The Development of Social Network Analysis Research in Mainland China: A Literature Review Perspective

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ABSTRACT

Social Network Analysis (SNA) has been introduced to mainland China since the end of last century. Now it is a hot research field and can also be applied to study other disciplines as a research method or analysis tool. It is often stated that SNA research has experienced rapid growth in mainland China these years, but few studies have been conducted to prove the statement. This paper aims at exploring the research status and development of SNA in mainland China by a critical assessment of journal articles. Through selecting papers from *China Academic Journals Full-text Database* (CAJFD), a literature review is conducted to get an overview framework about SNA research both as a research object and a method in mainland China by bibliometric analysis and classification scheme based approach. Finally a discussion is made from the systematical data analysis, and an interesting finding is that the iSchool community in mainland China plays a leading role in the SNA related researches. Furthermore, some implications are put forward to explore how SNA can be applied to or fit with the IS-related disciplines or topics in the future.

Categories and Subject Descriptors

A.1 [**General Literature**]: Introductory and Survey. H.3.5 [**Information Systems**]: Information Storage and Retrieval-*Online Information Services: Web-based Services.*

General Terms

Measurement

Keywords

Social Network Analysis (SNA), Information Studies, Literature review, Bibliometric analysis, Classification scheme, Research status and development, Mainland China

1. INTRODUCTION

Social networks are nodes of individuals, groups, organizations, and related systems that tie in one or more types of interdependencies, which included kinship, social contact, conflict, financial exchanges, membership in organizations, and group participation events, among numerous other aspects of human relationships [19]. Social network analysis (SNA from here on) focuses on the structure of relationships, ranging from casual acquaintance to close bonds, and measures formal or informal relationships to understand the connection and structure of numerous nodes [9]. Today, SNA has its own professional association, annual conference, and academic journals.

Since the 80th of last century, the concept of SNA had been introduced to mainland China, and mainly appeared in Sociology. In 1986, Tianjin Academy of Social Sciences collaborated with Columbia University in the research project named "Career, lifestyle and social network of urban residents in Tianjin". An early journal paper on SNA was published in 1995 by Fang, who introduced the preliminary concepts and methods of SNA [8]. Later in 1997, Yuan incorporated SNA as a research method in his new book "social research method textbook" [21]. Gradually, researchers in mainland China started to pay attention to SNA and its applications. Two books have to be mentioned here due to their significant contribution to the application of SNA by Liu and Luo in 2004 and 2005, respectively [14, 15]. They systematically introduced the SNA both as a research object and a research method in Chinese. Furthermore, Liu also translated John Scott's handouts on SNA into Chinese and published a monograph by SNA methodology [13]. Furthermore, owing to the establishment of Committee of Social Network affiliated with Chinese Sociological Association, SNA experienced a rapid development. Since then, the committee organized regular seminars on related topics and themes. In summary, these academic activities positively promoted the development of SNA research in mainland China.

This paper aims at exploring the research status and development of SNA in mainland China by a critical assessment of journal articles. Through selecting papers from China Academic Journals Full-text Database (CAJFD), a literature review is conducted by employing different methods to get an overview about SNA research in mainland China from both research object and method

perspectives. Finally we put forward some potential directions on how SNA can be applied to or fit with the IS-related disciplines or topics in the future.

2. DATA COLLECTION

CAJFD[1], the largest full-text interdisciplinary Chinese journals database, was used to collect literatures on SNA. It is the largest Chinese academic database in the world with more than 31 million articles, thus we think it is an appropriate database for our study.

Although it is essential to select a package of academic journals before the paper selection, there are some difficulties in doing so in this study. First, there are no specific academic journals on SNA in mainland China now, hence, these studies were scattered in different kinds of journals; Second, we assume that the research of SNA has a diverse characteristic, thus we don't want to confine to any specific discipline. Conversely, we would like to include the most of research papers related with our subject. Therefore, we chose the "Title" and "Keywords" as our search fields given that SNA may appear in either of them, and some related search terms were selected to retrieve the articles. It is worth noting that the translation of SNA as a terminology from English to Chinese has two principal versions, i.e. "社会网络分析"and "人际网络分析", also with some other trivial expressions like "在线网络分析", "社会支持网分析"etc. This was due to the different understanding from experts of various disciplines when they introduced the SNA to mainland China at the early stage. Accordingly, we used the multiple terms related with SNA, either in Chinese or English, to collect the potential articles in the subject.

