An Analysis of Co-authorship of Management Science in China[1]

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Abstract

Collaboration in scientific study plays an important role in science and humanity. The object of the study is correlate collaboration in China with management science. Based on the Chinese Journals Fulltext Database (CJFD), we conducted a quantitative analysis of the co-authorship rate with the published time, the age group and address sources of the authors. The analytical results indicate that the scholars at the age group of 40 years old are gradually becoming the academic leaders and younger scholars at the age group of 30 years old are the new blood. Chinese cities could be categorized to different grades according to the analytical results of the address sources of the authors. Beijing and Shanghai are the first grade cities, which means that they are the national centers in management science; Xi'an, Wuhan, Nanjing, Tianjin, Hangzhou and Shenyang are the second grade cities, which are the mid-collaboration level cities and the regional centers in management science; the rest of the cities are the third grade cities.

Introduction

Scientific collaboration has become increasingly important for science and technology development since 1960s, especially when the modern sciences came into the great science period. It has been shown that between years of 1650 and 1800 less than 2.2% of scientific papers were published in co-authorship. However, during the period second half of the 20th century, 60-70% of scientific papers were published in co-authorship (Beaver&Rosen 1978,1979).

Table 1. Data sources

Journal	Level of impact	Number of papers
Systems Engineering -- Theory & Practice	1	2958
The Journal of Quantitative & Technical Economics	2	3042
Systems Engineering	3	1302
Journal of Systems Engineering	4	796
Journal of Industrial Engineering and Engineering Management	5	919
Control and Decision	6	1996
OR Transactions	7	333
Forecasting	8	1299
Chinese Journal of Management Science	9	858
Application of Statistics and Management	10	948
Systems Engineering —Theory Methodology Applications	11	763
Journal of Management Sciences in China	12	793
Accounting Research	13	1684
Studies In Science of Science	14	995
Science Research Management	15	1174
R & D Management	16	1315
Journal of the China Society for Scientific and Technical Information	17	1430
Sum		22605

Collaboration on some specific fields has been studied by many researchers in recent years. However, not many reports on management science could be found. Management science is the discipline of

[1] The work presented in this paper was supported by the Financial support from NSFC (7031027).

Proceedings of ISSI 2005, pages 733–739.
Edited by P. Ingwersen and B. Larsen.

studying all kinds of management activities in human society and is a general designation of management disciplines studying on management activities. (Wu Jiapei, 2000)

As co-authorship is related to collaboration, in most cases for research, we analyze the co-authors in management science in China according to: (1) the trends of co-authorship rate;(2) age group of the co-authors; (3) the city distribution of the co-authors and co-authorship strength between different cities in China.

Data sources

In this study, 17 important journals from CJFD were selected by NSFC as the data sources (Chen Xiaotian, et al. 1999), which are the high impact journals in China. The results are drown in Table 1:

Trends of *Co-authorship Rate* in Management Science

Co-authorship rate (CR) is an indicator for the level of co-authorship in management science, and is related to the following equation:

CR = number of papers co-authored / number of all papers.

It is a relative measure with values between 0 and 1.

The results of analysis with co-authorship rate varies years of management science per the selected 17 journals mentioned above are shown in Figure 1. (appendix 1).

