such as degree, betweenness, closeness, and eigenvector centrality are calculated and applied to the data. These measures are explained in the previous section. These measures can be calculated via the statistics overview in Gephi (see Figure 6). The program has a statistics overview where all different kinds of statistics can be calculated. For the degree centrality, you click on the run button 'average degree' and for closeness and betweenness centrality you click on the button 'network diameter' and it will give you the output. Additionally, the network roles will also be analyzed to see if certain roles are in key positions or not.

This step also includes the creation of visual representations of the network, which can be customized to highlight specific attributes or to display different layout algorithms. This research will show different visualizations highlighting different attributes. Gephi is a commonly used software for this purpose and provides a variety of options for visualizing and analyzing networks.

To help identify patterns and communities within the network, the ForceAtlas2 algorithm is typically used. This algorithm utilizes a physics-based model to arrange nodes based on the strength of their connections, making it particularly useful for identifying clusters or communities within the network (Jacomy et al., 2014).

Creating an effective visualization of a network often involves highlighting specific characteristics or patterns within the data. One way to do this is by assigning attributes to nodes, such as color or size, which can be used to represent different types or groups of nodes. For example, if you want to demonstrate the distribution of men and women in a network, you could use color to distinguish between men (e.g., blue) and women (e.g., pink). Additionally, by filtering the node size based on a specific attribute, such as degree, it is possible to show which individuals have a higher level of connectivity in the network. Those individuals with a higher degree will appear larger than those with a lower degree, making it easy to identify key players or outliers.

### Sense of community

The sense of community will also be analyzed in this step. The scores that were collected in step 2 will be analyzed to better understand the organization's dynamics and identify potential areas for improvement. Combining the sense of community scores and the social network of an organization can provide valuable insights. For instance, the social network can be used to identify employees who are central to the network, as well as those who are highly connected to other highly connected employees. These individuals are likely to be influential in the organization and may be targeted for efforts to improve the sense of community. They could act as community leaders.

Also, to compare the network positions of employees to their sense of community scores to see if there is a relationship between the two. For example, do employees with higher sense of community scores

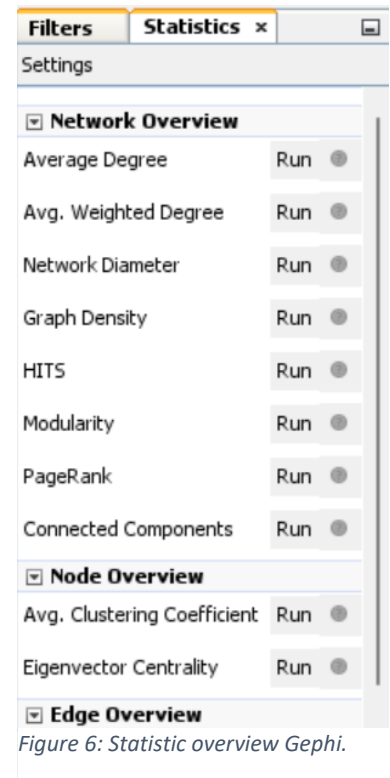


Figure 6: Statistic overview Gephi.

tend to have more central positions in the network? This analysis can help you understand the relationship between the social network and the sense of community in the organization.

Lastly, the sense of community scores can be used to identify areas where the organization could improve its sense of community. For example, if there are clusters of employees with low sense of community scores, you could target those areas specifically.

Overall, the combination of social network analysis and sense of community scores can provide an understanding of the dynamics of an organization and can be used to improve its sense of community.

#### Step 4: Data interpretation

The last step is to interpret the results in the context of the research question or problem. This involves identifying patterns or trends in the data, and making conclusions based on these observations. Additionally, this step may involve testing hypotheses about the role of specific actors or structures in the network. For instance, do key actors of the organization have a high sense of community? By testing these hypotheses, you can gain a better understanding of the factors that contribute to the sense of community in the organization.

In addition to analyzing the data, it is also important to communicate the results of the SNA to relevant stakeholders. This may involve presenting the findings in a report or presentation or using the results to inform decision-making. By sharing the findings with stakeholders, you can provide new insights and perspectives. Moreover, stakeholders may have different perspectives on the results, and by considering these alternative views, you can gain a better understanding of the network and its dynamics.

Overall, interpreting the results of the SNA and communicating them to stakeholders is a critical step in the research process. By doing so, you can ensure that the findings are not only meaningful and relevant, but also relevant for those who need to make decisions based on the analysis.

The Mulder method offers that organizations can get valuable insights about their social network and sense of community by implementing it. However, in order to fully understand its practical usefulness, it is important to test the method in real-world settings. In the next chapter, we will present a case study where the Mulder method is implemented in a real organization. Its goal is to test the practical usefulness of the method and to what extent it is appropriate.

## 4. Case study

In this chapter, the Mulder method mentioned in the previous section is applied to Marotura. Marotura is a SME located in the Netherlands. Marotura is a Dutch-German family business and expert in the field of digitalization, online business, and technology. All of their employees have a healthy dose of the Achterhoek/Twente work ethic: no fancy words, boasting, or empty talk, but putting action behind their words, keeping their promises, and working hard to achieve a good end result for their partners. They do this in a positive work environment where they support one another. This analysis focuses on the basis of SNA and especially is interested in sense of community within the team of Marotura. The data that this research uses are the LinkedIn connections of employees of Marotura.

### Step 1: Why use SNA?

There are a couple of reasons why this research wants to use SNA. SNA provides a way to map and assess the relationships and interactions between individuals within Marotura. This can help identify patterns and trends within the social network that might not be immediately apparent through other methods. Another reason is that SNA can provide a better view of Marotura by taking into account not only the personalities of individuals but also the connections and interactions between them. Additionally, SNA can also be used to identify central and influential individuals within the network of Marotura and show how their position and influence are within the network. Lots of possibilities. This research wants to focus on these possibilities of SNA and present a methodology for organizations on how to conduct SNA. Its goal is to test the Mulder methods practical usefulness and to what extent it is appropriate for organizations to implement it.

This study will be conducted within the population or context of Marotura, an organization based in the Netherlands consisting of 18 employees. To conduct a SNA, we will use LinkedIn connections of the employees of Marotura as our source of information and Gephi as the software application for the SNA. Additionally, we want to collect data on the sense of community within the organization, and we will use Microsoft Excel to store and clean the data.

### Step 2: Data collection

In order to begin the analysis, data must first be gathered. For this study, we will be utilizing the LinkedIn connections of employees as our primary data source. The database has a total of 2572 individuals, with 3140 undirected connections among them (as LinkedIn connections are bidirectional). All of these individuals are connections on LinkedIn of Marotura employees. The number of connections is higher than that of individuals, as employees may have connections with the same people in their networks. To obtain this LinkedIn data, employees of the organization were requested to provide their LinkedIn connections. The data was then organized, cleaned, and formatted appropriately using Microsoft Excel. To be imported into Gephi, the data needs to be in an Excel sheet.

This research wants to understand the sense of community within Marotura. The data for this was collected via the Sense of Community Index-2 (SCI-2) test (Chavis et al. 2008). This test is designed to measure an individual's psychological sense of community, consisting of 24 questions in total. These questions are further divided into the four subscales, namely membership, influence, reinforcement of needs, and shared emotional connection, each with six questions. By analyzing the responses to these questions in the next step, we can gain valuable insights into both the overall sense of community within the organization, as well as the specific subscales.

