

Scientific Research Team Cooperation Analysis and Research

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Abstract

In order to reveal the unqualified situation of the scientific research team in China, this paper takes the scientific research team W of A university as the sample and analyzes the cooperation of the sample scientific research team through the cooperation network diagram and the social network analysis method. This article research team cooperation is mainly study the close degree and characteristics of cooperation, can use the network of the connection strength and the density of cooperation network, cooperation network cohesion index, the cooperative network of factions and cooperation network centrality index analysis, summarized out a real characteristics of the scientific research team should have.

Keywords

Scientific research team, social network analysis, cooperation network.

1. Introduction

In the age of science and technology, with the increasing difficulty of scientific research, more and more complex problems need to be solved by scholars from different disciplines in various fields. Cooperation has become a trend and an inevitable requirement. An effective research team can share resources between teams, which is conducive to improving research productivity and innovation. It is precisely because of changes in the needs of scientific research teams that most scientific research teams are reduced to project application groups that are temporarily gathered for application projects. If the project application is successful, large projects are divided into small topics, which are still separate battles. The essence of cooperation has not been achieved[1]. There are also some "fake teams" who have been pursuing resources and striving for projects, which are very different from the inherent requirements and original intentions of scientific research teams. These "unqualified" teams have problems such as team structures that do not meet standards, waste a lot of academic talents and academic resources, and are very unfavorable to the development of scientific research. Therefore, identifying these "unqualified" teams and screening out effective scientific research teams are of great significance to the decision-making of science and technology management departments and the development of scientific research teams.

Social networks are structural networks used to represent actors and their relationships. An actor, also called a node, can be a person, a group, or even a country[2]. By using social network analysis method, people can not only quickly understand the status of each node in the network, but also have a certain degree of grasp on the integrity of the network[3]. Positive real long-term among the members of the research team cooperation should have a close working relationship and cooperation network feature team should, therefore, this study is committed in a given research team, using social network analysis of relevant indicators, by building co-author network diagram, cooperation on the team analyzed to identify whether they have the conditions for scientific research team, whether it is a real positive of the research team. This research can enable limited

scientific research project funds to be invested in a real scientific research team, which is conducive to improving the efficiency and quality of scientific research, and more rationally formulating scientific research plans and talent policies[4] .

2. Review of Related Research

At present, there are many definitions of scientific research teams. It is widely recognized that scientific research teams are based on scientific and technological research and development. They are complemented by a small number of advantages and are willing to cooperate with each other for common research purposes, research goals and working methods. A group of responsible scientists[5]. Research on teams abroad is relatively early. Early researches were aimed at corporate R&D teams. The related theories and research of scientific research teams are derived from corporate team theories. Foreign scholars through empirical research and case studies, research mainly focused on the factors affecting the performance of the research team, the factors affecting the ability of technological innovation and evaluation research team[6]. In China, the research objects of scientific research teams are mostly university scientific research teams, which mainly focus on theoretical evaluation of team performance evaluation, team formation mechanism and operation mode, team leadership mechanism and cohesion , team identification and discovery, etc.[7]. The current research on the identification and discovery of scientific research teams is mainly focused on: traditional scientific team discovery, that is, to discover teams through data surveys, expert interviews and other data information; social network-based scientific research teams find that they generally use a large amount of data, such as Information, author citation information, etc. to build a network and discover scientific research teams .

Many studies have introduced social network analysis methods to study the phenomenon of scientific research cooperation[8]. Foreign Yang[9] and others studied the cohesion and team structure of information system development teams from the perspective of social networks. Jose[10] et al. Studied the impact of team closeness and social integration on the individual behavior and performance of scientists. Liu Bei and Yuan Yi[11] Using social network analysis methods to analyze the network of researchers' cooperative publications, and found the closeness and cooperation rules of researchers . Xu Yuanyuan[12] from the network density, centrality and cohesion three subgroups citation network, results of experimental studies have shown that the angle of the network density reflects citations between authors cited extent, central figure out the core of cohesion subgroups reflect the Influence between authors. Pang Hong Sun[13] et al combined the indicators of the structure , density, faction group , and centrality of the cooperative network in the social network analysis method to analyze the tightness of the analysis team. Zhang Yang and Liu Jinyuan[14] center of utilization, network characteristics , etc. of the 1986-2010 co-author network competition in the field of intelligence analysis.

Although there are many research collaborations at home and abroad, there is no comprehensive analysis of teamwork by organically linking research objects and methods. For the current research team there is substandard grid situation is also not relevant empirical research and case studies. Therefore, this paper analyzes the cooperation of scientific research teams by using indicators such as connection strength, density, cohesion index, faction, and centrality in social network analysis methods.

