Chapter XX
Social Networks in Information Systems: Tools and Services

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ABSTRACT

A social network represents a set of social entities that interact through relationships like friendship, co-working, or information exchange. Social Network Analysis studies the patterns of relationships among social entities and can be used to understand and improve group processes. The arrival of new communication tools and networking platforms, especially the Web 2.0 Social Networking Services, opened new opportunities to explore the power of social networks inside and outside organizations. This chapter surveys the basic concepts of social networks methods, approaches, tools, and services. In particular, this chapter analyzes state-of-the-art social networks, explaining how useful Social Network Analysis can be in different contexts and how social networks can be represented, extracted, and analyzed in information systems.

INTRODUCTION

The notion of a social network and the methods of social network analysis (SNA) have attracted considerable interest and curiosity from the social and behavioral science communities in recent decades (Wasserman and Faust 1994). Social Network Analysis (SNA) has been used as a
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powerful tool in organizations to understand the connections and influences both inside and outside the organization as well as how these connections affect the performance of core processes.

A social network is generally defined as a set(s) of actors and the relationship(s) defined among them. Actors, also defined as social entities, can be individual or collective social units that are connected by links. Links constituting a social network may be directed or undirected, but they can be categorized as confirmed or unconfirmed based on the confirmation of the relationship by both actors (Cross and Parker 2004). The relationships between actors can be also classified based on cardinality: a dyad is a linkage or relationship between two actors and a triad involves a triple of actors and associated ties.

In structural terms, there are different kinds of social networks: one-mode networks study just a single set of actors, whereas two-mode networks focus on sets of actors and one set of events. Dyadic networks and affiliation networks are examples of two-mode networks (Wasserman and Faust 1994). An ego-centered network is an example of a one-mode network and consists of a local actor (termed ego), a set of alters who have ties to ego, and measurements of the ties among these alters (Wasserman and Faust 1994). Subsets or subgroups can be identified and studied separately in the network. A clique designates a subset of a network in which the actors are more closely tied to one another than they are to other members of the network (Jamali and Abolhassani 2006).

Both social actors and links may have additional attributes that express additional information about them. Such attributes include the relationship role played by the entity (Masolo, Vieu et al. 2004), more information about the entity, or the relationship between nodes.

The introduction of computational methods opened new opportunities for the use of social networks by allowing the analysis of larger datasets. This analysis facilitates the addition of social networks as well as their automatic extraction from existing information repositories.

Web 2.0 popularized the concept of the semantic web. Several social communities permitting users to connect and share information and knowledge with their friends or the whole community appeared.

This chapter presents the tools and methods for correctly extracting a social network and representing it in a form that can be later analyzed. After that, different software tools for performing SNA are analyzed. With regard to the organizational context, the Web 2.0 social networking services phenomenon is developed. Several examples of known worldwide platforms are presented and compared, and we show how organizations are using these tools to improve connections and knowledge sharing inside organizations. We discuss also our vision about what the future can bring to this field with the integration of different platforms and methodologies. Finally, we present SNARe (Social Networking Analysis and Reengineering Environment), a system we are currently developing that proposes to integrate Organization Network Analysis and Social Networking Services with different approaches and techniques. We conclude with our vision of the major concerns in these topics and how they are related to the general topic of the book.

BACKGROUND

Social Network Analysis represents a method for achieving analytical results about almost any group interaction in which social entities are present. This section introduces SNA and its most common measures and explains its use in the organizational context.
Social Network Analysis

The roots of SNA techniques were affected by three main influences beginning in 1930s. The most notable influence was Jacob Moreno, who investigated how an individual’s group relationships affected his own actions and development. Moreno was credited of devising a sociogram as a way to depict such social relationships (Fredericks and Durland 2005). Most of the concepts and techniques were introduced in the 1950s by work done in the fields of sociology, anthropology, mathematics, networks, and graph theory. Even, if it was not always considered a theoretical field, the arrival of computer methods and the automatic analysis of large quantities of data gave SNA new importance. Since then, it has been the subject of studies and applications from widely diverse fields of study (Borgatti and Foster 2003).

In the 1990s, network theories emerged in virtually every traditional area of organizational scholarship (e.g. leadership, power, turnover, job satisfaction, job performance, entrepreneurship, stakeholder relations, knowledge utilization, innovation, and profit maximization) (Borgatti and Foster 2003).

