

# Automated Social Network Analysis for Collaborative Work\*

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**Abstract.** Inter-networked computers enable virtual collaborative work. In the course of interacting with one another, individuals send and receive messages and files of various sorts. This may be done within specialized collaborative work environments, or by simply employing a combination of different communication tools and applications. In the course of doing their work, collaborators perform different actions that create and/or otherwise manipulate digital artifacts that are related to different aspects of their collaboration. Social network analysis is used to develop a fuller understanding of interactions between people. We describe a software prototype of a tool that automatically measures and analyzes aspects of collaboration developing visualizations of likely social interactions. In this paper we describe the system, some early results, and several different possible applications of the technology.

## 1 Introduction

“Computer-supported cooperative work” (CSCW) refers to cooperative work carried out by one or more individuals with computer and network support [1]. CSCW is often used to refer to the situation where people work together in dynamically-formed groups to accomplish particular tasks. Many of the different tasks may be accomplished using various computer applications. The nature of the applications may include file sharing of design documentation, white board applications for brainstorming, messaging systems, video conferencing to facilitate more tangible connection between collaborators and email for asynchronous communication.

These different types of network applications are used at different times depending on which of four modes of CSCW operation [1, 2] participants prefer to use: synchronous, distributed synchronous, asynchronous and distributed asynchronous. Many software applications have been developed specifically for CSCW, while other desktop applications are evolving to include collaboration functions [3].

In this paper we describe the implementation of a system intended to determine, in real time, the development of social networks during collaborative work. This Automated Social Network Analysis Technology (ASNAT) is an implementation and

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extension of work we have introduced previously [4]. As its key advantage, it is not reliant on the use of any particular design or visualization application. The technology has many different possible uses, some of which we describe in a subsequent section.

In this paper, section 2 describes the problem we are addressing. Section 3 presents our approach, from our abstraction model, to system implementation details. We discuss some results, sketching possible applications of ASNAT in Section 4. Section 5 provides a discussion and conclusions.

## 2 Problem Statement

Social Network Analysis (SNA) [5] is a very powerful tool used to help form a better understanding of how people work together. SNA has been applied for many different purposes [6, 7, 8, 9]. However it has been found especially useful in understanding how groups of people interact via electronic communication [10, 11] such as usenet news and email. Social network analysts seek to describe, as fully as possible, networks of relationships between people, including relationships maintained by computer or network mediated interactions, or for the allocation of resources needed for work. SNA display relationships as graphs, with nodes representing individuals, and edges representing interactions types. The degree and type of interactions may be represented by the lengths, colors, and widths of nodes and edges. The information used in a social network analysis is almost always gathered manually. Manual collection involves observation and recording of activities, and/or the use of questionnaires, interviews and diaries. The reliability of the SNA results is often questioned because of the complex nature of this process. For instance, incorrect reporting (intentional or not), often occurs when participants record their own activities. Different interactions may not be remembered equally as well. Statistical data processing tools have been used to discover interaction patterns [9]. Analysts have used these patterns to interpret and to uncover what aspects were responsible for successful collaboration (for instance for design purposes) [10]. On a wider scale, SNA has been used to determine how organizations operate.

Our work involves the development of a system for automatically discovering and analyzing social networks inferred from the digital artifacts created when people interact with one another over computers and computer networks.

## 3 Our Approach

Figure 1 provides a schematic overview of the ASNAT approach. People within organizations communicate and collaborate with one another, while working to achieve their objectives. Computer networks form a common means for communication and interaction. In a computer-mediated environment, people often don't communicate in real space and time with one another. Instead, they work together using digital means. Networks facilitate remote interaction. In the course of performing various computer and network interactions, digital artifacts are created, shared, modified, moved and destroyed among collaborators. These artifacts may be files, email messages, instant text messages, mouse or keyboard actions, network activities, etc. The artifacts are