3. Data Sources and Analytical Methods

3.1. Data Sources

Due to the development of Internet technology, most of the academic papers have been included in the electronic literature database. For the convenience of statistics, the research data set only uses the Chinese data set . The sources of Chinese data are mainly composed of CNKI , Articles and VIP three major database. Therefore, the data source of this article is based on the three complementary ones. The W team of X University (18 people) is selected as the sample of the research team.

Followed by a number for each member (F1 to F8) and build the authors co-authored the network , count the number of papers published by each two authors, and then by means of UCINET[15] tool for analysis of multiple indicators of the social network of team cooperation degree was analyzed.

3.2. Research Process

Outputs achievement is the most scientific measure of the degree of cooperation team principal indicators, and academic research output is the main show the way. First, get the name of the team members, and then through a database search team members jointly published academic papers , the use of paper data to build cooperative co-author network diagrams , analyze network-related indicators to measure their level of cooperation, specific research process following Figure 1 As shown.

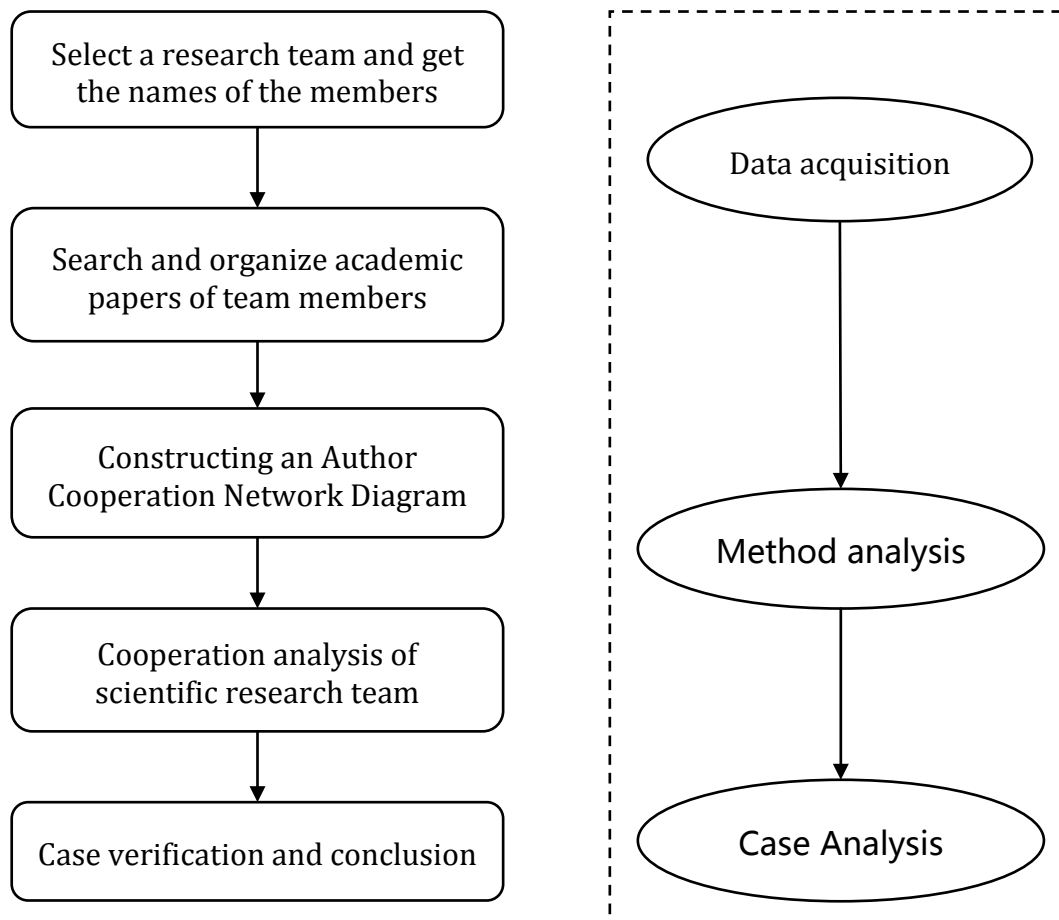


Figure 1:Research process of scientific research team cooperation analysis

3.3. Research Process

At present, there is no unified and standardized method for the collaborative analysis of scientific research project teams. Compared with a temporarily formed team, a team with a higher degree of cooperation should have a more stable cooperative relationship among its members, and its cooperative network relationship should be closer. We can select a series of indicators to analyze the cooperation of scientific research project teams. As used herein, the coupling strength, network density, cohesion index, factions analysis, central analysis and other indicators from the corporate level to research teams collaborate degree of quantitative analysis , analysis method shown in Figure 2 .