SNA is now used wherever a social network is present, and its study can be interesting for understanding and improving any group process. Recent projects applied the same methods in the following totally different social network contexts:

- Economy (the analysis of economic relationships between countries (Krempel and Plümpner 2002))
- Health (the analysis of social networks in epidemiology studies (Chen, Tseng et al. 2007; Rubeis, Wylie et al. 2007))
- Politics (the analysis of the political relationships in a congress (Fowler 2006))
- Academic research (the analysis the research network on a continent (Besussi 2006))
- Leisure and sport (the analysis of all the actions performed among all players on a football team during a game (Bundio and Conde 2004))
- Organization improvement (the identification of tacit knowledge in enterprises (ZHU, SHAO et al. 2007))
- Marketing (the analysis of customer preferences for buying certain items (Kappe 2006))
- Fight against crime and terrorism (Tsvetovat and Carley 2005).

Social Network Analysis is also the focus of associations (INSNA, INSNAE), conferences (SUNBELT), and journals (JOSS, Social Networks and Redes).

SNA Measures

To perform SNA, it is necessary to define measures that can be compared between actors or networks. Measures in SNA can be distinguished as those that evaluate the entire network and those that evaluate only a specific node (Wasserman and Faust 1994).

At the individual level, the most frequently analyzed measure is centrality. This measure evaluates an actor’s position in the network and can be interpreted as the prominence of an actor in the social group. It can be measured using: (1) nodal degree (number of nodes adjacent to a node, with ties from it, or with ties to it), (2) betweenness (the number of times a person lies along the shortest path between two others), and (3) closeness (how far a person is from all others in the network). Other important concepts are the geodesic distance (the shortest distance between one node and another in the graph) and the structural equivalence (the extent to which an actor shares the same set of links with another).

At the network level, it is important to understand how the network is structured. Clustering measures the ease of partitioning the graph into a finite number of subsets: a higher clustering coefficient indicates greater separation between
the groups in a network. Centralization is directly connected with the notion of central nodes: a more centralized network indicates that most of the ties are dispersed around one or a few nodes. Path Length is defined as the average of the distance between all pairs of nodes. Cohesion measures the percentage of actors directly connected to each other by cohesive ties. Directly linked with this concept are the members who would disconnect the group if they were removed. These kinds of nodes are called cutpoints. Ties that disconnect parts of the graph when removed are called bridges.

**Organizational Network Analysis**

The need for more agile, flexible, dynamic, and polyvalent organizations and employees in locations where organizational change is a daily routine, and the rise of new ways of working, collaborating and interacting has caused Social Network Analysis to become a “must-have” tool for analyzing communities and groups. Management consultants use this methodology with business clients and refer to it as Organizational Network Analysis (ONA). As Rob Cross states in his book, real organizations are typically different from those expressed in organizational charts (Cross and Parker 2004). A company’s hierarchy topology is represented in Figure 1 along with the relationships extracted by internal questionnaires. Looking to the sociogram, we can understand that actors in lower hierarchical positions can have great importance inside the organization due to their knowledge, role, or personal relationships with other peers.

Factors like gender, age, ethnicity, and education can drive people to communicate primarily with peers who do not have relationships with them in the organizational chart or are not connected to their organizational role. The same reasons, when introduced into department and project separation, can produce a lack of communication, lack of awareness of resources, and lack of collaboration between actors within a company. Conversely, the excess of importance of an actor can bottleneck the entire organization. SNA is a powerful managerial tool because it makes

**Figure 1. Example of differences between an organizational chart and real relations (adapted from Cross and Parker, 2004)**
visible the patterns of relationships within and across strategically important networks (Cross and Parker 2004).

Social network analysis can be used in an organization to better understand the social capital (connections within and between the network) (Borgatti and Foster 2003), support partnerships and alliances (Cross and Parker 2004), measure the degree of embeddedness of the actors as well as actors’ importance in the network, support knowledge management policies, identify who really knows what in the company (Helms and Buijsrogge 2005), integrate networks across core processes, promote innovation, integrate new members or organizational changes, support the development of informal communities of practice, improve leadership effectiveness, replicate high performance throughout an organization, and understand and improve the disconnects between groups in the organization or between groups and the outside world (Cross and Parker 2004).