We employed a two-stage process for paper selection. First, we formed a pool of all collected SNA research articles. The editorial introductions, book reviews, dissertation abstracts, letters, and announcements were removed from those candidate articles in order to focus on the contents of the research papers. Meanwhile, those articles without any keywords and abstracts were excluded from our study since they are not suitable for further analysis on research topics. As a result, we identified 383 articles to form the first pool. Second, we evaluated each paper again for its relevance to SNA. We excluded those articles that might contain SNA terms in the title or keywords, but essentially have a non-SNA focus. For example, the acronym of "System of National Accounts" and "System Network Architecture" also corresponds to SNA, but they are totally different from our topic. We also excluded papers if they were about pure introduction of social network or description without any focus on the theory-building, methods or applications of SNA. Finally, a total of 240 articles were included for the final analysis.

3. RESEARCH APPROACH

There are generally three approaches for reviewing a discipline or a research field. The first is to use bibliometric analysis to discover the research progress and frontier. Some methodologies are frequently used, such as citation analysis [6], content analysis [11], co-word analysis [23] and cluster analysis [10], etc. The second is to use classification schemes to code interesting elements such as research topics, methods, levels of analysis and

reference discipline of published articles in the field [16, 18, 22]. The third is to use surveys or interviews to collect researchers' perceptions [12, 20]. In this study we considered a combination of the first and second approach discussed above, i.e. the bibliometric analysis and classification-based approach. Although there are many widely used classification schemes in information related studies to meet the needs of different facets, we cannot apply those schemes directly since SNA has some unique characteristics. Therefore, some modifications are used to better our schemes. In the coding stage, some studies often confined each paper to only one category of a classification [16, 18], we believe that this is a limitation and may prevent the complex nature of the research field from being revealed. Therefore, we allowed a paper to be assigned to multiple categories in some facets, such as applied discipline and research method. Meanwhile, we also considered the most important and primary categories for a classification, for example, we keep the level of analysis fixed for the rigorous of the study.

Two authors of this study independently evaluated and coded a subset of the papers to examine the classification schemes. After several iterations we finalized all classification schemes and independently coded some papers. Then we discussed with the third author to resolve those disagreements and go ahead with the next small set of papers until finished. During the process, we carefully record coding results and disagreements, also with the resolutions for any disputes. Moreover, we evaluated the inter-rater reliability of the coding results by Cohen's Kappa Coefficient, and the results show that the kappa coefficients across all categories are highly significant. The kappa values for the three categories range from 0.844 to 0.915, all exceeding the 0.70 standard recommended [3]. Before further analyses, we discussed all disagreements and achieved a consensus.

4. DATA ANALYSIS

It is often stated that SNA has experienced rapid growth these years, but few studies have been conducted to prove the statement. Figure 1 depicts the yearly distribution of SNA publications in Chinese. Among the 240 papers, the first paper was published in 1995, and there was a slow increase from 1995 to 2004. However, there was obvious increase since 2005, with an over five-fold rise from 2005 (n=15) to 2009 (n=83), and we have to notice that the number of 2009 might be more than 83 because of the lag by the index of CAJFD.
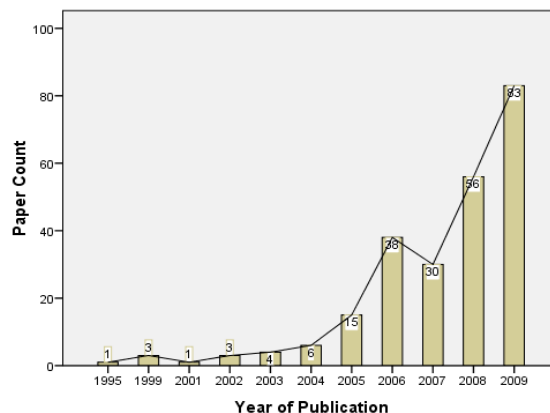

Figure 1. Yearly Publication of SNA Research

The graph demonstrates the fact that although SNA had been introduced to mainland China since the last 90th, it was actually in

the 2004-2005 that SNA started its career. Interestingly, that period was also the turning point from Web 1.0 to Web 2.0, which was advocated by Tim O'Reilly and then flourished [17]. Till now we are not sure if it was a coincidence or some potential connection between SNA development and Web 2.0. However, we believe that the issuing of two books for the introduction of SNA by Professor Liu and Luo in 2004 and 2005 may play a critical role in popularizing and catalyzing the research of SNA.