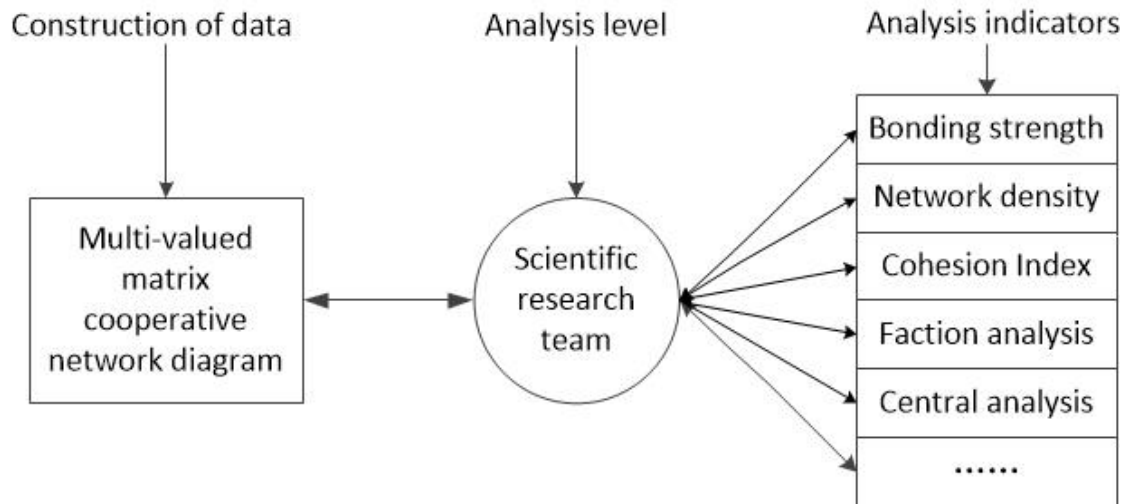


Figure 2: Schematic diagram of analytical methods of scientific research team cooperation

4. Cooperation Analysis of Scientific Research Team

4.1. Analysis of Joint Strength

If there is a cooperative relationship between the two authors, there will be a connection between the corresponding two nodes in the network diagram. The more co-authored papers, the stronger the connection, and the thicker the lines in the figure. The cooperation network diagram of the scientific research team is shown in Figure 3 .

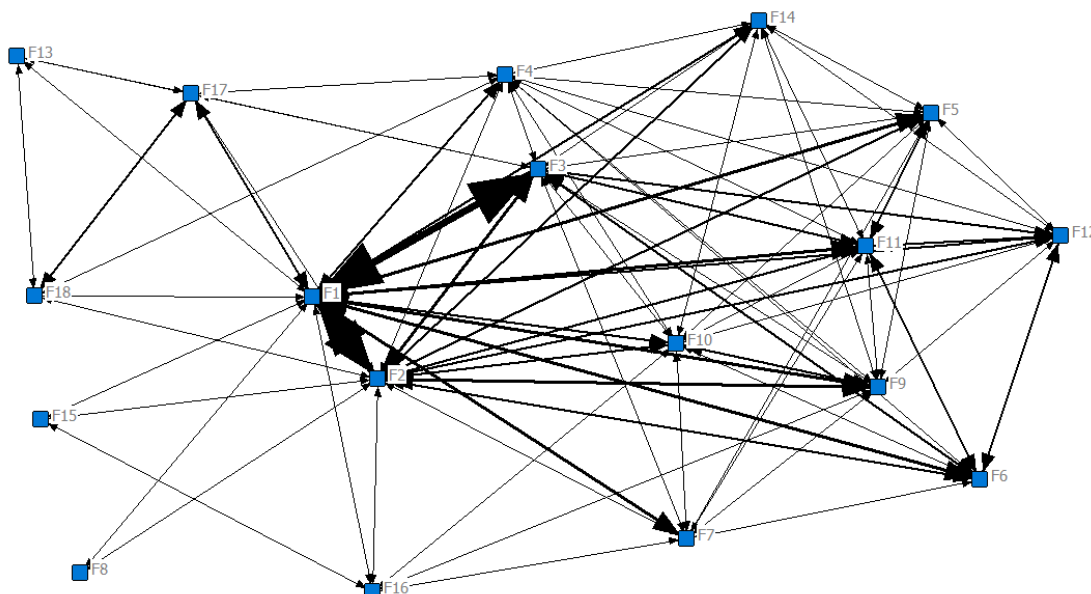


Figure 3: Network diagram of scientific research team cooperation

However, only the thickness of the line is used to represent the connection strength of the network graph, and the strength difference between members cannot be directly and clearly seen. Therefore, this article counts the number of co-authored papers among members of the scientific research team of more than five, as shown in Table 1. It can be seen that the scientific research team has more than 3 cooperating members, and the majority of the more than five papers are cooperating, which can indicate that the scientific research team has a close cooperation relationship and a stable team structure.