TOOLS AND SERVICES

Several software packages that support Social Networks Communities or perform SNA are available. The packages can range from complete software to analyze and visualize social networks to systems that permit the design and execution of surveys and then use the data obtained to perform a full network analysis. Other systems allow the automatic discovery of network information via mining a data repository or communications gateway. As depicted in Figure 2, this section surveys approaches and formats for representing Social Networks as well as approaches, tools, and services supporting Social Network Analysis.

Representations

Most common forms of representing and analyzing social networks work through (1) descriptive methods (e.g. text or graphs), (2) analysis procedures based on matrix operations presented in data files with proper formats or ontological representations, and (3) statistical models based on probability distributions. One reason for the use of mathematical and graphical techniques in SNA is their ability to represent the descriptions of networks compactly and systematically (Jamali and Abolhassani 2006).

Graphs

Graph theory provides a vocabulary that can be used to label social structural properties: points called nodes are used to represent actors, and lines or arrows connecting the points are used to represent links. A graph is called directed when its edges have a direction, and it is called undirected when they do not. Visual representation of graphs can be used to center in the screen the most connected actors in the network, isolate in
the periphery the less connected, and alter the actor and tie sizes in order to represent more or less importance in the network. It thus offers a powerful tool for uncovering patterns in the network (Cross and Parker 2004).

Matrices

Matrices contain the same information as graphs but are more suitable for calculation in the analysis. The adjacency list is the primary matrix used in SNA and is usually referred as the sociomatrix. Actors occupy the first line and first column of a matrix composed of as many rows and columns as there are actors in the dataset, and cells have a positive value when relations are present.

Ontologies

Conceiving ontologies (explicit specifications of the conceptualization of a domain) as engineering artifacts permits their objectification, separation from their original social context of creation, transference across the domain (Mika 2005), and export to other sources. GraphML (Brandes, Eiglsperger et al. 2002) is a language for modeling graphs that can be adapted to represent social networks. FOAF (Miller and Brickley 2000) is a machine-readable ontology describing people, their activities, and their relationships to other people and objects. hCard (Çelik and Suda 2004) is a format for publishing contact details of people, companies, organizations, and places that is used to import and export data in social networking websites. DyNetML is a universal data interchange format that enables the exchange of rich social network data and improves the compatibility of analysis and visualization tools (Tsvetovat and Carley 2003; Diesner and Carley 2005).

Statistical Models

Statistics models enthusiasts argue that it is most fruitful to consider models where network evolution is represented as the result of many (usually unobserved) small changes made at discrete times occurring between consecutively observed networks (Carrington, Scott et al. 2005). That kind of model describes the evolution of local structure, global connectivity, search ability, and highly skewed degree distributions as mathematical formulae that can be predicted and analyzed. Recently, there has been a growing interest in exponential random graph models (ERGMs) (Robins, Pattison et al. 2007) that describe a general probability distribution of graphs on \( n \) nodes and consider the possible ties among nodes of a network as random variables.

Social Networks Tools

The common way to extract a social network is by instantiating it directly through SNA software packages. However, it is also possible to automatically extract Social Networks from information gateways or through automatic survey analysis. Figure 4 represents the most important tools organized by their main scope of application. Most of the software packages analyzed share common features to extract, analyze, and visualize social networks.

Visualization and Analysis Software

Ucinet (Borgatti 2002) is probably the best-known and most frequently used software package for the analysis of social network data (Wasserman and Faust 1994). It is a commercial product developed by Steve Borgatti’s team, but an evaluation version is available for 30 days. Ucinet uses datasets as collections of matrices, can import data in various formats, and has a spreadsheet editor to permit data manipulation. Ucinet works as a graphical application and is distributed with a user manual and reference guide for social network analysis. It contains a large number of network analysis methods, such as analysis procedures for computing centrality degree, ego network analysis, and
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Figure 3. Main scope of Social Network Software

the detection of subgroups and structural holes in both the entire and parts of the network. It includes statistical procedures and can handle two-mode network transformations and analysis. Ucinet does not contain graphic procedures or visualization techniques, but it can export directly to NetDraw (developed by the same team and included in its package) or other formats.

