Social network analysis and activity theory: A symbiotic relationship

Abstract

The chapter outlines benefits that can be accrued by combining SNA approaches with those based on activity theory. The two frameworks take different perspectives and are from very different origins. However, in essence they are both concerned with understanding the interactions that take place between individuals or networks in order to achieve a goal. The combination of these two research approaches can be utilised to address some of the limitations of both SNA and activity theory.

This chapter will initially explore similarities and differences in the philosophical principles underpinning SNA and activity theory, before moving on to the strengths and weaknesses of research designs based on each. It will then progress to discussing how a combination of the frameworks can create a stronger design; in particular we will explore how activity theory can place SNA in a qualitatively rich context, while SNA provides a structured exploration of the community and division of labour elements of an activity system. While there are several benefits to combination, there remain limitations that are not addressed by mixing these particular frameworks, such as a lack of focus on cognitive processes. Finally, the chapter will end by giving an example of a research design that combined SNA and activity theory to illustrate how researchers may implement this particular mixed methods approach.

Introduction

Social network analysis (SNA) and activity theory are both frameworks that can give great insight into the dynamics of situations. Some similarities exists as the two frameworks can each be thought of as a collection of theories that focus on a particular aspect of a situation, with associated methods of inquiry. Research designs utilising SNA will place relationships at the heart of their study, whereas studies using activity theory explore how a community works together to achieve their aims. Each approach can be operationalised in a variety of ways, making both frameworks flexible tools with the ability to be tailored to address specific research questions. The strong influence of theories on each approach creates clear methodological considerations that must be taken into account by any research design incorporating either. While neither approach offers a prescribed step by step process to investigating a phenomenon, these explicit requirements make it easier for researchers to make the necessary move from theoretical stance to research design (Twining, Heller, Nussbaum, & Tsai, 2017).

One of the primary reasons to employ a mixed methods design is to address limitations that exist in particular standalone approaches (Creswell & Plano-Clark, 2011). For details on the strengths and weaknesses of SNA see Chapters 1 and 2. Due to its strengths, social network techniques can be a powerful tool when used in case studies (Rienties, Johan, & Jindal-Snape, 2015). Quantitative social network surveys offer a relatively objective perspective on the dynamics of a network (Knoke & Yang, 2008), while qualitative approaches can probe the "why" and "how" questions of a situation (Stake, 1995). When brought together with other methods within a case study, social network approaches can provide information on network dynamics and, at the same time, perspectives on relationships that are important in interpreting the situation being examined.

This chapter will explore the synergies that exist between SNA and activity theory based case studies. As will be discussed, relationships are of vital importance to both SNA and activity theory. In SNA the relationships between individuals and networks form the central focus (Knoke & Yang, 2008), while activity theory revolves around the wider context in which those relationships exist to achieve objectives (Engeström, 2000). This common ground allows triangulation of the two frameworks to create a detailed analysis of the dynamics of particular networks. Nonetheless, each approach emphasises a different aspect of collaboration. This difference becomes a strength of a mixed method design employing both frameworks, as each addresses some limitations of the other. The chapter finishes with an example of how a design employing SNA and activity theory can be implemented in practice.

The authors of this chapter assume that readers are familiar with SNA, and are exploring ways to integrate it into mixed methods designs. The chapter therefore spends time detailing activity theory and mixed methods case studies, as readers may not be necessarily familiar with the literature on these topics, but relies on the reader having read additional material on SNA.

Activity Theory

Activity theory is a framework that states human activity is mediated by various social, cultural, and historical elements (Roth & Lee, 2007). A brief overview of activity theory is presented here, for further information readers are recommended to see Engeström (2014). Activity theory can be conceptualised as an individual (usually termed a 'subject') trying to achieve certain objectives (usually labelled as an 'object') through the use of artefacts. Achieving these objectives will lead to desired outcomes. For example, in a Mathematics class a student (subject), may use a calculator (artefact/tool) to complete a set of questions (object). This should lead to the outcome of improved mathematical knowledge. It is worth noting that the term object has been used in subtly different