Table 1: Statistics of scientific research team paper cooperation

Numble	Number of co-authors with more than five papers	Numble	Number of co-authors with more than five papers
F1	15	F10	7
F2	13	F11	7
F3	8	F12	8
F4	5	F13	3
F5	4	F14	3
F6	6	F15	0
F7	3	F16	2
F8	0	F17	2
F9	6	F18	4

4.2. Density Analysis of Cooperation Network

The density of the cooperative network graph is the ratio of the lines that actually exist in the graph to the theoretically maximum number of lines. Through multi-valued matrix network density analysis, the results shown in Table 2 below are obtained. Wherein, the research team of network density of 0.4859, indicates the presence of the network connecting lines representing the upper limit of the number of network edge ratio of 0.4859, described in each of the cooperative network between the team members have 4.859 the presence of the members of the partnership; standard quasi difference 0.5367, represents the collaboration between fluctuations in the number of team personnel, the lower value of the standard deviation, it means that cooperation to stabilize the frequency of personnel; join relationship the number is 78, indicating that the co-cooperative network 39 exists cooperation between the members, the members of accounts for the total number 48.6%. After the above analysis, we can think that the cooperation strength of the project team is relatively strong.

Table 2: Density analysis of multi-value matrix cooperative networks

Network density	Standard deviation	Number of bonding strength
0.4859	0.5367	78

4.3. Cohesiveness Index Analysis of Cooperative Networks

The cohesion index analysis of the multi-value matrix cooperation network in Table 2 was performed, and the cohesion index was calculated to be 0.732. The index is higher. In addition, this study also attempts to understand the change of the cohesiveness index by removing the core and marginal members of the cooperative network. From Table 1 can be seen directly, the core members F1, F2, F3, the F10, the F11, F12, edge members F8, F15. First, the core member F1 in the cooperation network is removed, and the cohesion index is 0.497, which indicates that the core members have a very important role in team cohesion. After removing the edge member F8, it was found that the cohesiveness index became 0.772 instead, which

proves that the members at the edge have a negative impact on the team's cohesiveness index, and the team is closer after the removal.

4.4. Factional Analysis of Cooperative Networks

About cohesion subgroup analysis should be preferred factions analysis, further analysis if the faction does not exist n-factions, n-sectarian, k-plexus. However, the cooperation between members of the general scientific research team is relatively close, and it can be easily obtained through faction analysis. If the result shows that there are no factions, it can be regarded as loose and there is no need for further analysis. The faction analysis of this scientific research cooperation network finally found 11 factions, as shown in Table 3.

Factions during the analysis process, there are two cases. One is that there are few faction coefficients but there are more members in the faction, and the other is that there are more faction coefficients but there are fewer members in the faction, the cooperation network can be considered to be tight; And there are fewer members in the faction, the network is considered loose. According to Table 3 situation of view, the team factions are more and less number of members of each faction, you can consider cooperation of the team is relatively close in. At the same time, we can find that F1 exists in each faction. F1 can be regarded as the core figure of the scientific research project team, and it plays the role of leader in the team.

Table 3: Faction division of research team cooperation network

Faction number	Faction member
1	F 1, F 2, F3, F4, F5, F9,F10, F11, F12, F14
2	F 1, F 2, F3, F4, F6, F10, F11, F12
3	F 1, F 2, F3, F4, F17
4	F 1, F 2, F3, F5, F7, F9, F10, F11
5	F 1, F 2, F3, F6, F7, F10, F11
6	F 1, F 2, F8
7	F 1, F 2, F15, F16
8	F 1, F 2, F7, F9, F10, F16
9	F 1, F 3, F13, F17
10	F 1, F 3, F13, F17
11	F 1, F 13, F17, F18

4.5. Centrality Analysis of Cooperation Networks

Analysis Center is one of the priorities of social network analysis , it can measure the individual or organization has the right kind of living in a social network or how the center position [16] . In social networks, centrality is measured by two important methods: centrality and central potential. It refers to the center of the core bit at a node in the network set level. Central potential describes how tight the entire network is. Centricity is divided into: the point of the heart and mind, betweenness centrality and closeness centrality are three centers of each of the center and the center have the potential two kinds of index. Therefore, by analyzing the central potentials of the three centralities , the central potential values obtained are shown in Table 4 .