4.1 The Most Prolific Journals

Among the 119 journals that published a total number of 240 articles from Chinese authors, 20 of them (16.80%) published more than 3 articles each, which account for 53.33% (n=128) of total publications. There are also 13 journals publishing 2 papers and a large sum of 86 journals only published 1 paper each, which indicates a strong discrete distribution and central tendency (similar with power-law principle), i.e. only a few journals contribute more than half of the publications while the rest just contribute a small number. As shown in Table 1, *Library and Information Service* is on the top of the list, which accounts for 6.7% of the total papers (n=16). *Journal of the China Society for Scientific and Technical Information*, a prestigious peer reviewed journal in information studies of mainland China, is in second position with 5.4% of total publications (n=13). Another eight journals published articles varied from 6 (2.5%) to 10 (4.2%). An interesting finding is that among the top 10 journals who published SNA papers, 6 of them are information studies related journals, which indicates that our discipline plays a very active role in discussing trends, new questions, and innovative ideas regarding SNA.

Table 1. Ranking for the Most Prolific Journals

Rank	Journal	Count	Percentage (%)
#1	*Library and Information Service*	16	6.7
#2	*Journal of the China Society for Scientific and Technical Information*	13	5.4
#3	*Information Science*	10	4.2
#3	*Journal of Information Studies*	10	4.2
#4	*Science of Science and Management of Science & Technology*	8	3.3
#5	*Open Education Research*	7	2.9
#6	*Studies in Science of Science*	6	2.5
#6	*Information Studies: Theory & Application*	6	2.5
#6	*Sociological Studies*	6	2.5
#6	*New Technology of Library and Information Service*	6	2.5

4.2 The Principal Research Topics

In this paper, we adopt the co-word analysis as our research method to detect the principal research topics in this field. The main feature of co-word analysis is that it reveals patterns and trends in a specific discipline by measuring the association strengths of terms representative of relevant articles published in this area. Many researchers have used co-word analysis as an important method to explore research topics, structures and trends in different fields [5, 7, 23].

Generally, there are three steps for co-word analysis: data collection, data standardization and data mapping [7]. In data collection stage, we chose the keywords added by the CAJFD database indexers, and also extracted keywords from the titles and abstracts of the corresponding articles manually. The average number of keywords per article is found to be 4.28, and the range of keywords for each article varies from 3 to 8. In data standardization stage, the first and most important work is data cleaning. Among 240 articles, some related concepts are represented by different keywords, thus further work are needed to make them consistent, unified and unambiguous. For example, we use *e-learning* to cover all its synonyms such as *electronic learning*, *distant learning* and *online learning*; we use *blog* to replace *blogging* and *blogger* in order to eliminate ambiguity; and we use *culture* to broaden terms like *culture elements*, *culture styles* and *culture diversity*; and so on. After that, a total of 542 unique keywords were collected, and then a further step is taken to ignore those words with frequency less than three in our list. We also exclude "SNA" and "social network analysis" from our sampled keywords for their absolute fitness to this research topic. Finally, 55 keywords with frequency more than 3 were chosen as the research sample for co-word analysis. We form a co-occurrence matrix of 55*55 keywords, and the higher co-occurrence frequency of the two words means the closer relationship between them. The matrix was then transformed into a correlation matrix by Pearson's correlation coefficient. In data mapping stage, the most commonly used methods are clustering techniques and multi-dimensional scaling (MDS). We chose hierarchical clustering techniques with Ward's method and Phi-square Measurement by SPSS 13.0. Figure 2 shows that these 55 keywords can be divided into eight clusters. Each cluster is labeled according to the most frequent keywords appearing in the clusters and the common characters revealed by the keywords and those papers they tagged.