ways in activity theory literature. Sometimes it is used as a particular physical or conceptual object on which activity is focused, and can itself be altered by an activity (e.g., Jonassen, 2000). Alternatively others describe the object as the objectives of the activity (e.g., Nardi, 1996). Perhaps the best way of understanding the object is as outlined by Engeström (2000), where the object is the physical or conceptual focus of the activity, but its importance comes from the fact that it becomes a manifestation of the overall objectives and goals of the activity system. As it is the motivations and desired outcomes of a community that really drive how an activity is enacted, we find considering the object as synonymous with objectives as the most useful way of operationalising the object. As with object, slightly different terms have been used to describe the mediating artefacts central to activity theory. Roth and Lee (2007) refer to the 'means', Engeström (2001) talks about 'mediating artefacts', while Larsen et al. (2017) specifically labels this part of the system 'tools'.

Activity theory also examines the dynamics of the subject's community, how labour was divided between members of that community, and the rules governing the community. Finally, activity theory acknowledges that there are often different communities conducting related activities that interact and influence each other. The outcomes of different communities can mutually affect the activities of others. As Figure 1 shows, this allows for partially overlapping objects of activity systems, which can cause renegotiation of the purpose of both activity systems, creating news objectives.
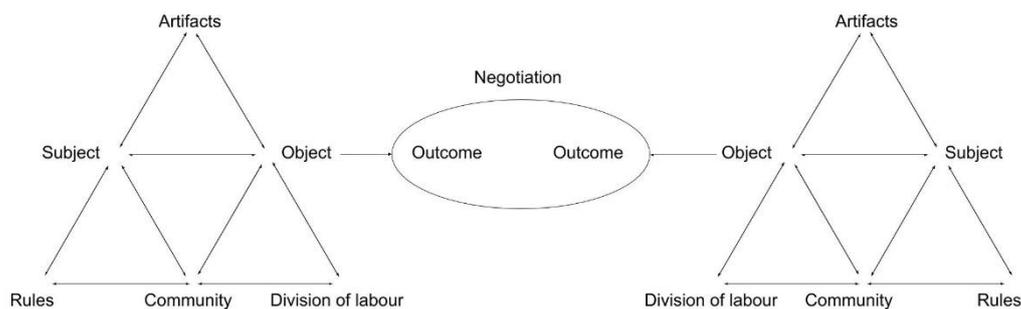

FIGURE 1 – Third generation of activity theory

Activity Theory and Social Network Analysis

While SNA and activity theory have evolved from very different schools of thought, they share a common understanding of the importance of social context, and the way that different networks can influence each other. The dynamics of the community and division of labour elements of activity theory in particular have an affinity with social network theories. Social capital, for example, is a theory that could play a role in explaining both community dynamics and division of labour. Furthermore, the addition of the two interacting activity systems could be considered as two connected networks. Concepts from network theories, such as brokerage, could be utilised to understand the interplay between the activity systems (Burt, 2004).

An additional aspect that aligns well between SNA and activity theory is the importance of history. In activity theory it is understood that there could be tensions between, for example, how an artefact is used and the objectives of a system (Roth & Lee, 2007). As shall be discussed later in the chapter, one way to utilise the activity theory framework is to identify contradictions between elements of the systems (Engeström & Sannino, 2011). Contradictions are given importance in the

theory as it is by overcoming structural tensions that development occurs. These contradictions are often influenced by historical factors. For example, the traditions of the workplace in Japan mean that fax machines are still commonly used for communication (Fitzpatrick, 2015). This could be a potential tension when working with international partners who no longer use fax machines. This dynamic nature of communities and networks is also a central component in many studies utilising SNA. For example, SNA research designs can aim to understand how interventions influence network compositions over time (e.g, Rienties, Johan, & Jindal-Snape, 2015).