The SCI-2 test has been collected from six employees. The test had a low response rate, a cause of this could be that the test asks sensible questions that not everyone is willing to answer and they do not want that others know it. Nevertheless, the analysis will be done and explained with these six responses. The results of this test can be seen in Table 4. This table presents data collected from six people (labeled A to F) on their scores from the SCI-2 test, as well as their scores on the four subscales

that make up the test. The scores for each person on the SCI-2 test and the four subscales are presented in the table. For example, person A scored 43 on the SCI-2 test, with scores of 13, 9, 11, and 10 on the reinforcement of needs, membership, influence, and shared emotional connection subscales, respectively.

The table also presents the average score for each of the subscales across all six people. The average SCI-2 score across all individuals is 48.3. This table provides an overview of the data collected and allows for comparison between individuals and subscales.

Table 4: SCI-2 scores.

Person	SCI-2 score	Subscale 1 (Reinforcements of Needs)	Subscale 2 (Membership)	Subscale 3 (Influence)	Subscale 4 (Shared Emotional Connection)
A	43	13	9	11	10
B	47	13	12	9	13
C	31	6	8	9	8
D	59	16	13	14	16
E	57	15	16	12	14
F	53	12	14	13	14
<b>Average</b>	48.3	12.5	12.0	11.3	12.5

In addition to the sense of community, data is also collected on the employees' job functions. This data is gathered from asking the employees about their function. Additionally, gender is also collected for a portion of the sample, which will be further analyzed in the next step.

Lastly, the Excel file with all the data was imported into Gephi to generate network maps. The initial network output is dense and uninterpretable. However, by applying layout algorithms and attributes, a clear narrative can be extracted from the visualization. The adjusted networks will be discussed and displayed in the following step.

### Step 3: Data Analysis

#### Centrality scores

The analysis of centrality measures is an important step in studying the internal social network of an organization. In this step, we present the results of the centrality analysis of Marotura employees, focusing on degree, betweenness, closeness, and eigenvector centrality (Table 5). The goal is to identify key players within the network of Marotura.

#### **Degree Centrality**

Degree centrality measures the number of direct connections a node has in a network, and it is an important metric to identify employees who have the potential to spread information quickly and efficiently. In our analysis, we found that the top five employees with the highest degree centrality scores in the Marotura network were E1, E7, E12, E3, and E9. Among them, E1 had the highest degree centrality score, indicating that they were the most directly connected employee in the network. E7 and E12 followed closely, indicating that they were also well-connected actors in the network.

#### **Betweenness Centrality**

Betweenness centrality measures the extent to which an employee is positioned as a bridge between other employees in the network, allowing them to broker relationships between others. In our analysis, we found that the employees with high betweenness centrality scores in the Marotura network were E1, E3, and E14. Among them, E1 had the highest betweenness centrality score, indicating that they

were a key actor in the network, connecting employees who might not otherwise be connected. E3 and E14 followed closely, indicating that they were also important gatekeepers in the network.

**Closeness Centrality**

Closeness centrality measures how easily an employee can reach other employees in the network. In our analysis, we found that the employees with the highest closeness centrality scores in Marotura’s network were E1, E14, and E2. Among them, E1 had the highest closeness centrality score, indicating that they were the employee who was closest to all other employees in the network, in terms of the shortest path between them. E14 and E2 followed closely, indicating that they were also well-positioned in the network in terms of their ability to reach other employees quickly.

**Eigenvector Centrality**

Eigenvector centrality measures the extent to which an employee is connected to other highly connected employees in the network, and it is an important metric to identify employees who are the information brokers of the organization. In our analysis, we found that the top five employees with the highest eigenvector centrality scores in the Marotura network were E1, E7, E12, E8, and E9. Among them, E1 had the highest eigenvector centrality score, indicating that they were highly connected to other highly connected employees in the network. E7 and E12 followed closely, indicating that they were also well-positioned in the network in terms of their connections to other highly connected employees.

Based on the centrality analysis, we can identify the key players in the internal social network of Marotura. E1 emerges as a central and influential actor in the network, based on their high scores across all four centrality measures. E7 and E12 also appear to be important actors in the network, with high scores across multiple measures. Our analysis provides insights into the structure of the internal social network of Marotura and the key players within it, which can inform the development of strategies to enhance collaboration and communication among employees.

Table 5: Centrality measures table

Centrality	Rank	Employee
Degree	1	E1
	2	E7
	3	E12
	4	E3
	5	E9
Betweenness	1	E1
	2	E3
	3	E14
	4	E9
	5	E12
Closeness	1	E1
	2	E14
	3	E2
	4	E7
	5	E12
Eigenvector	1	E1
	2	E7
	3	E12
	4	E8
	5	E9

**Sense of community test**

After analyzing the centrality measure, we analyzed the SCI-2 test. The scores of the test ranges from 0-72, and the subscales ranges from 0-18. It consists of 24 statements, rated on a Likert scale, that evaluate an individual's feelings of belonging, influence, reinforcement, and shared emotional connection (four subscales). The test provides an overall measure of an individual's sense of community. A score of 36 or higher is considered positive, while a score below 36 is considered negative. The results of Table 4 can also be seen in Figure 7 below.

We can see that the average SCI-2 score for the six individuals is 48.3, which suggests a moderate level of sense of community in this organization. However, individual scores range from 31 to 59, indicating some variability in the extent to which people in the organization feel a sense of

community. As an organization, you would not like to have someone who has a low sense of community in a central network position. In a central position, an employee has significant influence over the flow of information and resources within the organization. If this individual lacks a strong sense of community, they may not be able to effectively build relationships and create a positive work environment, which could have a negative impact on employee morale and productivity. Additionally, a lack of community could hinder collaboration and communication among team members. For this organization, it is also important that its central connectors have a strong sense of community. What we know from the available data is that person E is a central connector (later explained) and has a strong sense of community. This is beneficial for the organization, supporting that influential people in the organization should have a strong sense of community (House, 1983). Although it is only a single person, it is valuable information for the organization.

Another possibility to use the SCI-2 scores is to compare scores across different groups within the organization. For example, the scores could be compared between different departments or job roles. This can help identify areas of strength and weakness within specific groups. In this study, this cannot be analyzed since most of the responses are anonymous. For Marotura it would have been useful to know whether individuals with similar scores are more likely to be closely connected in the network. For example, investigating whether individuals with lower scores (A and C) and those with higher scores (D and E) tend to have distinct network positions, which could reveal a potential relationship between scores and network position. Nonetheless, the test has already given Marotura valuable information about their sense of community.

Looking at the individual scores, the figure shows that person C scores the lowest on all the subscales, giving an indication that this employee feels disconnected from the organization, which can be a concern for the organization.