Bibliometrics & Scientometrics includes the research topics relating to citation analysis, co-author study, scientific collaboration, knowledge map, technology forecasting, and discipline evolvement and development, etc. Social Structure, Relationship and Culture includes the research topics relating to social class status, social structure, social capital and support network, culture and social norm, life condition in urban and rural area, etc. E-learning includes topics on cyber classroom, distant learning, collaborative learning, IT in education, and so on. Theory & Foundation of SNA includes topics on complex network, structure hole, core-periphery model, centrality and weighted network, social capital theory, weak and strong ties, etc. Competitive Intelligence covers topics on business intelligence, information retrieval, competitive intelligence systems, human network and relationship, P2P, patent network, and so on. Information & Knowledge Management includes topics on information and knowledge sharing, knowledge communication and transfer, team work in/between organizations, technology innovation, information consultation, user's behavior study, etc. Community Informatics & New Media includes topics on virtual community, online community, computer-mediated participation, communication and collaboration, link analysis, web mining, new media studies, etc. Industrial Economy & Structure includes the research topics relating to enterprise clusters, industrial cluster, strategic alliance, channel evolution and management, inter-organizational cooperation, and so on. Therefore, these eight clusters and their sub-domains explain the hot research topics of SNA in mainland China.
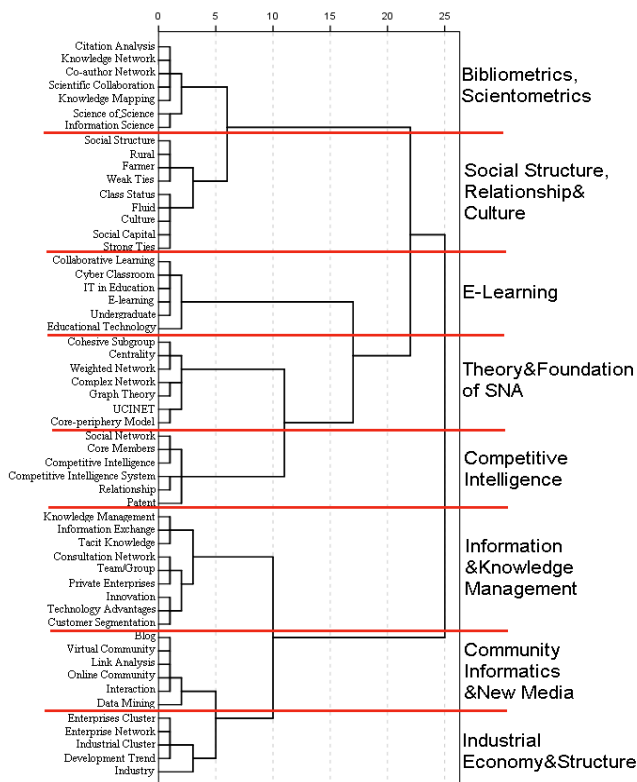
Figure 2. Principal Research Topics

4.3 The Levels of Analysis

The notion of level of analysis has been introduced by Bariff and Ginzberg in an effort to understand behavioral IS research [2], and many other researchers took such kind of studies [18, 22]. In this study, we identified the level of analysis by examining relevant sections of the articles, especially the abstract, introduction and data collection part (if have).

Three of the authors discussed together to finalize our own classification scheme for the level of analysis related with the SNA studies. Among them, Abstract Concept/Theoretical Framework level focuses on the construction of theoretical foundation and basic concept of SNA itself as well as the integration with any other theories; Professional level captures papers that take SNA as an effective research method or analysis tool to study some specific discipline or subject, thus contributing to the knowledge accumulation and recognition of any academic research disciplines or communities; System level pays attention to the model construction, lab simulation, system planning and developing, in order to build and develop social network sites, social software platforms and any other systems with social network services; Group/Team level captures papers whose focus is on specific group or team, no matter what it is real or virtual. Those studies highlight the structure and organization of a group or team; Organizational level focuses on connections and structures in organizations, such as enterprises, non-profit institutions, or between organizations, such as industries and alliance. SNA can help the researchers to investigate the dynamic relationships in and between the organizations; Social level captures papers that examine SNA issues or use SNA as a method