Nonetheless, despite potentially complementary views of the world, activity theory and SNA differ in several significant ways. When using activity theory the base unit is an activity system (Engeström, 2000), and the individuals involved in that activity form the boundary as to who is considered part of the community. Boundaries are usually defined based on alignment of motivations and objectives (Nardi, 1996). In contrast, in SNA it is often difficult to define a boundary, and boundaries can often be considered dynamic (Knoke & Yang, 2008). For example, in studies of ego-networks a single relationship could be considered as a meaningful unit of analysis (Borgatti, Brass, & Labianca, 2009). Alternatively it may not be meaningful to define a network boundary at all, as people completely un-related in principal to an activity can have an influential role. For example, the romantic partner of a CEO is likely to be a source of support and influence his or her work activity, but will to be missing from an analysis based on activity theory. Another difference is that activity theory places a large emphasis on the context and in particular the objectives of a network. Some studies have focused entirely on the differing objectives of connected networks (Larsen et al., 2017). In the next section of this chapter it will be argued that it is these differences that result in value when activity theory and SNA are combined.

Social Network Analysis and Activity Theory in Practice

Activity theory is in essence a theoretical framework to describe the interactions and context of a network trying to achieve goals (Shanahan, 2010). It has been operationalised in several different ways: as the basis for an intervention (Engeström, 2001), as an analytical tool to describe working on a task (Jurdak, 2006), or as a guide to identify tensions in an activity (Kaatrakoski, Littlejohn, & Hood, 2017). One of the most common ways that it has been used in research is as framework for data triangulation in case studies (Lazarou, Erduran, & Sutherland, 2017). Mixed-method designs often use analytical frameworks to aid data triangulation (Creswell et al., 2003), and activity theory can be a guide for bringing together different methods to create a cohesive picture of a situation (Shanahan, 2010). It is through the case study approach that several opportunities exist for combining activity theory and SNA.

Researchers employing activity theory develop an in-depth qualitative understanding of all elements of an activity system. However, when reporting activity theory the complexities of the community and division of labour elements are often explored in less depth than other parts, such as the objectives. In Engeström's (2001) article on medical practitioners, the community boundary was described in detail, and the formal positions of those involved were named. Nonetheless, there is an opportunity to communicate more precise understandings of the structures and density of ties within a community using SNA (Borgatti et al., 2009). Quantitative SNA techniques offer a more objective understanding of a community than techniques traditionally used in activity theory. One of the central tenants of activity theory is that each element influences others (Engeström, 2000). It is therefore desirable to be able to describe the community and their division of labour in as much detail as possible.

Conversely, SNA places relationships, the dynamics of a community, and the roles which people play at the centre of its focus. When studying networks, such as teams in a workplace, a major strength is bringing structure and precision to relatively general concepts, such as friendship (Borgatti, Everett, & Johnson, 2018). One criticism that has been levied against SNA is its lack of consideration of context, in other words, its inability to address questions on why a network is the way it is, or why the structure of the network matters (Borgatti et al., 2009). Another limitation that has been suggested is its lack of taking larger scale influences, such as cultural norms, into account (Emirbayer & Goodwin, 1994). Activity theory, on the other hand, is primarily a culturally driven theory and places communities in context to understand their impact on outcomes (Roth & Lee, 2007). As activity theory places networks in context, while SNA provides details on community and division of labour, the two frameworks may present compatible approaches.

Despite the combination of activity theory and SNA building on each other's strengths, there remain limitations that are not addressed by this kind of research design. Perhaps the largest is the lack of focus of either methodology on individuals' internal factors (Emirbayer & Goodwin, 1994). Emotions and cognitive processes of individuals have been identified as influential on individual behaviour (Illeris, 2003), but often neither of these are taken into account in either SNA or activity theory. Furthermore, combination in the way suggested by this chapter is subject to many of the limitations that are inherent to case studies and qualitative research in general, such as limited generalisability (Creswell & Poth, 2018). Additionally, limitations that are common across mixed methods designs could become issues in this type of research design. SNA and activity theory are both broad frameworks which are associated with multiple methods; skills and knowledge related to both frameworks are required to effectively carry out a research project, and can be time consuming to develop (Creswell & Plano-Clark, 2011). Ultimately, like any research design, the combination of activity theory and SNA is suitable in some situations. Affordances and limitations must be weighed against the specific research questions.