Pajek is a free software developed by the University of Ljubljana and is designed to handle large data sets (Batagelj and Mrvar 2008). It is distributed with a reference manual containing a list of commands and operations, but there is also a textbook about SNA theory, applications, and the use of Pajek in network analysis (Nooy, Mrvar et al. 2005). Data can be entered directly into the program by 1) importing ASCII network data from network files, 2) importing data with other formats (e.g. UCINET), or 3) opening a Pajek project file (.paj) that combines all the data structures supported in one file. Pajek permits the manipulation of all of its structures (e.g. of the transposition of networks, change of directionality in graphs, or extraction of networks). Advanced visualization techniques are present in Pajek: network drawing is based on the principle that distances between nodes should reveal the structural pattern of the network. Pajek uses spring-embedding algorithms that seek a configuration of the bodies with locally minimal energy; they seek a position for each body such that the sum of the forces on each body is zero (Eades, Battista et al. 1999). The algorithms from Kamada-Kawai (Kamada and Kawai 1988) and Fruchterman-Reingold (Fruchterman and Reingold 1991) are good examples of this kind of technique. Graph images can be exported to traditional image formats. In Pajek, descriptive methods are also present and include: the computation of degrees, depths, and cores; centrality (closeness, betweenness); the detection of components, paths, structural holes, and some binary operations in two-mode networks (Carrington, Scott et al. 2005). Unlike Ucinet, Pajek has no direct procedures for detecting cliques due to the difficulty of this procedure for large networks. However, it contains a p-cliques procedure that partitions the network nodes into clusters such that the nodes within one cluster have at least a proportion of p neighbors inside the cluster. Some statistical procedures are also available, and Pajek can invoke directly statistical software.

Netminer is a commercial product developed by Cyram and contains analysis and visualization techniques (Cyram 2007). NetMiner has an innovative data model composed of a dataset of various unit data designed to represent almost
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every feature of network data. NetMiner has the easiest and simplest user interface of all of the software in this category, and almost all of its results are presented both textually and graphically. Constructing new datasets out of nodes and links on a visualized network map for subgroup analysis can be easily achieved by mouse-dragging on the network map without time-consuming main menu navigation. Network-drawing can be based on spring-embedding algorithms, multidimensional scaling, analysis procedures (e.g. centrality), and simple procedures (circle, random). Built-in standard statistical procedures and charts are also integrated in NetMiner.

Survey Analysis Platforms

The problem present for software introduced in the last section is that this software requires the analyst to insert data gathered through other means (e.g. interviews, surveys, or observation) into specific formats. Other kinds of tools, including initial surveys to infer relationships in a network, have appeared to aid SNA.

Netvis is a web-based tool distributed as an open-source program to analyze and visualize social networks using data from comma-separated value files (csv) and surveys (Cummings 2008). The software permits the registration of actors present in the network, and then it allows users to define a survey and use the data received from the answers to perform a social network analysis. Although the software itself has standard procedures to analyze and visualize networks, it can also export data to most common formats.

A team at University of Virginia’s McIntire School of Commerce headed by Research Director Rob Cross developed an application called Network Round Table. Most of the content and documentation is not public and is only available to clients who subscribe by paying an annual fee; however its features, steps, and procedures are available on the website. Based on an organizational perspective, the software permits an analyst to register or import all of the actors into the system, join them into teams or groups, and assign them roles. After that, the analyst can create a survey with questions to infer all of the social relationships in the network as well as their strength or frequency. The software is powerful enough to direct specific questions and answers to specific actors or groups, and questions can be open-ended, rating scale type, multiple-choice, order importance choice, or nested in groups. The analyst can explain how each question is important and what he wants to infer from the analysis of the answers. After the survey’s activation, the users registered receive an email directing them to visit a web address and properly complete the survey. The analyst can check the status of the survey; when he gets a satisfactory amount of answers, he can close it. After closing the survey, an individual action plan is available to all actors with the analysis of their own answers. The analyst can view and analyze the results of the complete network. There are options available to export the data to the most common formats, but simple direct analyses are also present in the software. The analyst can also view, edit, annotate, or delete individual answers and filter them by parameters. The team states that the personal network feedback enables by itself each actor to assess his connectivity within the network and improve it by planning changes. The feedback is delivered either on paper that can be analyzed in group meetings or in an online action plan that allows actors to annotate and plan actions to increase connectivity.