to study social structure, class status, social capitals, and people's living condition in different stratums at regional, national, or international levels that have no organizational context. Figure 3 shows that among 240 papers, 76 (32%) papers are on the professional level, 53 (22%) papers are on the organizational (inner/inter) level, the followings are abstract concept/theoretical framework level (16%), social level (13%), group/team level (11%) and system level (6%).
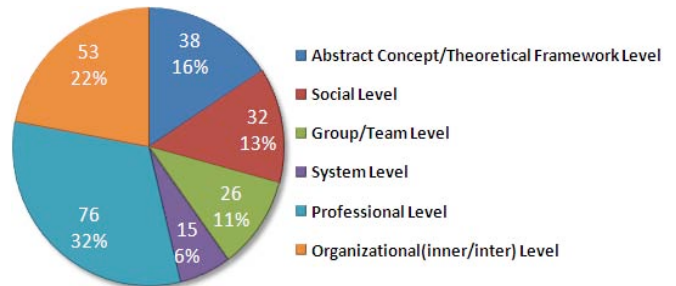

Figure 3. Overview of Level of Analysis

4.4 The Applied Disciplines

The Previous studies usually focused on the reference discipline or contributing discipline for a research field. Their classifications referred to the disciplines that support or contribute to the development of some research theories, conceptual models, and hypotheses, etc. However, in our study we view the SNA as both a research object and a research method which can be applied to different disciplines and make contributions, thus it is more interesting to explore the applied disciplines of SNA.

The extant literatures used various classification schemes [18, 22]. In this paper we aim at studying the research status of SNA in mainland China, so we want to choose a classification scheme more localization-oriented which can fit well with our subject. Finally we adopted the Discipline Classification Codes developed by Ministry of Education, China. During our coding, we focused only on the disciplinary level, not the division level (too broad) or subject level (too narrow), yet we used the subjects to justify a discipline when coding any particular paper. Meanwhile, we also used classification number provided by each paper to help us making a discussion. Keep in mind that each paper was not limited to one applied discipline to ensure that the diversity can be well demonstrated in this study.

Figure 4 illustrates that 10 disciplines was detected after our classification coding. Among them, 87 articles are labeled with Library & Information Science discipline, 62 articles are classified to Science of Business Administration discipline, and 42 articles are included into Management & Systems Science discipline. The followed are Education Science (29), Sociology (29), Computer Science & Technology (23), Economics (23), Communication (18), Philosophy (10) and Science of Physical Culture & Sports (3). From the radar map we can find that the most applied disciplines were Library & Information Science, Science of Business Administration, and Management & Systems Science, which had a significant advantage over other disciplines. Figure 5 depicts the changes on the applied disciplines over these years. The ten disciplines in our study all show an ascending trend with minor fluctuation. We can see that Library & Information Science had the most marked growth rate, which is fairly consistent with our finding on the most applied disciplines. We

also notice that most of the applied disciplines had gone through a significant increase since 2005, which is also a turning point for SNA to be widely studied and employed in mainland China.
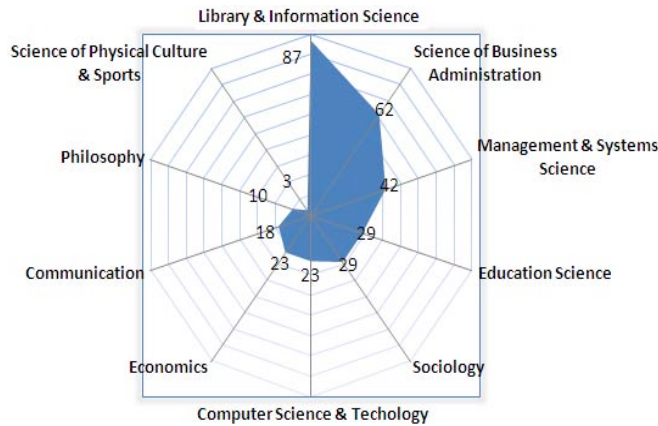