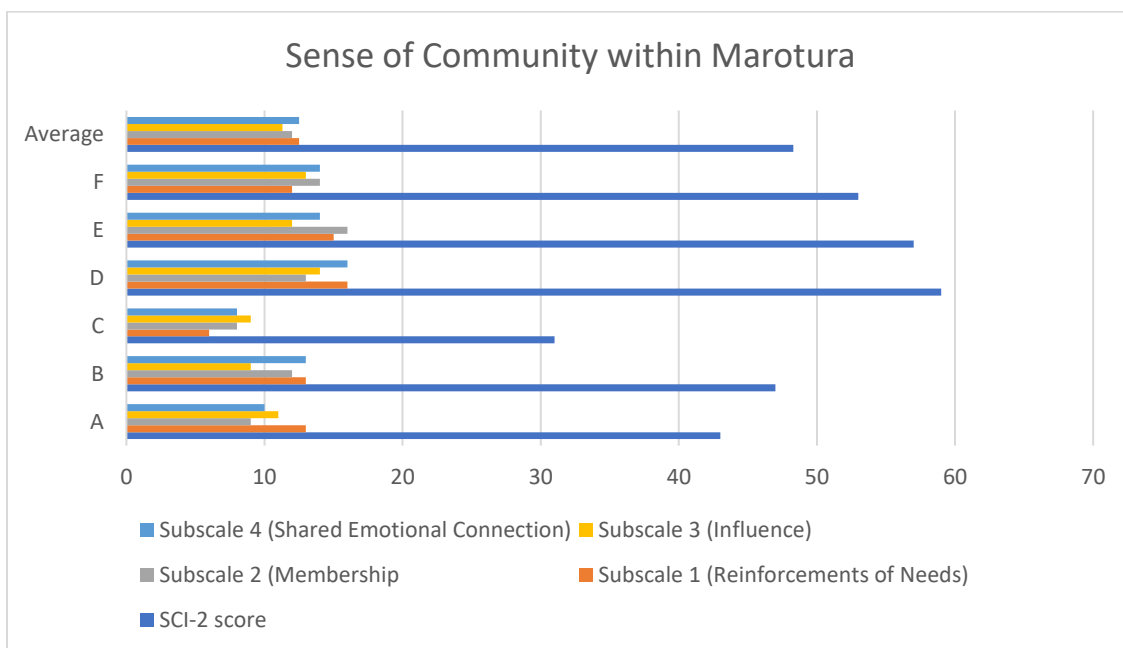


Figure 7: Bar chart with sense of community within Marotura

Breaking down the SCI-2 scores by subscale, we see that the ‘reinforcements of needs’ subscale (Table 6) has an average score of 12.5. This suggests that, on average, people in the organization perceive that their needs are being met by the organization. However, there is some variability in individual scores, with person C having a subscale score of 6 (well below the average) and person D having a subscale score of 16 (well above the average).

Table 6: SCI-2 scores Reinforcements of Needs subscale.

Person	Reinforcements of Needs
<b>A</b>	13
<b>B</b>	13
<b>C</b>	6
<b>D</b>	16
<b>E</b>	15
<b>F</b>	12
<b>Average</b>	12.5

The ‘membership’ subscale (Table 7) has an average score of 12.0, which suggests that, on average, people in the organization perceive a moderate level of membership in the community or organization. Again, there is some variability in individual scores, with person E having a subscale score of 16 (well above the average) and person C having a subscale score of 8 (well below the average).

Table 7: SCI-2 scores Membership subscale.

Person	Membership
<b>A</b>	9
<b>B</b>	12
<b>C</b>	8
<b>D</b>	13
<b>E</b>	16
<b>F</b>	14
<b>Average</b>	12.0

The ‘influence’ subscale (Table 8) has an average score of 11.3, which suggests that, on average, people in the organization perceive a moderate level of influence on the organization. There is less variability in individual scores on this subscale compared to the other subscales.

Table 8: SCI-2 scores Influence subscale.

Person	Influence
<b>A</b>	11
<b>B</b>	9
<b>C</b>	9
<b>D</b>	14
<b>E</b>	12
<b>F</b>	13
<b>Average</b>	11.3

Finally, the ‘shared emotional connection’ subscale (Table 9) has an average score of 12.5, which suggests that, on average, people in the organization perceive a moderate level of emotional connection with others in the community or organization. Again, there is some variability in individual scores, with person D having a subscale score of 16 (well above the average) and person C having a subscale score of 8 (well below the average).



Table 9: SCI-2 scores Shared Emotional Connection subscale.

Person	Shared Emotional Connection
A	10
B	13
C	8
D	16
E	14
F	14
<b>Average</b>	12.5

Overall, the SCI-2 scores for this organization suggest that there is room for improvement in certain areas, such as membership and influence. However, the organization also has some strengths, such as meeting the needs of employees and fostering an emotional connection. On average the organization has a positive sense of community, representing Marotura's positive work environment. By focusing on areas for improvement and building on existing strengths, Marotura can work towards creating a stronger sense of community among its employees, resulting in a better work environment and higher levels of productivity (Mehta and Krishnan 1999).

#### Network visualizations

After analyzing the centrality measures and the sense of community, we created different visualizations. Different visualizations were created, all highlighting different attributes and some with a smaller sample. These are created to see if new information and insights about the organization can be found. We will show these different visualizations and explain them.

The original social network of Marotura was dense and uninterpretable and could not be used for analysis. However, after using a layout algorithm and selecting the attribute 'employee', which colors employees as green and adjusts node size based on degree, the network transformed resulting in Figure 8. Figure 8 illustrates a network with two central individuals, E7 and E8, who function as information brokers and central connectors within the organization. Such a central position provides them with great access to information and other resources (Cross et al., 2003). This gives them greater potential for social influence or control over the flow of information within the network. E7's involvement in many projects and his responsibility for planning make him very important to the organization, and his central location in the network is therefore a logical consequence. E3 and E13 are the two most distant nodes in the network and are both trainees with lesser involvement in the organization, which can also be seen in the network.

The largest node in the network is E1 and has the highest degree centrality. He lies more at the periphery of the network. E1 maintains the most contacts with customers and networks the most, explaining his location at the network's edge. E1 can be identified as a boundary spanner, he lies at the edge of the network and acts as a bridge to most of the customers of the organization. The network reflects the close communication between the owners, as they are both closest linked to each other.

The network also indicates that the employees who have not provided me with their connections are grouped together in a cluster. This represents the close communication the organization has. The network clearly shows that each employee has their own cluster of contacts. These are all clusters in which the employees play as boundary spanners to the organization. This would only be the case if the employees would use these clusters for resources and information. For this organization, this is only very little the case. Furthermore, there are clusters that contain nodes that overlap. For instance, at the top right of the network, you see an overlap between the two nodes. These two nodes are the owners

who are closely connected and have close communication with each other, this is reflected by the overlap in nodes. In the center of the network is the most overlap. The central nodes represent influential individuals within the organization, the high level of overlap could indicate that they work closely together and share information frequently. This could be beneficial for decision-making and collaboration within the organization.

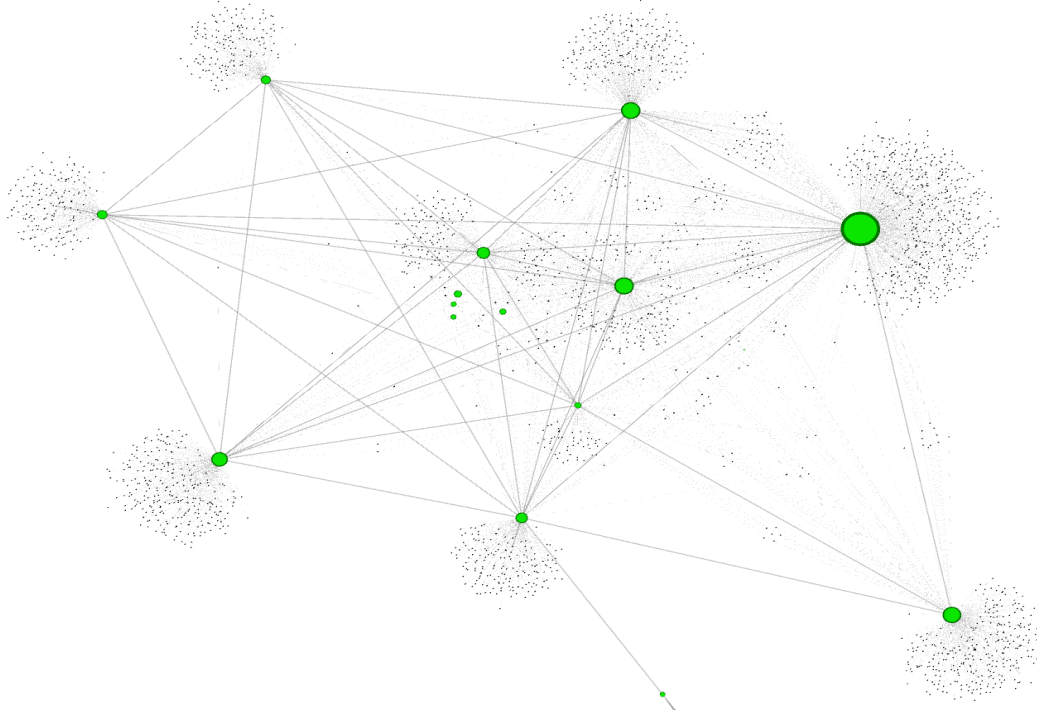


Figure 8: Social network of the organization (green nodes are employees, and node size is based on degree of connections).