Network genie is an online application developed by Tanglewood Research for designing and managing social network projects. It includes the design of surveys and survey questions, the management of social network projects, the collection of social network survey data, and the import/export of data to SNA software.
The main objective of this kind of software is to gather information from surveys and automatically export data to the most common software applications for SNA.

**Platforms to Social Networks**

**Extraction, Transformation and Load**

More recently, the use of electronic data extraction became popular in the study of social networks. While traditional survey or interview methods are limited by the size of networks and the number of measurements (time-points), gathering electronic data enables large scale, longitudinal studies of networks (Mika, Elfring et al. 2006). Automatic detection of relationships is possible from various sources of information, such as e-mail archives, schedule data, and web citation information (Matsuo, Mori et al. 2006). What this kind of systems proposes is to 1) gather information from a large collection of data, 2) identify and disambiguate social entities, and 3) understand both the links between them as well as their strength, periodicity, and probability.

The SONAR platform developed by Trampoline Systems proposes to plug into a corporate network and connect to existing systems like email servers, contact databases, and document archives to extract and analyze data to build a map of social networks, information flow, expertise, and individual interests throughout the enterprise (TrampolineSystems 2008). The platform consists of several functional modules that can be combined as required by each customer; all information is available to managers, and personal data is available to users.

Flink, the best semantic web application at the semantic Web Challenge of 2004 in ISWC2004, was developed by Peter Mika's team and supports the complete process of data collection, storage, and visualization of social networks based on heterogeneous sources of electronic data (Mika, Elfring et al. 2006).

Data comprising social networks tend to be heterogeneous, multirelational, and semi-structured (Han and Kamber 2006). Link mining is an emergent field of research with contributions from many areas that can help in social network mining. It can be used to classify entities based on their links, predict the type or even the existence of links and their evolution, and detect subgroups and properties common to some group (Han and Kamber 2006). Polyphone (Matsuo, Mori et al. 2006) is a social network mining system that has been used at four academic conferences in Japan to infer the relationships between authors, reviewers, and participants. It is a good example of the use of link mining, because it uses web search engines to understand and measure the connections between people via balanced coefficient that define relationships.

**SOCIAL NETWORKING SERVICES**

Although the Web itself is an example of a social network and the formation of communities is one of its most important achievements, the Web 2.0 boom brought the possibility of group information sharing to users via the spread of wikis, forums, blogs, and social networking communities. Although these websites feature much of the same content that appears on personal Web pages, they provide a central point of access and bring structure in the process of personal information sharing and online socialization (Jamali and Abolhassani 2006). People can register or be invited to these websites. After uploading information about themselves, they can upload photos, join groups of people, and connect to other friends or people with similar interests. People become organized in networks or groups and can see each other’s profiles, relationships, and actions in the network. Most of these websites allow people to upload and tag photos, share files, post in blogs, and interact in other ways with their peers.
Community-Wide Services

According to web statistics (HitWise.com), MySpace is still the dominant social networking service and has more than 200 million users registered (Alexa.com 2008). It is also the sixth most popular website in the world. Founded in 1999, MySpace offers to its users features like profile customization, comments, and the ability to post videos and music and participate in groups and bulletins. Apart from these functions, MySpace offers users an instant message service, a classified ads system, news, and a video sharing system.

Founded in February 2004, Facebook.com was initially open only to college students; today, it has more than 70 million active users and 55,000 networks. The website permits people to register and join a university, workplace, or village network, upload information and photos, tag photos, organize and join events in the network, and exchange messages and other content with friends’ networks. Facebook’s Platform API enables anyone to build complete applications that users can join and use with their profiles and friends network, opening new opportunities for development of new concepts using the social network. To date, 12000 applications have been built on Facebook platform. Other facts about Facebook are impressive: the number of active users doubles every 6 months; more than half of the active users return daily; people spend an average of 20 minutes on the site daily.

Friendster.com, with almost 50 million registered users, is a very important website in Asia and has recently developed a public API as Facebook that permits the growth of the community. In Europe, Netlog.com has more than 32 million registered users and Hi5.com has 50 million users.

Big enterprises are also already in this market: Microsoft has Live Spaces, Google has Orkut.com, and Yahoo has Yahoo 360º.