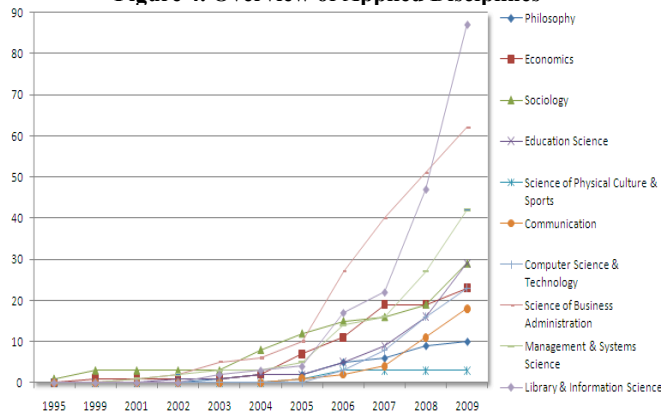**Figure 4. Overview of Applied Disciplines**

Figure 5. Changing Trends of Applied Disciplines

4.5 Research Methods

In this study, we used Alavi and Carlson's classification scheme [1] for research method owing to its comprehensiveness and wide acceptance. Our framework distinguished between non-empirical and empirical papers at the highest level. The former captures the essence of studies relying on observation and illustration; while the latter is primarily based on ideas, data, speculation, and verification. Here we did not subdivide the non-empirical approaches because of the difficulties in differentiating those sub-methods from the papers. Meanwhile, we made some modifications to Alavi and Carlson's framework on empirical methods by added individual-based "Interview" and group-based "Focus Group" to the scheme, which has also been validated by Zhang and Li's work [22]. Among the empirical studies, due to the dual roles of SNA both as a research object and a method, we would like to explore several questions like: how many papers used SNA as sole method; how many papers adopted other methods to study SNA as a research object; and how many papers used SNA and other methods together to study SNA or other topics? As shown in Table 2, among 240 articles, 90 are non-empirical studies while 150 are empirical studies. We also extracted several empirical methods according to our coding. Besides SNA itself as a method which has been used for 136 times, other three mostly used methods are secondary data (62), survey (30) and case study (21). Moreover, 30 papers took SNA

as the solo method in their studies, 14 papers used other methods without SNA (method) to study issues related with SNA (object), while 106 papers co-used SNA (method) and other methods.

Table 2. Overview of Research Methods[2]

Research Method	Frequency	Method Used
None-Empirical	90(37.5%)	——
Empirical*	150(62.5%)	SNA(30)
		Others(14)
		SNA & Others(106)
Total	240(100%)	

Although we have examined the research methods mentioned in our scheme, we still want to investigate a clearer picture on the relationship between SNA (method) and other methods, which are more specific and detailed. Therefore, we read the papers one by one and extracted method-related information mainly from several sections of the articles, such as title, keywords, abstract, research method or data analysis, and then we used the UNICET to draw the connection map between different methods and analysis tools covered in our paper pool. Figure 6 illustrates the overview of collected methods from the papers in our study. In the method network graph, we can find that SNA itself was the most frequently used method to study SNA issues or other topics, meanwhile some quantitative methods such as citation analysis, co-occurrence analysis, and cluster analysis, etc., and some qualitative methods such as questionnaire survey, interview, and case study, etc., are closely related with SNA and each other, which indicates that those methods or analysis tools are often co-used with SNA method.

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[2] Secondary Data (62), Survey (30), Case Study (21), Focus Group (14), Lab Experiment (13), Interview (11), Development of Instruments (9)
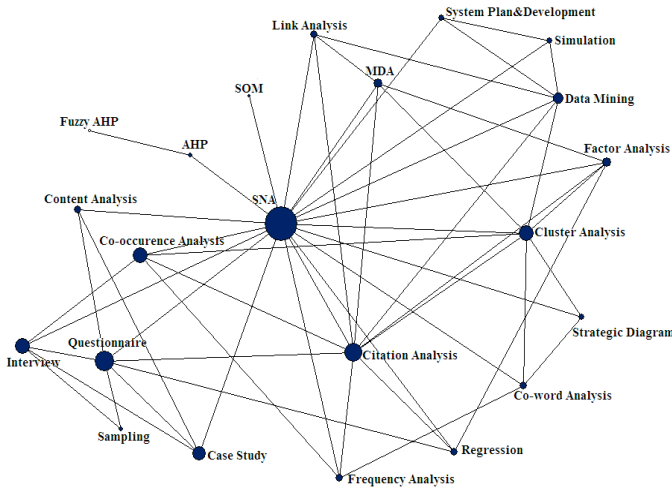
Figure 6. Overview Relationship between SNA and Other Methods

5. DISCUSSION AND IMPLICATION

5.1 Discussion

We summarize some key findings in data analysis and provide an overview framework for the research status and development of SNA in mainland China. Figure 7 illustrates the related components, dimensions and issues that are pertinent to our study.