Mixed Methods and Activity Theory Based Case Studies

Mixed method approaches and case studies, including those based on activity theory, have a certain natural affinity. A case study involves the collection of multiple types of data (Yin, 2013). Mixed methods designs are defined by their multiple data sources, some quantitative and some qualitative (Creswell & Plano-Clark, 2011). One difficulty however, is that both types of study come with various classification systems. Yin (2013) differentiates between case studies based on the aims of the study: cases can either explain, describe, illustrate, explore or be a meta-evaluation. Additional classifications of case studies include instrumental or intrinsic, depending on whether the cases being studied are illustrative examples or unusual exemplars of the phenomenon of interest (Stake, 1995). Likewise, mixed methods research has been divided based upon such criteria as the sequence in which data is collected (Creswell & Plano-Clark, 2011), whether one data source is nested within another (Creswell et al., 2003), or the relative importance given to quantitative and qualitative methods (Leech & Onwuegbuzie, 2009). Guetterman and Fetters (2018) suggested that when case studies and mixed methods are combined they can be classified as either case study-mixed methods designs, in other words a case study that utilises mixed methods, or mixed-methods case studies, a mixed methods study that has nested within it a case study.

It can be a challenge to master all the terminology associated with mixed methods, case studies, activity theory, and social network analysis. Nonetheless, there are some questions that can help researchers decide on how they should classify their design, and how different types of data will be brought together to describe a more holistic understanding of a phenomena – a goal of both case studies and mixed methods.

1. Sequence of data collection

This distinction is not usually made within case studies, but is an important consideration of mixed methods (Leech & Onwuegbuzie, 2009). Data for activity theory based studies is often collected over an extended time period, similar to ethnographic or grounded theory approaches (e.g., Engeström, 2001). Methods for collecting SNA data vary, but observation techniques have commonly been used to determine where ties exist (Knoke & Yang, 2008). This method of SNA data collection aligns well with concurrently collecting all data. Alternatively, if interviews are used to gather information about elements of the activity system, it could be beneficial to send a social network survey first. SNA can be used to initially estimate boundaries for activity systems if there are uncertainties regarding the formal structures, such as work networks, although as it is objectives rather than connections that define an activity system (Nardi, 1996) this should still be investigated through other methods. SNA results additionally could be used to identify interview participants, based on their position or role in the community, and can produce diagrams for reflection during qualitative inquiries (e.g., Mittelmeier, Rienties, Tempelaar, & Whitelock, 2018).

2. Importance of each method

One common aspect of mixed methods typologies is the relative importance and relationship between qualitative and quantitative methods (Creswell et al., 2003; Leech & Onwuegbuzie, 2009). As SNA gives rich detail of the community and division of labour aspects of an activity system, SNA becomes nested within the broader activity theory based case study. In their review article Guetterman and Fetters (2018) found 83% of studies combing case studies and mixed methods in their designs were primarily case studies that utilised mixed method approaches. Nesting SNA in an activity theory based case study would therefore be a natural way to mix the two frameworks. However, it could be that the case study is itself embedded in wider SNA research. Imagine a research project where the goal is to understand the variety in social structures of 100 classes in a school. Classes of interest could then be selected for further investigation using activity theory based case studies as exemplars of certain situations. In this approach the case study would be embedded in broader SNA research.

3. Number and type of cases

The number and type of cases is always of fundamental concern in case studies (Yin, 2013), although practical restrictions may dictate that there are limited options (Stake, 1995). In general it is necessary to consider whether the case you are choosing is typical of the phenomenon of interest, or a particularly unusual situation that gives insight into the phenomenon (Guetterman & Fetters, 2018). In the most rigorous approaches to case selection, mixed methods can be employed to select cases, which may include SNA data (Sharp et al., 2012). The number of cases that should be included in the study is also something to be deliberated. Royer (2009) suggests that the type of cases being examined should be a consideration, but the central driving force for the number of cases selected should be the goal of the research. As each case is a single unit of analysis (Engeström, 2001; Harland, 2014), whether the purpose of the research is to describe a situation, generate a theory, or test a hypothesis will dictate how many cases are appropriate. As with data collection, the sequence of case selection may be something that a researcher needs to consider, as cases may be investigated concurrently or one after another (Chmiliar, 2009).