Figure 9 shows the network again but here the network is more dense and the nodes have been made smaller. There is one large outlier, which is an employee that is a foreign exchange student. At the top and the bottom of the networks, there are two nodes that are a bit distant from the others. These two have clusters of their own. The people in the organization that are in the center of the network and have a more leading position in the organization can play as information brokers between the clusters. The cluster at the bottom can especially be important for the organization. Since this employee is a student, who has many connections with others students. Something the organization can be interested in if they want to attract new employees.

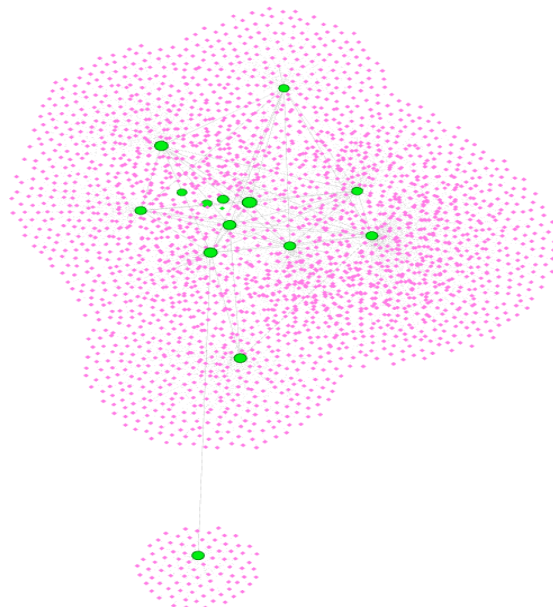
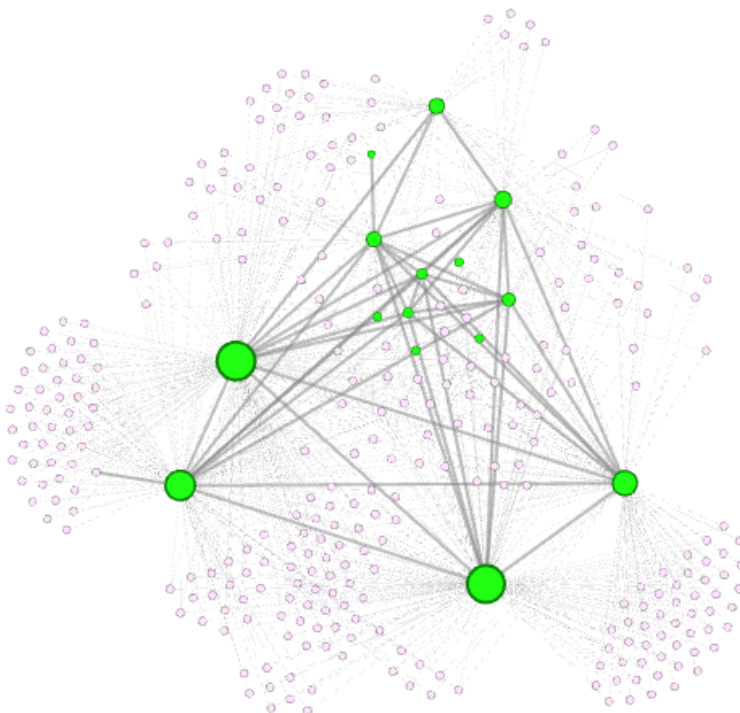


Figure 9: Dense social network of the organization (green nodes are employees).

In the sample, there are many nodes that only have one tie. Therefore, a smaller sample was created (a total of 311 nodes) by only including nodes that had at least two connections. This was done because then the sample would be more representative and remove some obsolete ties and nodes. Figure 10 shows the adjusted network. The network has changed, the two employees that used to be in the center of the network are now more at the edge of the network, and another employee that was at the edge of the network has shifted now to the center. What you can see better now is that E1, E7, and E12 are the people who have the most overlap in total. They are the people in the organization who are involved in many projects and have more of a leading function in the organization. The overlap with many employees indicates that they share information and collaborate on tasks. This can be beneficial for collaboration and communication between different teams and departments and can lead to a more cohesive organization.



*Figure 10: The organization's social network with a smaller sample (green nodes are employees, and node size is based on degree).*

Figure 11 shows the full network of the organization again, but now the attribute 'job function' has been added. In the legend, you can see the different functions the employees have with the adjacent color. The thing that stands out at first impression is that the interns are most at the periphery of the network, this makes sense because they are less integrated into the organization and have less communication with the team. Additionally, the network reveals that individuals with similar job functions tend to cluster together. For example, digital marketers are located near the top of the network, while search, conversion & big data marketers, along with their manager, are closely connected in the network.

The central cluster in the network comprises two digital marketers, a co-founder, an interaction designer, and a senior web developer. These are the employees who did not actively participate in the study. The co-founders are closely linked, which is consistent with their strong connection to one another. The interaction designer in the lower right is a peripheral specialist in the organization,

positioned at the periphery of the network and providing graphic design expertise to anyone in the organization.

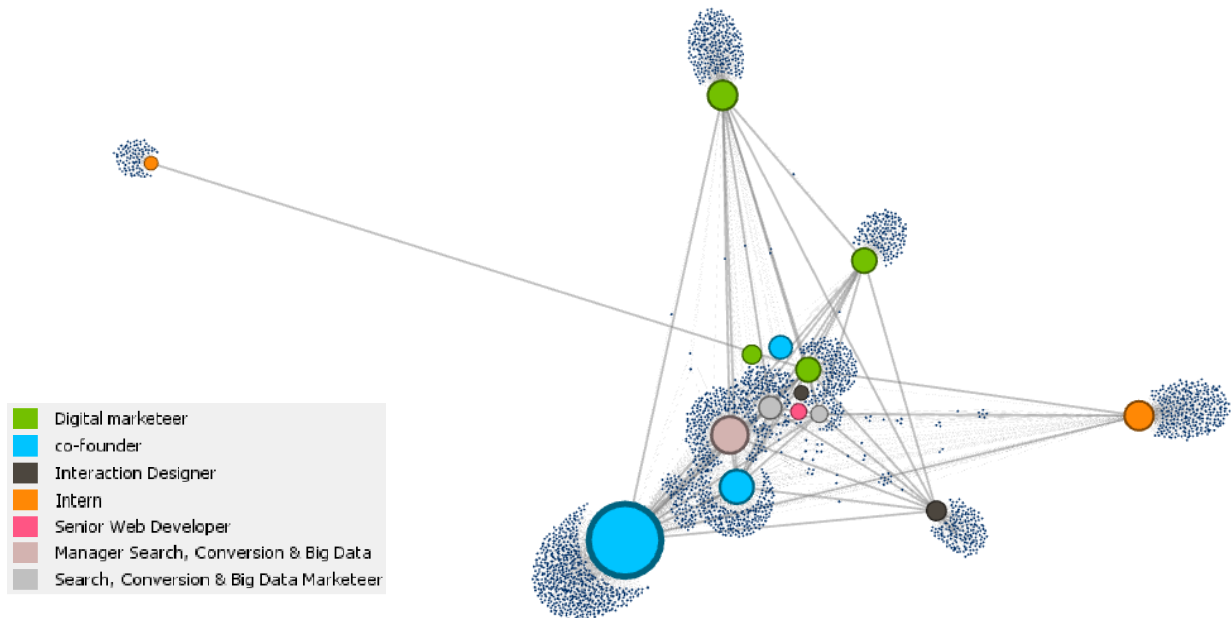


Figure 11: Social network of the organization, where the node colors represent job function of employees.