Specific networks oriented to people with similar interests (e.g. Tribe.net, iMeem, Last.fm), people who want to find old friends (e.g. classmates.com, graduates.com), people who want to share photos with friends (Flickr.com), or people who want to join in charity projects (SixDegree.org) also exist.
According to Hitwise.com, 6.5 percent of all Internet traffic in February 2007 in the world was generated by this kind of social networking website. According to Nielsen/NetRatings (another web statistics website), social networking sites are the reality television of the Internet. In Portugal, the most frequently used social networking website is Hi5; this was the most frequently visited website in Portugal in 2007 according to Alexa.

Even if few social networks currently charge money for membership, the fact that these kinds of communities are constantly renewed by their members and organized in networks by interests, location, or situation means that these websites can sell specific ads to specific groups. This is quite appealing for investors and can extend the context of these communities even further in the future. There is also a tendency to define a standard way to exchange data between these services. Google OpenSocial (Google 2008) provides a common set of APIs for social applications across multiple websites and is supported by some social networking websites. It is composed of three APIs that permit programmers to access core functions and social network information like profiles, friends’ information, and activities.

Table 1. Most popular social networking services

<table>
<thead>
<tr>
<th></th>
<th>Users (Millions)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myspace</td>
<td>200</td>
<td>Oldest and most famous SNS. Sixth most visited website in the world.</td>
</tr>
<tr>
<td>Facebook</td>
<td>70</td>
<td>Has the most rapid current growth. The number of users doubles every six months.</td>
</tr>
<tr>
<td>Friendster</td>
<td>50</td>
<td>Used particularly in Asia.</td>
</tr>
<tr>
<td>Hi5</td>
<td>50</td>
<td>Most visited website in Portugal in 2007.</td>
</tr>
<tr>
<td>Netlog</td>
<td>32</td>
<td>Used particularly in Europe.</td>
</tr>
</tbody>
</table>

Social networking services can be also used in a more oriented professional context. LinkedIn is a website where people can post their professional experience as well as share and connect with others with the same interests, professional background, or company. Ryze is designed to link business professionals, particularly new entrepreneurs. The site claims to have over 250,000 members in 200 countries, with over 1,000 external organizations hosting subnetworks on the site. The Portuguese website theStarTracker allow its members to join communities of Portuguese people working abroad and understand what they are doing.

It is not easy to explain why different services have different popularities in different countries and cultures. Each service is mainly used by a certain type of community or culture. ValleyWag published in 2007 a world map of social networks according to their use in different countries. Even though MySpace is still the global leader, different websites are more popular SNSs in different regions.

Organization-Wide Services

Big companies have begun to understand the power behind this kind of system for sharing knowledge, experience, and practices inside and outside their companies. In November 2007, a team in Oracle launched Oracle Mix (Oracle 2007). Oracle Mix is a social network for oracle developers, partners, employees, and customers that allows them to share the best practices, experiences, and ideas. Dell also developed a similar
system called IdeaStorm (Dell 2007), which is used by customers to share ideas with the company and receive feedback from the community. Sap developed an internal system called Harmony that is already being used by SAP Labs users behind the firewall. IBM went further, introducing in July 2007 the Lotus Connections Suite. This software suite permits a company’s employees and partners to register profiles, share ideas, experiences, activities, and resources about company products as well as what they are doing in the company, and create new communities. IBM uses this suite inside the company as the company yellow pages. Even SharePoint 2007, a collaboration suite from Microsoft, already has some business social networking capabilities like user profiles, people search facilities, and tools like wikis and blogs; it is expected to be expanded by a social networking driver. Other firms like AwarenessNetworks and HiveLive are also developing this kind of social networking applications for enterprises.

**FUTURE TRENDS**

The integration of social network-based platforms is already a reality, and their use should prove effective to organizations that adopt them. Platforms that gather social communities, social network analysis, and knowledge management features would be an amazing information broker inside the organization. They would offer a powerful directory in which knowledge and expertise is easy to find, and they would centralize information and reduce the distance between departments and groups inside the organization. Additionally, these platforms would also be a powerful decision tool to help managers understand the real connections and daily activities developed by their employees. By joining the best of these two worlds, organizations would gain a real notion of what is going on inside and outside their walls; employees would have access to a new tool to increase their productivity and provide precious information that would be covered in other ways.
However, copying or adapting existing social networking services is not sufficient. These kinds of joined platforms that can be referred to as Social Networking Services for Enterprises (SNES) have different requirements than normal social networking systems do. They need to be used in an organizational context, and they should be used to increase productivity. They should be extremely secure, and privacy should be a major concern. Users should be able to feel secure and in total control of the information they share.