4. Boundaries

One key part of both SNA and activity systems is consideration of boundaries (see Chapter 3 for a detailed discussion of boundaries in SNA). Nardi (1996) proposed that boundaries of activity systems

can be defined by considering which individuals have similar objectives. Official position or role has been used to differentiate boundaries of activity systems, such as students versus supervisors (Larsen et al., 2017). However, as outlined above, sequential designs offer opportunities to base decisions on activity system boundaries on the results of SNA. As an alternative, boundaries could also be drawn up in a sequential design after qualitative methods have been used to determine the similarity of objectives between communities.

5. Data integration

Data integration is a key concept in both mixed methods and case studies (Creswell & Plano-Clark, 2011; Yin, 2013). Readers are recommended to read Fetters, Curry, and Creswell's (2013) thorough article on integration that can occur at several points during a mixed methods study. Depending on the exact research design integration could occur at several stages. A type of integration that will always be appropriate in case studies combining SNA and activity theory is the weaving approach during reporting. As activity theory can be conceptualised as six elements a narrative description of each, where all qualitative and quantitative sources of data are combined, will always be possible. However, depending on the research questions being addressed, there are likely to be other opportunities, for example, building methodologically by using SNA to design qualitative interview protocols (Creswell & Plano-Clark, 2011). It is, however, vital that purposeful integration is considered as part of the research design.

An Example Design

To end this chapter a practical example will be presented to illustrate one potential research design using both SNA and activity theory. Readers can additionally consult Panchoo (2012) for an example of a study design using both SNA and activity theory.

Research Questions

The context of the design was learning from incidents, a type of organisational learning process where incidents, accidents, and near-misses are used as a stimulus for an organisation to learn (Drupsteen & Guldenmund, 2014). In high risk industries, such as energy and aviation, learning from incidents that others have experienced is viewed as "free lessons" (Rose, 2004). It is hence vital that networks are used to share incident information and make industry-wide steps forward in safety. However, receiving information is only the starting point in learning. This research area thus appeared to be one where networks played an important role in distribution of information. Nevertheless, the context in which these networks existed was of paramount importance to exactly how learning occurred. The specific research questions to be addressed by the study were:

1. How is incident information shared across an organisation?
2. What do organisations perceive as learning in the context of learning from incidents?
3. How do people use the incident information that they receive to learn?

Due to the importance of networks and context, a case study using both activity theory and SNA was implemented.

Case selection

A company was selected with the requirement of having a well-developed learning from incidents system. The company structure involved regional teams of engineers who would visit distributed sites across the UK. Each team comprised of between 10 and 30 engineers who worked predominantly independently, but reported to the same team supervisor. Teams were additionally divided between two different types of job, repairing equipment or installing equipment, and two

different types of region, urban or rural. Two teams from each job type, one from an urban location and one from a rural location, were selected to take part in the study.

Data Collection

Two different types of data were collected. Initially a social network survey was distributed to each team. The instrument involved three parts. The first asked for an example of a time that the employee had used incident information. The second section listed all members of that person's team and asked the participant to indicate who on their team they would ask for advice on safety, and who they received incident information from through formal means such as meetings. The final part of the survey was an open-ended name generator, where the participant was asked to list anyone outside of their team who they would ask for safety related information, or from whom they formally received incident information.

After responses to the surveys were collected, network-level SNA was undertaken. Based upon their position in the social network, and whether they were an engineer or a team supervisor, participants were selected for interviews. The positions of interest from a social network perspective were the bridge builders, more specifically, the person in the team besides the manager with the highest in-degree in the advice seeking network, someone who selected the bridge builder, an isolate, and someone who did not select their manager as a person to ask for advice.

The interview protocol was developed based upon the answers to the social network questions. Participants were asked to expand upon their own answers and additionally identify themselves on their team's sociogram. Additional questions were created to explore the other sections of the activity system. Participants were asked to expand upon the example they provided in the survey, and asked what they thought was the purpose of learning from incidents. These questions allowed exploration of the perceived objectives of the activity system. Furthermore, participants were asked to describe the process by which incident information was shared, in order to probe the rules and tools of the company's learning from incidents system.