In Figure 12, we see a similar network to figure 11, but with a smaller sample size. Although the overall structure of the network remains similar, there are a few notable differences. Firstly, the peripheral specialist, who was previously on the edge of the network, has moved to the center. Secondly, the trainees, who were previously more distant from the rest of the network, are now closer to each other, suggesting that they may be forming their own cluster within the organization.

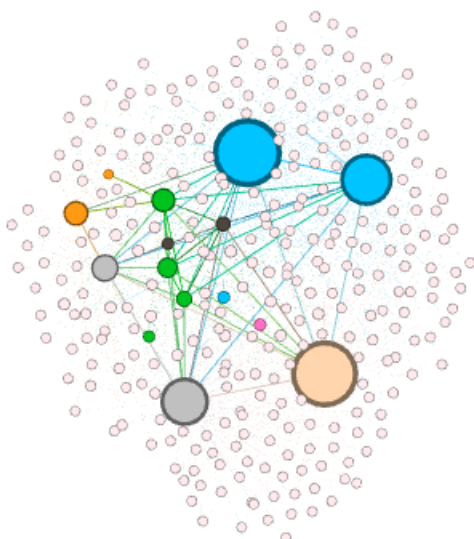


Figure 12: Social network of the organization based on a smaller sample, where the node colors represent the job function of employees.

Adding an attribute like gender can provide insights into how gender diversity is reflected in the organization's social network. Figure 13 shows the network of the organization, the color of the nodes represents the gender they have, where blue is male and pink is female. The network shows that it is mainly dominated by males.

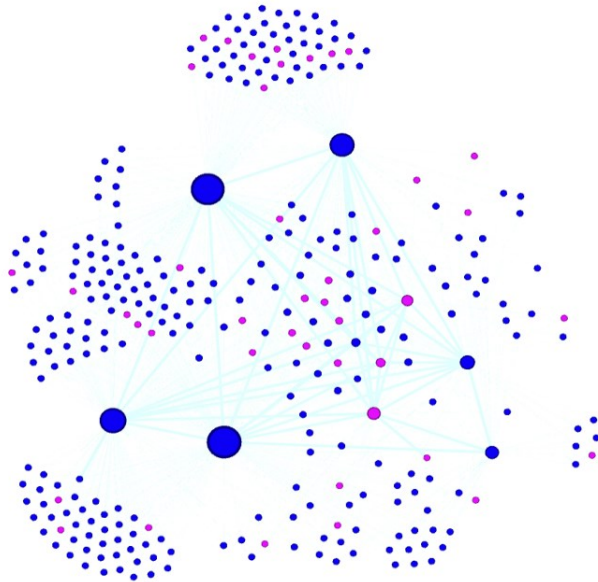


Figure 13: Social network of the organization based on a smaller sample, where the color of nodes is based on gender (blue is male and pink is female).

Another analysis that was possible if the study knew more about the sense of community of all the employees is to research if there is a relationship between the sense of community of the employees and the time they have been working for the organization. According to research (Zani & Cicognani, 2012), people who have been part of the community longer, have a stronger sense of community. Then you would need to have the information on the time they have been in service and the sense of community of employees and analyze if it supports the theory or not. This analysis of a sense of community can also be done by gender or network position for instance. Do male respondents have a significantly higher sense of community in your organization or do people who are at the edge of the network have a significantly lower sense of community?

Furthermore, the LinkedIn accounts of 311 people (this is the smaller sample in the visualizations) have been scraped, this was done to see if there were any other relationships or trends. The data consisted of names, the number of connections, gender, jobs, and place of work. For this research, only the genders were used, but for other organizations, there may be some other valuable information in this data. For instance, if an organization is looking for certain types of job clusters in its network or wants to analyze if there are clusters of regions in its network. There are many possibilities that this case study has not shown but is all possible. It all depends on what an organization wants to analyze and what data is available.

#### Step 4: Data interpretation

Now, the results of the analysis will be interpreted. The key findings of the case study can be seen in Table 10. Regarding the analysis of the SCI-2 test, the average score for the six individuals is 48.3, which indicates a moderate level of sense of community in the organization. However, there is some variability in individual scores, with a range from 31 to 59, indicating that some people in the organization feel a stronger sense of community than others. The SCI-2 scores suggest that the organization has room for improvement in certain areas, such as membership and influence, but also

has strengths, such as meeting the needs of employees and fostering an emotional connection. The organization can implement new strategies and initiatives to increase its membership and influence. They should consider that something is happening and that not every employee is as satisfied as others.

Based on the analysis of the internal social network, it is clear that some individuals hold a more central and influential position within the organization. E1, E7, and E12 are identified as key players in the network, with high scores across multiple measures. These individuals may play important roles in the organization's communication and decision-making processes, and it may be beneficial for the organization to leverage their influence to help promote a stronger sense of community and collaboration. They can be involved in initiatives aimed at increasing the sense of community.

Moreover, E7 and E8 are identified as central connectors and information brokers in the network. As they hold a position that gives them great access to information and other resources, they may be able to facilitate communication and collaboration between different parts of the organization. Therefore, the organization should consider leveraging their central position to promote more effective communication and collaboration across the network.

E7 is an important employee for the organization, he has a central position in the network and high influence. Luckily for the organization, he also has a strong sense of community and is more likely to be committed to the organizational goals and values. His position and sense of community can lead to higher levels of job satisfaction and engagement, which can improve productivity and contribute to a positive work environment.

Table 10: Key findings of the case study

<b>SNA mathematical analysis</b>	<ul style="list-style-type: none"> <li>- E1 emerges as a central and influential actor in the network, based on their high scores across all four centrality measures.</li> <li>- E7 and E12 also appear to be important actors in the network, with high scores across multiple measures.</li> </ul>
<b>Sense of Community</b>	<ul style="list-style-type: none"> <li>- Average sense of community score is 48.3, which is considered positive.</li> <li>- Person C scores the lowest on all the subscales, indicating a sense of disconnection from the organization, which can be a concern.</li> <li>- The test also highlights areas of strength and weakness within specific groups, and the need for central connectors to have a strong sense of community.</li> </ul>
<b>SNA visual analysis</b>	<ul style="list-style-type: none"> <li>- Two central individuals, E7 and E8, function as information brokers and central connectors within the organization.</li> <li>- E1 is identified as a boundary spanner and maintains the most contacts with customers and networks the most, explaining his location at the network's edge.</li> <li>- The network shows that individuals with similar job functions tend to cluster together</li> </ul>

This case study focused on the Mulder method and presented how organizations can implement it. Its goal was to test the practical usefulness of the method and to see whether the method is appropriate. The method is useful and appropriate when it can be implemented by an organization and it produces valuable insights for organizations about its sense of community and social network. The case study has given Marotura valuable insights into its sense of community and key players within their network. Overall, the study demonstrated the appropriateness and practical usefulness of the Mulder method for Marotura.