The basic component of SNA can be classified to theory, methodology and application. There are mainly two kinds of theories regarding the papers we have reviewed. Formalist theories are primarily concerned with describing the mathematical form of social networks, while structuralist theories are concerned with how patterns of relations and various structures can influence the interaction and collaboration between different nodes. In methodology section, SNA can be solely used or collaborate with other methods in terms of the research topics. Interestingly, some papers also used other methods to study SNA and its related topics. On the temporal dimension, we construct a four-stage evolution for the development of SNA according to the literature review. We find that in the initial stage SNA was usually studied as a research object, and some researchers introduced its theories, foundations and potential applications to mainland China. It was actually in 2005 that SNA started its career (the second stage). Many researchers gradually recognized the value of SNA as a research method. In the third stage we define it as the integrative phase of SNA, which means more emphasis will be placed on the contribution to the theories and applications of SNA, and those who adopt SNA will take a closer look at the rigorous and effectiveness of this method. In the fourth stage we assume that an innovation and diffusion will occur and SNA can fit much better with other disciplines and subjects. Now we are on the transition from the second stage to the third stage based on our findings by literature review. With respect to the application of SNA, it can be used in different contexts and studied in various levels. As shown in figure 7, we summarize three levels for this dimension, which is in accordance with our level of analysis above. We also list the main applied disciplines and research topics in our overview framework, which have been discussed in the section of data analysis.
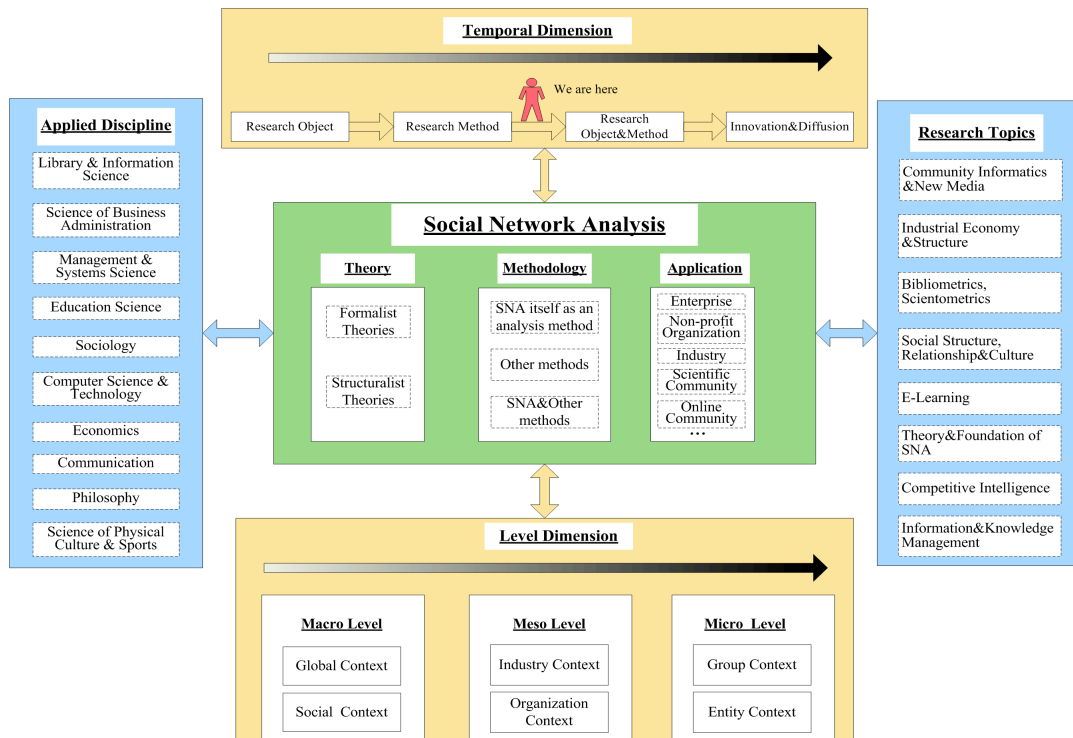