Data Analysis

A comparison of the diversity of ties in the ego networks of managers versus engineers was made to establish an initial estimate of how many activity systems were present. Thematic analysis was used to generate a taxonomy of the different types of objectives held by managers and engineers to further establish that they were separate activity systems. Relevant sections of the interviews were then coded as either 'tools', 'rules', 'community', or 'division of labour', in other words, the non-objective related elements of an activity system. For the community and division of labour elements the SNA and interview data were compared to establish if they confirmed each other's findings. Finally, a sentence by sentence coding scheme was applied, where tensions in the activity system were identified. Identified tensions were then compared to the narrative descriptions of the activity systems, and where appropriate to the SNA results, for potential explanations. Figure 2 presents a visual description of this research design.
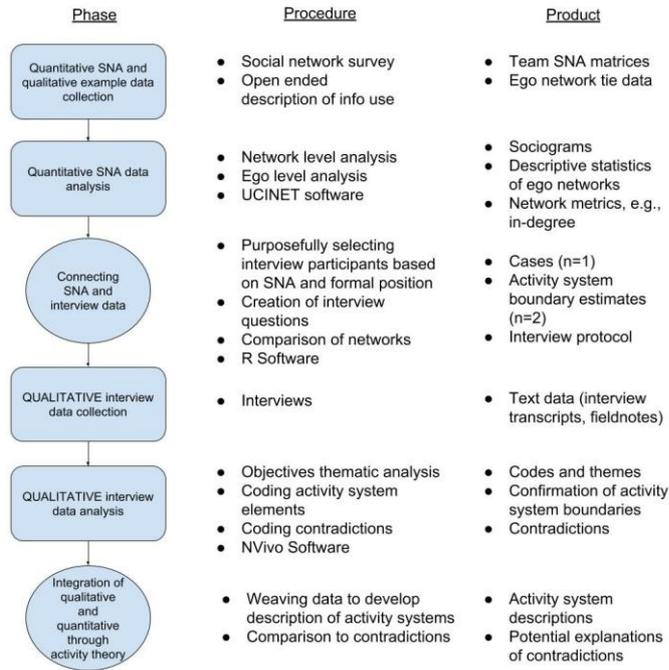
Phase	Procedure	Product
Quantitative SNA and qualitative example data collection	• Social network survey • Open ended description of info use	• Team SNA matrices • Ego network tie data
Quantitative SNA data analysis	• Network level analysis • Ego level analysis • UCINET software	• Sociograms • Descriptive statistics of ego networks • Network metrics, e.g., in-degree
Connecting SNA and interview data	• Purposefully selecting interview participants based on SNA and formal position • Creation of interview questions • Comparison of networks • R Software	• Cases (n=1) • Activity system boundary estimates (n=2) • Interview protocol
QUALITATIVE interview data collection	• Interviews	• Text data (interview transcripts, fieldnotes)
QUALITATIVE interview data analysis	• Objectives thematic analysis • Coding activity system elements • Coding contradictions • NVivo Software	• Codes and themes • Confirmation of activity system boundaries • Contradictions
Integration of qualitative and quantitative through activity theory	• Weaving data to develop description of activity systems • Comparison to contradictions	• Activity system descriptions • Potential explanations of contradictions

FIGURE 2 – Visual model of research design phases, protocols and products

Results

While a full description of the results is beyond the scope of this chapter, certain selections are presented to aid understanding of how data was integrated. From both the comparison of interview themes, and from the analysis of ego-network diversity, it was concluded that the supervisors and the engineers represented different activity systems. As can be seen from Figure 3, the team supervisor was important for informal distribution of knowledge, and was the primary means by which a team was informed about incidents. The interviews revealed that, as the team was distributed, engineers relied on formal positions to know who to contact for advice, for example several team members were designated as mentors. On the surveys participants often mentioned that they would contact the safety engineer for advice. During the interviews it became clear that the safety engineer was in fact the first person they would contact for advice in most situations.