## 5. Conclusion and future directions

In this study, the aim was to describe a social network analysis method that measures the sense of community and present the practical usefulness of the method for organizations. Thereby, we provided the possibilities of using SNA to measure and understand the sense of community within an organization, and how to use SNA to make predictions and assumptions. In the case study, we showed that the Mulder method can produce valuable insights about key players within the organization and its sense of community. The Mulder method showed how SNA can be used to analyze and detect influential individuals, clusters, leaders, and the sense of community in an organization, providing valuable information for management. The research showed the potential for SNA to be an important tool for managers and organizations looking to improve organizational performance. By measuring the sense of community within an organization, the study identified areas of improvement, allowing organizations to target specific areas for enhancement to increase the sense of community among its members. For example, in the case of Marotura, the SCI-2 test identified variations in the sense of community, and the analysis provided insights into areas where improvements could be made to increase the sense of community within the organization. Furthermore, the case study presented who the key players were in the network of Marotura and which employees had great access to information and other resources. This information is beneficial for the organization because these influential people can be used to promote initiatives within the organization; for instance, promoting a stronger sense of community.

Referring back to the research question, "What is an appropriate network analysis method for understanding the sense of community in SMEs?", we can conclude that the Mulder method is an appropriate method for understanding the sense of community in SMEs. The case study has provided evidence that the Mulder method is a practical and repeatable network analysis approach, which can be easily implemented by SMEs and used annually. Moreover, it has been shown that the method can yield valuable insights, making it an appropriate method for understanding the sense of community in SMEs and identifying key players in their social network. Furthermore, the method can be further developed to provide insights into decision-making processes. Thus, the Mulder method appears to be an appropriate and effective approach for SMEs seeking to gain a better understanding of their social networks and their sense of community.

This research is in line with previous research that shows the importance of SNA for organizations. That it gives a comprehensive and objective view of an organization's social structure (Borgatti et al., 2013). The study highlights the importance of network roles in creating and maintaining a sense of community among employees within an organization. The use of SNA in this study allows for the identification of network roles such as brokers, gatekeepers, and central connectors, which are crucial in determining the effectiveness of knowledge sharing and collaboration within a community. The findings of this study support the previous literature that has emphasized the significance of network roles in facilitating knowledge sharing (Borgatti et al., 2009; Cross et al., 2002). The study highlights the importance of strong ties in developing a sense of community among employees (Granovetter, 1985). Supporting Granovetter that strong ties are valuable for providing emotional support and social cohesion. The study also has implications for the role of leadership in promoting a sense of community within an organization. It suggests that leadership can facilitate the development of a sense of community by promoting collaboration, trust, and shared values among employees, which was also concluded by Klein and D'Aunno (1986) and House (1983).

This research offers organizations a method for conducting social network analysis and explains the possibilities and value that the technique offers. Furthermore, it explains the role and value of a strong sense of community in organizations. Providing this information, organizations can use this to analyze their own social network, that of their competitors, or that of their customers, and use it as a tool to detect opportunities and areas of improvement within their network and organization. By using the technique, managers will gain a better picture of the organization. It can show them if certain people



within their organization have too much influence over the flow of information, or if there are bottlenecks in their network. Identifying who the central connectors are will have a better understanding of who should be used to stimulate innovation, collaboration, and communication. The study also informs people about the theories involved in SNA, so that they understand and interpret the networks better. The method can be used as a business model, where an organization will be hired to perform SNA on other organizations.

By using SNA to measure the sense of community within an organization, organizations can gain insights into the social networks that exist between employees. This information can be used to identify employees who may be isolated or disconnected from the organization and to take steps to improve their sense of belonging. This, in turn, could lead to increased employee satisfaction and retention. The insights gained from SNA can provide leaders and managers with a better understanding of the informal social networks within their organizations. This information can be used to make more informed decisions as well as to design more effective communication strategies.

To conclude, the Mulder method (Table 11) presented in the study is a suitable network analysis method for understanding the sense of community in organizations. Although the method did not contain all the data required, it explained what is possible if the data is available. Overall, it provides a useful way for organizations to use SNA to understand the sense of community in their organization and to identify areas for improvement. This study provides insights into the possibilities of SNA for measuring and understanding the sense of community within organizations, and it demonstrates the potential for SNA to be an essential tool for improving employee satisfaction and performance. With further research, SNA could become even more valuable for organizations looking to enhance their sense of community and improve their overall performance.

Table 11: The Mulder method

<b>Step 1: Why use SNA</b>	<ul style="list-style-type: none"> <li>• Identify why you want to use SNA. What problem do you want to solve or what are you interested in to know?</li> <li>• What data do you want to collect?</li> <li>• Choose an appropriate data source</li> <li>• Choose the applications for analysis</li> </ul>
<b>Step 2: Data collection</b>	<ul style="list-style-type: none"> <li>• Collecting data regarding relationships of individuals</li> <li>• Checking data reliability and validity</li> <li>• Collecting data about interested attributes</li> </ul>
<b>Step 3: Data analysis</b>	<ul style="list-style-type: none"> <li>• Applying social network analysis techniques</li> <li>• Analyzing network measures</li> <li>• Creating visualizations</li> <li>• Analyzing individuals</li> </ul>
<b>Step 4: Data interpretation</b>	<ul style="list-style-type: none"> <li>• Draw conclusions</li> <li>• Identifying patterns</li> <li>• Identifying key individuals</li> </ul>

This research has several limitations. To start, LinkedIn connections do not display the real interactions that employees have with each other in the organization. This could have led to networks that display the wrong kind of connections in the network. Furthermore, the SCI-2 test asks sensible questions the employees had to fill in, these results may be biased because employees may not always be honest or accurate. The SCI-2 also only has been filled in 6 times, which is a sample that is too small to make generalizations about the organization. This limits the statistical power of the study and the ability to detect significant relationships between variables. In the overall analysis could have been mistakes that have been overlooked, which could have affected the results. The research focuses mainly on the internal network and neglects the strength of the relationships in the network. Lastly, the study misses general data that limit the ability to draw conclusions.

For further research, I would recommend conducting the research at different organizations with better access to data and information. This would perhaps give a better insight into the role and impact of a sense of community in organizations. Possibly detecting relationships between network positions, job functions, years of service, and sense of community. The study focused primarily on quantitative methods, but further research could explore the use of qualitative methods (e.g., interviews, and focus groups) to gain a deeper understanding of the experiences and perspectives of employees within the organization. The method should be tested at different organizations and industries to see if the results are generalizable. Furthermore, a study could focus on what the effect is overtime on the sense of community if you let the central connector(s) of an organization implement strategies for improving it. This study proposes a method that organizations can use. For future research, a study should be conducted to research whether managers are able to implement and understand this method effectively in their organizations, and to assess its practical usefulness. Research could be done if other network methods are more appropriate for understanding the sense of community in organizations by comparing the results with other established methods. Future research could investigate how variables such as the size of the company, cultural factors, and industry sector may impact the sense of community in SMEs. Finally, I aim to modify Chapter 3 to transform it into a white paper that can be easily comprehended by an organization and implemented.