Organizations already have their own information systems, and SNES should plug into them to make sure that information is automatically and constantly retrieved. This represents a huge challenge because of the heterogeneity of tools, servers, technologies, and software present inside organizations. SNES should plug into mail servers, workflow applications, client relation management systems, phone logs, or other information systems that employees or customers use to communicate or work.

Systems should adapt to an organization’s characteristics and workflow processes to provide increased value to employees and departments instead of creating unnecessary entropy inside an organization’s walls. Employees should recognize a system’s value before they begin using that system. These systems should contain important information even without the contribution of organizational actors. However, actor contribution is fundamental for success, so different modules should be present in order to promote strong connections among actors. These modules could include bulletin boards, profile pages, groups and communities of practice, messaging, the ability to find people based on their interests, departments, or related work, easy content sharing using wikis or blogs, and other popular Web 2.0 tools.

Following these concerns, we are currently working on the SNARE project (Barão and Silva 2008) to design and develop a suite of software tools to be used in organizations to analyze and capture social networks. The SNARE system provides social network features in information systems not originally designed for this effect. SNARE is also able to capture existing social networks by analyzing answers to surveys and inferring relationships and properties. These questions focus mainly on how people trust, rely, and work in the organization; they can thus be useful for analyzing the way people understand each other in the organization.

SNARE architecture is composed of a core application in which other applications can connect through web services. WebSNARE is a web application designed to help managers and consultants construct social communities, define social entities (persons, groups, and external entities), define the type of relationships and their instances, and enrich relationships and social entities with customized properties. Managers can also define surveys to apply to the network in order to infer relationships from the answers given. Every social entity can have a unique system login, so users can update their personal data or answers to surveys after seeing after their personal results. In addition to these functions, SNARE can be used like the usual Social Networking Systems: social entities can connect to each other and define what they do together. Each user is able to search in the organization by some context or name and retrieve the content required. Users can also organize and join groups (e.g. groups based on interest or communities of practice inside the organization). Users are able to publish and retrieve content in their profiles or network pages.

In addition to the ability to promote networking and knowledge sharing inside the organization, SNARE can also perform Social Network Analysis on relationships defined by users or extracted from surveys. Managers can identify bottlenecks inside organizations or specific groups, highlight social entities with specific properties, and use SNA measures to analyze different domains or enterprises processes. SnareExplorer is a stand-
alone application that is used to visualize and analyze social networks and can import and export data directly to SNARE.

SNARE ETL Services provide a technical interface-to-Desktop ETL Tool. This desktop application defines and controls ETL actions and has a required interface for executing SNARE Service methods. The aim of this component is to extract relevant social network data through ETL mechanisms. This tool allows users to specify transformations through a graphical user interface. Data transformation can involve the following: (1) smoothing, which works to remove noise from data, (2) aggregation, which involves summary operations applied to the data and is typically used in constructing a data cube for the analysis of data at multiple granularities, (3) generalization of the data, where low-level data are replaced by higher-level concepts through the use of concept hierarchies, (4) normalization, where attribute data are scaled so as to fall within a small specified range, and (5) attribute construction, where new attributes are constructed and added from the given set of attributes to help the mining process (Han and Kamber 2006). This module can be used to plug SNARE into different existing systems and constantly update data that can be analyzed.

Future work will be done in this field, and different modules will be developed in order to achieve integration with common systems.

SNARE is already being applied in some projects and tested in different contexts and with different goals. The SNARE model is able to represent relationships in almost any context and enrich them by populating relationships and entities with customized properties. The ability to join entities and relationships with temporal or contextual similarity is a powerful advantage and will be fundamental for achieving the richest analysis. It will better support reengineering in organizational contexts while it promotes networking and information sharing inside organizations.

Figure 6. Snare Snapshot
CONCLUSION

Social Networks are not a new or recent concept. However, Web 2.0 evidence suggests that they now constitute an emergent field of study. The way people connect and work in enterprises brought a new drive SNA and changed its main goals. Using traditional concepts, studies conducted in many subjects and areas uncovered interesting aspects. Now, the challenge is to create systems that are able to represent, extract, and analyze social networks in the context of enterprise information systems.