Based on the SNA and interviews an activity system was created. A simplified version of the activity system and associated networks are shown in Figure 3.
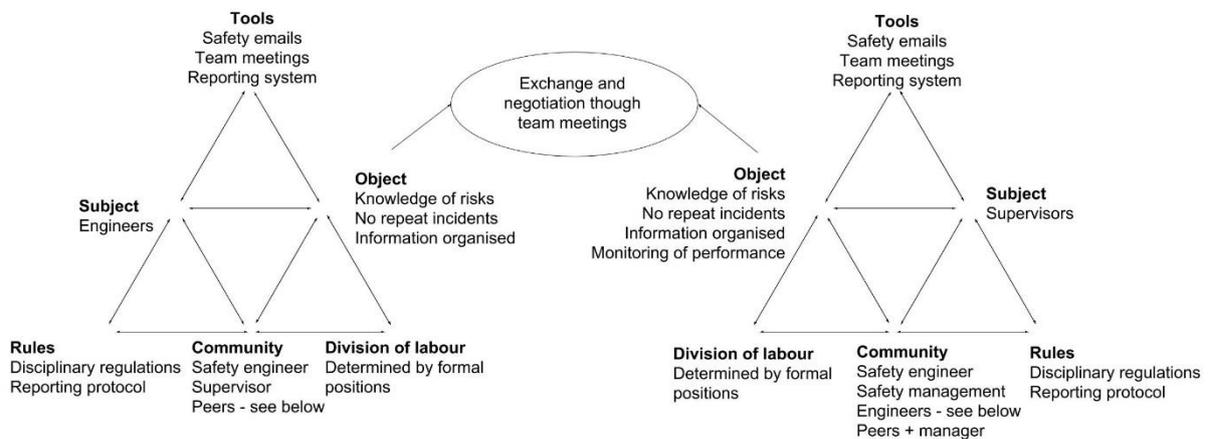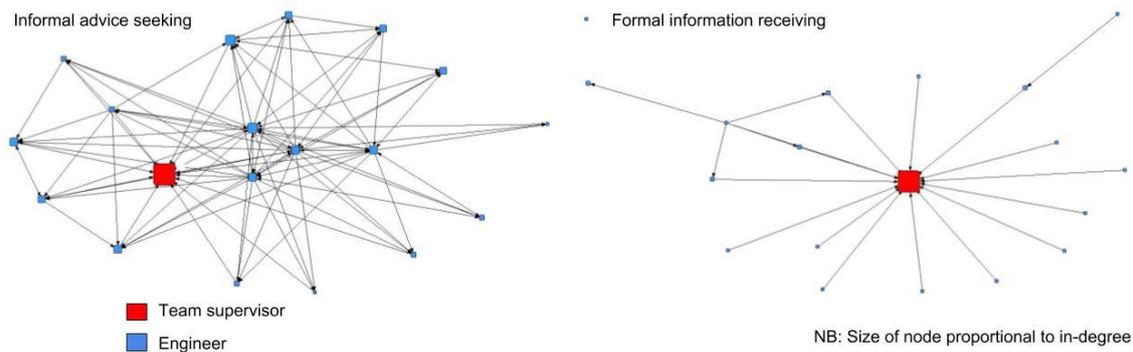
FIGURE 3 – Activity system of company's learning from incidents process

During the tension identification phase of analysis, several engineers mentioned that they received many emails, often on similar topics, causing the information on incidents received to fail to make an impact. Through analysis of the ego-networks of the surveys, and the comments of the interviews, it was clear that no feedback was given to the safety team who sends the emails. This could be depicted as a contradiction in the activity system between the tools and the object, and the tools and the community.

Conclusion

Combining SNA techniques and activity theory creates a more in-depth understanding of the dynamics of a particular situation than either approach could do independently. The design, as with any other, is dictated by the research questions under pinning it, and must take into consideration design requirements of activity theory, SNA, case studies, and mixed methods research. Activity theory and SNA each have strengths that the other can draw on to build a detailed understanding of a network co-operating to achieve a goal. While emerging from different philosophies their strengths complement some of the weaknesses of the other, in what can be described as a symbiotic relationship.

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