## Appendix A: SCI-2 test questions

2. How important is it to you to feel a sense of community with your colleagues?

*Vink alle toepasselijke opties aan.*

- Prefer not to be part of this organization
- Not important at all
- Not very important
- Somewhat important
- Important
- Very important

3. I get important needs of mine met because I am part of this organization.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

4. Organizational members and I value the same things.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

5. This organization has been succesful in getting the needs of its members met.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

6. Being a member of this organization makes me feel good.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

7. When I have a problem, I can talk about it with my colleagues.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

8. People in this organization have similar needs, priorities, and goals.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

9. I can trust people my colleagues

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

10. I can recognize most of my colleagues.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

11. Most colleagues know me.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

12. This organization has symbols and expressions of membership such as clothes, signs, art, architecture, logos, landmarks, and flags that people can recognize.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

13. I put a lot of time and effort into being part of this organizations.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

14. Being a member of this organization is a part of my identity.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

15. Fitting into this organization is important to me.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

16. This organization can influence other organizations.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

17. I care about what colleagues think of me.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

18. I have influence over what this organization is like.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

19. If there is a problem in this organization, members can get it solved.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

20. This organization has good leaders.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

21. It is very important to me to be a part of this organization.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

22. I am with colleagues a lot and enjoy being with them.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

23. I expect to be a part of this organization for a long time.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely



24. Members of this organization have shared important events together, such as holidays, celebrations, or disasters.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

25. I feel hopeful about the future of this organization

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

26. Members of this organization care about each other.

*Vink alle toepasselijke opties aan.*

- Not at all
- Somewhat
- Mostly
- Completely

## References

- Arif, Tasleem. (2015). The Mathematics of Social Network Analysis: Metrics for Academic Social Networks. *International Journal of Computer Applications Technology and Research*, 4, 889-893. 10.7753/IJCATR0412.1003.
- Block, L. (2022). Challenges in Social Network Analysis of social media data – Blockint. Retrieved November 1, 2022, from <https://www.blockint.nl/methods/challenges-in-social-network-analysis-of-social-media-data/>
- Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2013). *Analyzing Social Networks*, *The Journal of Mathematical Sociology*, 39:3, 221-222, DOI: [10.1080/0022250X.2015.1053371](https://doi.org/10.1080/0022250X.2015.1053371)
- Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009, February 13). Network Analysis in the Social Sciences. *Science*, 323(5916), 892–895. <https://doi.org/10.1126/science.11658>
- Boyd, D. M., & Ellison, N. B. (2007, October). Social Network Sites: Definition, History, and Scholarship. *Journal of Computer-Mediated Communication*, 13(1), 210–230. <https://doi.org/10.1111/j.1083-6101.2007.00393.x>
- Boyd, N., Nowell, B., Yang, Z., & Hano, M. C. (2017). Sense of Community, Sense of Community Responsibility, and Public Service Motivation as Predictors of Employee Well-Being and Engagement in Public Service Organizations. *The American Review of Public Administration*, 48(5), 428–443. <https://doi.org/10.1177/0275074017692875>
- Boyd, N. M., & Nowell, B. (2017). TESTING A THEORY OF SENSE OF COMMUNITY AND COMMUNITY RESPONSIBILITY IN ORGANIZATIONS: AN EMPIRICAL ASSESSMENT OF PREDICTIVE CAPACITY ON EMPLOYEE WELL-BEING AND ORGANIZATIONAL CITIZENSHIP. *Journal of Community Psychology*, 45(2), 210–229. <https://doi.org/10.1002/jcop.21843>
- Burt, R.S. (1992) *Structural Holes: The Social Structure of Competition*. Harvard University Press, Cambridge, MA.
- Burt, R. S. (2000). The Network Structure Of Social Capital. *Research in Organizational Behavior*, 22, 345–423. [https://doi.org/10.1016/s0191-3085\(00\)22009-1](https://doi.org/10.1016/s0191-3085(00)22009-1)
- Burt, R. (2004, september). Structural Holes and Good Ideas. *American Journal of Sociology*, 110(2), 349–399. <https://doi.org/10.1086/421787>
- Carpenter, D. P., Esterling, K. M., & Lazer, D. M. J. (1998). The Strength of Weak Ties in Lobbying Networks. *Journal of Theoretical Politics*, 10(4), 417–444. <https://doi.org/10.1177/0951692898010004003>
- Chavis, D. M., Lee, K. S., & Acosta, J. D. (2008). Sense of Community Index 2. *PsycTESTS Dataset*. <https://doi.org/10.1037/t33090-000>
- Chell, E., & Baines, S. (2000). Networking, entrepreneurship and microbusiness behaviour. *Entrepreneurship & Regional Development*, 12(3), 195–215. <https://doi.org/10.1080/089856200413464>
- Dawson, S. (2008). A Study of the Relationship between Student Social Networks and Sense of Community. *Educational Technology & Society*, 11(3), 224–238. [http://www.ifets.info/journals/11\\_3/16.pdf](http://www.ifets.info/journals/11_3/16.pdf)

Donath, Judith & boyd, danah. (2004). Public Displays of Connection. *Bt Technology Journal - BT TECHNOL J.* 22. 71-82. [10.1023/B:BTTJ.0000047585.06264.cc](https://doi.org/10.1023/B:BTTJ.0000047585.06264.cc).

Ellison, N. B., Steinfield, C., & Lampe, C. (2007, July). The Benefits of Facebook “Friends:” Social Capital and College Students’ Use of Online Social Network Sites. *Journal of Computer-Mediated Communication*, 12(4), 1143–1168. <https://doi.org/10.1111/j.1083-6101.2007.00367.x>

Fan, R., Xu, K., & Zhao, J. (2020). Weak ties strengthen anger contagion in social media. *ArXiv*, abs/2005.01924.

Friemel, T. N. (2017). Social Network Analysis. *The International Encyclopedia of Communication Research Methods*, 1–14. <https://doi.org/10.1002/9781118901731.iecrm0235>

Gamper, M. (2022). *Social Network Theories: An Overview*. SpringerLink. Geraadpleegd op 12 september 2022, van [https://link.springer.com/chapter/10.1007/978-3-030-97722-1\\_3?error=cookies\\_not\\_supported&code=9a421ac7-4aa2-4240-8860-288c6e4a36d0](https://link.springer.com/chapter/10.1007/978-3-030-97722-1_3?error=cookies_not_supported&code=9a421ac7-4aa2-4240-8860-288c6e4a36d0)

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360–1380. <https://doi.org/10.1086/225469>

Hansen, M. T. (1999). The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge across Organization Subunits. *Administrative Science Quarterly*, 44(1), 82–111. <https://doi.org/10.2307/2667032>

Hevner, Alan & R, Alan & March, Salvatore & T, Salvatore & Park, & Park, Jinsoo & Ram, & Sudha,. (2004). Design Science in Information Systems Research. *Management Information Systems Quarterly*. 28. 75-.

Himmelboim, Itai. (2017). *Social Network Analysis (Social Media)*. 10.1002/9781118901731.iecrm0236.

House, J. S. (1983). Work Stress and Social Support. *Contemporary Sociology*, 12(3), 329. <https://doi.org/10.2307/2069001>

Hughey, J., Speer, P. W., & Peterson, N. A. (1999). Sense of community in community organizations: Structure and evidence of validity. *Journal of Community Psychology*, 27(1), 97–113.

Jacomy, M., Venturini, T., Heymann, S. & Bastian, M. (2014). ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software. *PLoS ONE*, 9(6), e98679. <https://doi.org/10.1371/journal.pone.0098679>

Johnson, E. M., & Chew, R. (2021). *Social network analysis methods for international development*. RTI Press. RTI Press Research Brief No. RB-0026-2105 <https://doi.org/10.3768/rtipress.2021.rb.0026.2105>

Kiss, A, A Turrini and A Vandeplas (2022), “Slack vs. tightness in euro area labour markets: growing mismatch after COVID-19?”, *Quarterly Review of the Euro Area* 21(2), European Commission, Directorate-General for Economic and Financial Affairs.

Klein, K. J., & D’Aunno, T. (1986). Psychological sense of community in the workplace. *Journal of Community Psychology*, 14(4), 365–377.

Knocke, D. and Yang, S. (2008) *Social Network Analysis*. SAGE, Thousand Oaks. <https://doi.org/10.4135/9781412985864>

Kolleck, Nina. (2013). Understanding the chances and limits of social network analysis for innovation research. *European Journal of Futures Research*. 1.