Figure 7. Overview Framework for SNA Research in Mainland China

5.2 Implication for SNA Research in iSchools

The iSchool community in mainland China pays great attention to SNA both as a research object and a method, and researchers of iSchools are well positioned to address the challenges and frontiers in SNA by integrating perspectives from various disciplines. The study also found that the iSchools have played a leading role in SNA related researches. In this section, we attempt to point out several potential directions of SNA for the IS-related disciplines or topics in mainland China.

5.2.1 Web 2.0 and Social Software

With the emergence of Web 2.0, Internet is playing an increasingly important role in mediating social participation, communication and collaboration. The analysis of web user's behavior has attracted much attention in recent years. Therefore, the construction and analysis of social network is an interesting topic for iSchool researchers, and we also think that SNA is an effective method in studying the longitudinal studies such as the formation, evolution, and knowledge sharing of online communities, which may in turn lead to a crowd's wisdom. Additionally, SNA can facilitate the interactive design for user-centered social software and advance the behavioral, cognitive, and motivational aspects of HCI. Furthermore, SNA is also a useful tool for the opinion mining and sentimental classification for web information.

5.2.2 IT/IS Security and Privacy

IT/IS security and privacy covers broad issues at the individual, organizational and social levels, such as user-generated content, online shopping, inter-organizational information systems, collaborative business intelligence, and e-services, etc. SNA can be effectively applied to study the network structure, for example, core-periphery model, centrality and weighted network, etc., which may to some extent, influence the security or privacy of systems, services and applications. There are some research topics which deserve further studies by incorporating SNA method in mainland China, such as detection for online auction fraud and insurance risk, P2P botnet control strategy, assessment for reputation mechanism, and evaluation for the security and privacy metrics, and so on.

5.2.3 ICTs Adoption and Diffusion

The extant studies on ICTs adoption and diffusion are usually based on the survey, interview and case study. Although they highlighted the influence factors and put forward some suggestions for improvement, they were not very successful in explaining the effects which brought by the dynamic social network structure and heterogeneous ties between different roles. SNA captures the characters of social relationship and exchange, which may facilitate the adoption and diffusion of ICTs. Meanwhile, SNA places great emphasis on the accumulation of social capital and examines the context and environment of ICTs, which is also vital for the degree and speed of adoption and diffusion. Related topics may include inter-relationships of multi-level ICTs adoption & diffusion, cross-culture and cross-nation ICTs adoption & diffusion, sustainable intention and continual usage, etc.

5.2.4 Theoretical and Methodological Issues on SNA in Information Studies

SNA has been widely studied or used as a method by IS discipline in mainland China since 2004, especially in evaluation studies, business intelligence, knowledge management and e-learning, etc. However, we have to recognize that we made few contributions to the development of theoretical and methodological perspective of SNA although we commonly studied it or used it. For example, some studies simply used SNA as an analysis tool to get their results without any consideration on whether it is appropriate or has some limitations; some studies discussed the foundation of SNA under the context of IS without any further exploration on its theoretical boundary; some other empirical studies by SNA lack the systematical examination on reasonability and validity of their results. Therefore, iSchools researchers should scrutinize the feasibility on introducing and applying SNA for their studies and make contributions to the theories and methodologies.

6. CONCLUSION

SNA research has not a long history since the last 90th in mainland China. This study assesses the SNA related papers to depict the research status and development by bibliometric analysis and classification scheme. We also give some suggestions for the potential directions of SNA research in iSchools. Overall, this study contributes to the literature in a unique way. However, the paper also has some limitations. First, we only focused on journal literatures, which mean there might be neglects in some other sources; Second, we only collected papers from the database in Chinese without a further consideration on those papers published in English or other languages by Chinese authors from mainland China; Third, we lack a comparison study on the status and development of SNA research with that of international; Last, due to the time limitation we did not conduct some cross-facet analyses between different components. Thus, we hope that in further studies we can make some improvements for those points.

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