There is not a perfect way to take a snapshot of social relationships, and all methods present some problems and limitations. Surveys can be manipulated by who is answering. Direct observation does not permit understanding of all relationships present in a group, and the most important relationships cannot be extracted from information gateways like email servers. The combined application of these techniques can, however, provide the best approach to represent and analyze a social network.

Social Networking Services are also a key player in this field. They began as just a new way of connecting people but are already being used in organizations. Companies who use them understand that injecting trust into the equation lowers the barrier to entry and sharing ideas. Employees and customers find these systems useful and fun to use, and that permits a new way to connect inside and outside the company. The future will show what benefits social networking tools and services provide when they are connected with HR (Human Resources) systems, ERP (Enterprise Resource Planning), CRM (Customer Relationship Management) software packages, and different SNA tools.

REFERENCES


**Web Resources**


KEY TERMS AND DEFINITIONS

Organizational Network Analysis: Organizational Network Analysis (ONA) involves the use of Social Network Analysis in organizational contexts in order to help managers to better understand the relationships present inside and outside the organization. It can be used in an organization to better understand the social capital, support partnerships and alliances (Cross and Parker 2004), measure the degree of embeddedness of the actors and define their importance in the network, support knowledge management policy and reveal who really knows what in the company, integrate networks across core processes, promote innovation, integrate new members or organizational changes, support the development of informal communities of practice, improve leadership effectiveness, replicate high performance throughout an organization, and understand and improve both the disconnects between groups in the organization as well as connections to the outside world.

Social Network: A social network is generally defined as a set(s) of actors and the relation(s) defined for them. Actors, also defined as social entities, can be individual or collective social units that are connected by links. Links constituting a social network may be directed, undirected, or mixed. Social Networks can be analyzed using defined measures, and their results can be compared with those from similar networks. Each actor’s position and connections can also be individually analyzed and compared with those of other actors in order to understand their relative importance in the network and highlight network bottlenecks and cutpoints as well as isolated and equivalent actors.

Social Network Analysis Measures: Measures in SNA are the metrics through which networks and social actors can be evaluated and compared. SNA measures can be distinguished into those evaluate the entire network and those that evaluate only a specific node. At the individual level, the most frequently analyzed measure is centrality: this can be measured using nodal degree, betweenness, and closeness. At the network level, is important to understand how the network is structured; it is therefore important to measure
network cohesion, centralization, and clustering and identify important nodes like cutpoints.

**Social Network Tools:** Social Network Tools are software tools that can be used to represent, visualize, and analyze social networks. These tools can usually read and write in common formats and use matrices to compute social networks and graphs called sociograms to represent them. Other platforms have other important characteristics like the ability to convert answers from internal surveys to social network data or extract social network information from existing systems using ETL techniques. Some graph software or general network analysis software can also be used to identify key aspects in social networks.

**Social Network ETL:** Social Network Extraction, Transform, and Load designates the set of techniques used to map existing information system data into social network models. Entities present in the systems should be normalized and resolved, and the selected interactions between them are transformed into relationships. After extraction and transformation, data can be loaded in the usual SNA tools. Good examples of social network ETL use arise from community boards, server communication logs, knowledge repositories, and wikis.

**Social Networking Services:** Social Networking Services (SNS) are websites where people can register their personal profiles and connect with others to share information based on interest, upload photos, or join groups. This kind of website is a popular Web 2.0 phenomenon; millions of people are currently registered, and SNS websites are some of the most visited websites on the internet. SNS represent a new way to connect to collaborators, and they permit the sharing of information and breaking of common barriers. Although concerns regarding privacy issues arise, restricting information to only those users people trust circumvents the problems of sharing it with no restrictions in the network.

**Social Networking Services for Enterprises:** Social Networking Services for Enterprises are internal information systems used by organizations to increase connections and information sharing among their collaborators. These systems share the same features as social networking services but are used to low barriers inside organizations. They are intended to promote productivity by increasing information sharing. Usually, they are platforms that try to join features of Social Networking Services and knowledge repositories with Social Network Analysis. They give the managers and consultants the ability to access existing organization networks and hidden relationships and make decisions for reorganization based on what is really happening in the organization.