Center Potential Index and network density contrary , it represented the team or group interactive team collaboration focused on minority degree . Center potential index higher , the team knowledge concentrated in the higher level of the minority, the more unfavorable

exchange and sharing of knowledge . When the centrality is lower , the resources and power in the team will be more dispersed to each member. Therefore, if a scientific research team cooperates closely, the central potential value of the team should be as low as possible. According to the observation data, the central potential value of the research team in this paper is not high.

Table 4: Central potential analysis of scientific research team

Central Potential Index	Research Network
Point central potential	24.58%
Intermediate center potential	19.12%
Near-central potential	64.85%

5. Conclusion

This article will link strength, density, cohesion index analysis, factions and analysis center analysis and other indicators used in a known team in cooperation analysis of the research team . After the above analysis, these indicators can well reflect the degree of cooperation of the scientific research team. At the same time, it is concluded that a real team should have a high degree of connection strength, that is, a stable cooperative relationship between authors ; a high density of cooperation networks; a relatively high cohesion index; a small number of faction coefficients, but in factions There are more members, or there are more faction coefficients but fewer members in the faction; the centrality index of the cooperative network should be lower. Similarly, there are some shortcomings in this article. For example , the indicators for team analysis in this article are not comprehensive enough . The rationality of these indicators should be measured and adjusted. This article only uses one team for analysis, and multiple scientific research teams should be selected. Then carry out comparative research to further improve the index system of scientific research team cooperation analysis .

References

- [1] Xu Zhi, Chen Liyu, Wang Sihui. Research on the influencing factors of the degree of cooperation of scientific research teams in universities [J]. Scientific Research Management, 2015 (05): 151-163.
- [2] Sun Lixin. Social Network Analysis: Theory and Application [J]. Management Scientist (Academic Edition), 2012 (9): 66-73.
- [3] Xu Yuanyuan, Zhu Qinghua. An Empirical Study of Social Network Analysis in Citation Analysis [J]. Information Theory and Practice, 2008, 31 (2): 184-188.
- [4] Guo Mintao , Yang Siluo, Yan Piao . A Comparative Study on the Cooperation Mode of Library and Information Disciplines in China and Foreign Countries [J]. Information Theory and Practice, 2013, 36 (10): 120-123.
- [5] Chen Chunhua, Yang Yingshan. Operation and management of scientific research team [M]. Beijing: Science Press, 2004: 32.
- [6] Liao Bingzhu . Research on the Performance and Mechanism of Scientific Research Teams [M] . 2014 .
- [7] Zeng Haiyan, Huang Huiling. A Summary of the Research of Scientific Research Teams at Home and Abroad [J]. Future and Development, 2013 (03): 14-19.
- [8] Zhu Qinghua ., Liang social network analysis and its application in information processing and Information Science in Theory and Practice , 2008 (2): 179-183.
- [9] YangHeng- Li, Tang JihHsin. Team structure and team performance in IS development: A social network perspective. Information & Management, 2004, 41 (3): 335 -349 .

- [10] Jose Martin-Sempere, Belen Garzon-Garcia, Jesus Rey-Rocha. Team consolidation, social integration and scientists' research performance: An empirical study in the biology and biomedical field. *Scientometrics*, 2008, 76 (3): 457-482 .
- [11] Liu Bei, Yuan Yi, BOUTIN E. Research on the Application of Social Network Analysis in Paper Cooperation Network [J]. *Journal of the China Society for Scientific and Technical Information*, 2008, 27 (3): 407-417.
- [12] Xu Yuanyuan, Zhu Qinghua. An Empirical Study of Social Network Analysis in Citation Analysis [J]. *Information Theory and Practice*, 2008, 31 (2): 184-188.
- [13] Pang Hong Shen, Fang Shu, Yang Bo, et al analyzed tightness research team - Dalian University of Technology Laboratory WISE example [J] *Library and Information Service*, 2011 (4).
- [14] Zhang Yang, Liu Jinyuan. Research on Co-authored Networks of Competitive Intelligence in China Based on SNA [J]. *Library and Information Knowledge*, 2012, 2: 87-94.
- [15] UCINET. [2010 -06 -22] .<http://www.analytictech.com/ucinet>.
- [16] Liu Jun. *Introduction to Social Network Analysis* [M]. Beijing: Social Science Literature Press, 2004: 114 .