Krijkamp, A. R., Knobens, J., Oerlemans, L. A., & Leenders, R. T. (2021). An ace in the hole: The effects of (in)accurately observed structural holes on organizational reputation positions in whole networks. *Journal of Business Research*, 129, 703–713. <https://doi.org/10.1016/j.jbusres.2019.10.066>

de Laat, M., Lally, V., Lipponen, L. et al. Investigating patterns of interaction in networked learning and computer-supported collaborative learning: A role for Social Network Analysis. *Computer Supported Learning* 2, 87–103 (2007). <https://doi.org/10.1007/s11412-007-9006-4>

Labun, A. & Wittek, R. (2014). Structural Holes. *Encyclopedia of Social Network Analysis and Mining*, 2075–2083. [https://doi.org/10.1007/978-1-4614-6170-8\\_263](https://doi.org/10.1007/978-1-4614-6170-8_263)

Leon, R. D., Rodríguez-Rodríguez, R., Gómez-Gasquet, P. & Mula, J. (2017). Social network analysis: A tool for evaluating and predicting future knowledge flows from an insurance organization. *Technological Forecasting and Social Change*, 114, 103–118. <https://doi.org/10.1016/j.techfore.2016.07.032>

Liben-Nowell, D., & Kleinberg, J. (2007). The link-prediction problem for social networks. *Journal of the American Society for Information Science and Technology*, 58(7), 1019–1031. <https://doi.org/10.1002/asi.20591>

Liu, W., Sidhu, A., Beacom, A. M., & Valente, T. W. (2017). Social network theory. *The International Encyclopedia of Media Effects*, 1–12. <https://doi.org/10.1002/9781118783764.wbieme0092>

McMillan, D. W., & Chavis, D. M. (1986). Sense of community: A definition and theory. *Journal of Community Psychology*, 14(1), 6–23. [https://doi.org/10.1002/1520-6629\(198601\)14:1<6::AID-JCOP2290140103>3.0.CO;2-I](https://doi.org/10.1002/1520-6629(198601)14:1<6::AID-JCOP2290140103>3.0.CO;2-I)

Mastrangelo, A., Eddy, E. R. & Lorenzet, S. J. (2004). The importance of personal and professional leadership. *Leadership & Organization Development Journal*, 25(5), 435–451. <https://doi.org/10.1108/01437730410544755>

Min, S. J., & Wohn, D. Y. (2020). Underneath the Filter Bubble: The Role of Weak Ties and Network Cultural Diversity in Cross-Cutting Exposure to Disagreements on Social Media. *The Journal of Social Media in Society*, 9(1), 22+. <https://link.gale.com/apps/doc/A683074525/AONE?u=anon~93e68253&sid=googleScholar&xid=2efb7ef>

Mehta, P., & Krishnan, V. R. (1999). Role of Leadership in Building A Sense of Community: A Preliminary Investigation. *Management and Labour Studies*, 24(4), 236–242. <https://doi.org/10.1177/0258042x9902400403>

Mintzberg, H. (2009). Rebuilding Companies as Communities. *Harvard Business Review*, 87, 140–143.

Nowell, B., & Boyd, N. (2010). Viewing community as responsibility as well as resource: deconstructing the theoretical roots of psychological sense of community. *Journal of Community Psychology*, 38(7), 828–841. <https://doi.org/10.1002/jcop.20398>

Nunes, M., & Abreu, A. (2021). The Benefits of Applying Social Network Analysis to Identify Collaborative Risks. *IFIP Advances in Information and Communication Technology*, 16–23. [https://doi.org/10.1007/978-3-030-78288-7\\_2](https://doi.org/10.1007/978-3-030-78288-7_2)

Obstfeld, D., Borgatti, S. P., & Davis, J. (2014). Brokerage as a Process: Decoupling Third Party Action from Social Network Structure. *Contemporary Perspectives on Organizational Social Networks*, 135–159. [https://doi.org/10.1108/s0733-558x\(2014\)0000040007](https://doi.org/10.1108/s0733-558x(2014)0000040007)

- Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, 24(3), 45–77. <https://doi.org/10.2753/mis0742-1222240302>
- Pretty, G., & McCarthy, M. C. (1991). Exploring psychological sense of community among women and men of the corporation. *Journal of Community Psychology*, 19(4), 351–361. [https://doi.org/10.1002/1520-6629\(199110\)19:4](https://doi.org/10.1002/1520-6629(199110)19:4)
- Putnam, R. D. (1995). Bowling Alone: America's Declining Social Capital. *Journal of Democracy*, 6(1), 65–78. <https://doi.org/10.1353/jod.1995.0002>
- Riddell, J., Brown, A., Kovic, I., & Jauregui, J. (2017). Who Are the Most Influential Emergency Physicians on Twitter? *Western Journal of Emergency Medicine*, 18(2), 281–287. <https://doi.org/10.5811/westjem.2016.11.31299>
- Sagr, M., Alamro, A. The role of social network analysis as a learning analytics tool in online problem-based learning. *BMC Med Educ* 19, 160 (2019). <https://doi.org/10.1186/s12909-019-1599-6>
- Scott, J. (2000) *Social Network Analysis: A Handbook*. 2nd Edition, Sage Publications, London.
- Soda, G., Tortoriello, M., & Iorio, A. (2018). Harvesting Value from Brokerage: Individual Strategic Orientation, Structural Holes, and Performance. *Academy of Management Journal*, 61(3), 896–918. <https://doi.org/10.5465/amj.2016.0123>
- Sözen, H.Cenk & Basım, Nejat & Hazır, Köksal. (2009). Social Network Analysis in Organizational Studies. *International Journal of Business and Management*. 1. 21-35.
- Sparrow, M. K. (1991). The application of network analysis to criminal intelligence: An assessment of the prospects. *Social Networks*, 13(3), 251–274. [https://doi.org/10.1016/0378-8733\(91\)90008-h](https://doi.org/10.1016/0378-8733(91)90008-h)
- Speer, P. W., Peterson, N. A., Armstead, T. L., & Allen, C. T. (2012). The Influence of Participation, Gender and Organizational Sense of Community on Psychological Empowerment: The Moderating Effects of Income. *American Journal of Community Psychology*, 51(1–2), 103–113. <https://doi.org/10.1007/s10464-012-9547-1>
- Tichy, N. M., Tushman, M. L., & Fombrun, C. (1979). Social Network Analysis For Organizations. *Academy of Management Review*, 4(4), 507–519. <https://doi.org/10.5465/amr.1979.4498309>
- Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511815478>
- Weng, L., Karsai, M., Perra, N., Menczer, F., & Flammini, A. (2018). Attention on Weak Ties in Social and Communication Networks. *Computational Social Sciences*, 213–228. [https://doi.org/10.1007/978-3-319-77332-2\\_12](https://doi.org/10.1007/978-3-319-77332-2_12)
- Xinmin Peng, Fanghui Ju, Xuebing Peng, & Lin Wang. (2008). The relationship between interfirm network ties and innovative performance with contingent perspective. *2008 4th IEEE International Conference on Management of Innovation and Technology*. <https://doi.org/10.1109/icmit.2008.4654363>
- Zani, B., & Cicognani, E. (2012). Sense of community in the work context. A study on members of a co-operative enterprise.
- Zhao, J., Wu, J., & Xu, K. (2010, July 6). Weak ties: Subtle role of information diffusion in online social networks. *Physical Review E*, 82(1). <https://doi.org/10.1103/physreve.82.016105>

Zhu, B., Watts, S. & Chen, H. (2010). Visualizing social network concepts. *Decision Support Systems*, 49(2), 151–161. <https://doi.org/10.1016/j.dss.2010.02.001>