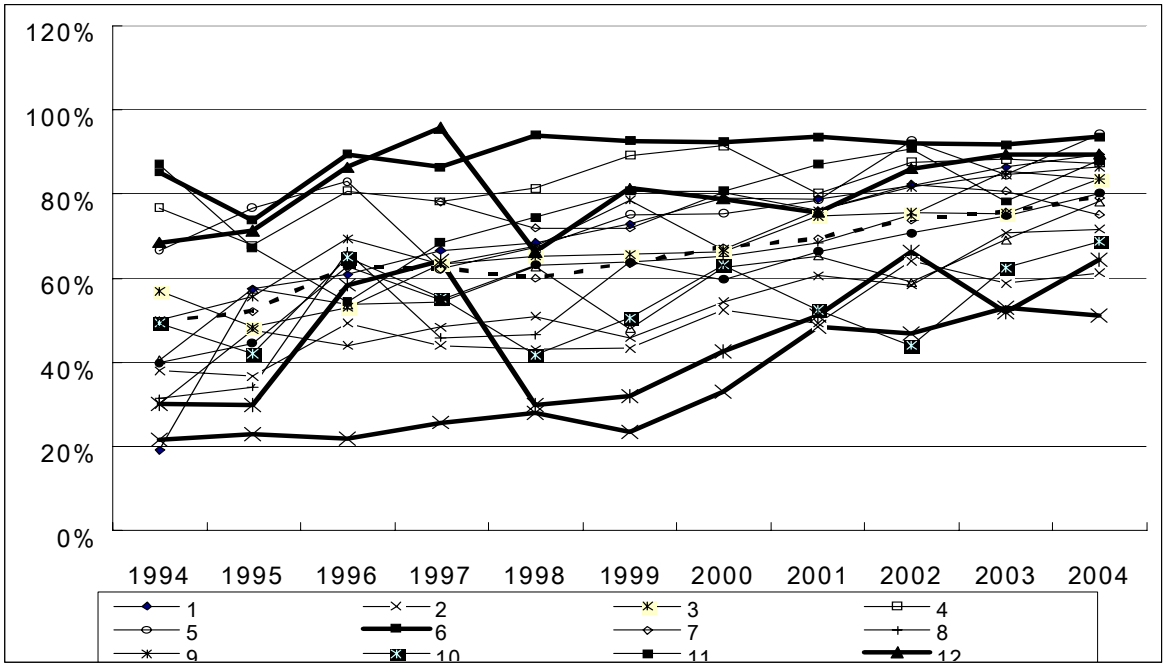

Figure 1: Co-authorship rate in 17 journals

It can be Seen from Figure 1, the co-authorship rate for every journal increases with the years, which means the collaboration is an inevitable trend in the great science period. In general, *co-authorship rates* in *Control and Decision* (91%)*, Journal of Systems Engineering* (83%)*, Journal of Industrial Engineering and Engineering Management* (83%) and *Systems Engineering -- Theory & Practice*(81%) is higher; in contrast, the co-authorship rate relate to *Accounting Research*(39%)*, the Journal of Quantitative & Technical Economics*(49%) and *Studies In Science of Science*(50%) is lower. It should be noted that, *co-authorship rate* of *Accounting Research* always remains the lowest, and co-authorship to *Control and Decision* is always the highest during 1994-2004.

In terms of the different focus of these journals, we found that papers written by individual authors in fundamental research field are much more than in practice and application fields. This result is in agreement with the result studied by other scholars (Jiang Chunlin & Ding Kun, 2004).

From 1994 to 2004, the average co-authorship rate in management science is only 68%. In comparison the co-authorship rate in environment sciences, which is a more comprehensive inter-discipline than management science, is 87.09% (Jiang Chunlin & Guo Yanhong, 2002). There is still a big gap between the two fields on co-authorship rate. Other phenomena such as the co-authorship rate of *Journal of Management Sciences in China* and *Studies in Science of Science* suddenly decreased in 1998 and then increased gradually and the co-authorship rate line of *Application of Statistics and Management* shows that the evident periodicity still needs to be further investigated in future.

Analysis of Age in Co-authors

Some results about authors' age was reported recently, however, studies on age structure of authors were limited. Liang, Kretschmer and Guo quantitatively analyzed the age structure of coauthors in computer science and control theory in China to provide the information of collaboration. Their results indicate that the collaborators in computer science are mainly young people under the age of 30, and the middle-and old-aged people above 50, and in control theory, under the age of 36, and above 47. (Liang Liming et al. 2001, Guo Yongzheng, 2003)

In our research, we made a primary analysis on the age structure to co-authorship in management science.

Due to the limitation of the database, only 7 journals, *Science Research Management, Studies In Science of Science, Control and Decision, Journal of the China Society for Scientific and Technica Information, Systems Engineering, Systems Engineering -- Theory & Practice* and *R & D Management* , have complete co-authors age information after 2000. Totally 2245 data were obtained from these journals as scattered in the figure 2. It should be noted that only the oldest and the youngest authors of a paper multi-authors are considered in this paper.

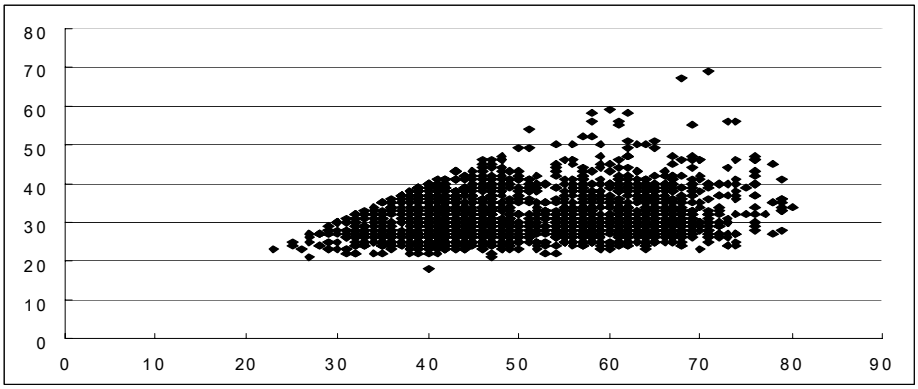

Figure 2. Distribution of co-authors ages

In Figure 2, the horizontal axis indicates the eldest age, the vertical axis indicates the youngest age in the co-authors. It is easy to see that the eldest is distributed between 30-70 years old, the youngest is 20-45 years old. Two sections highly concentrated is presented indistinctly in figure 1. Further analysis on these two sections demonstrate the age structure of co-authors in Figure 3, Figure 4 and a table (Appendix 2).

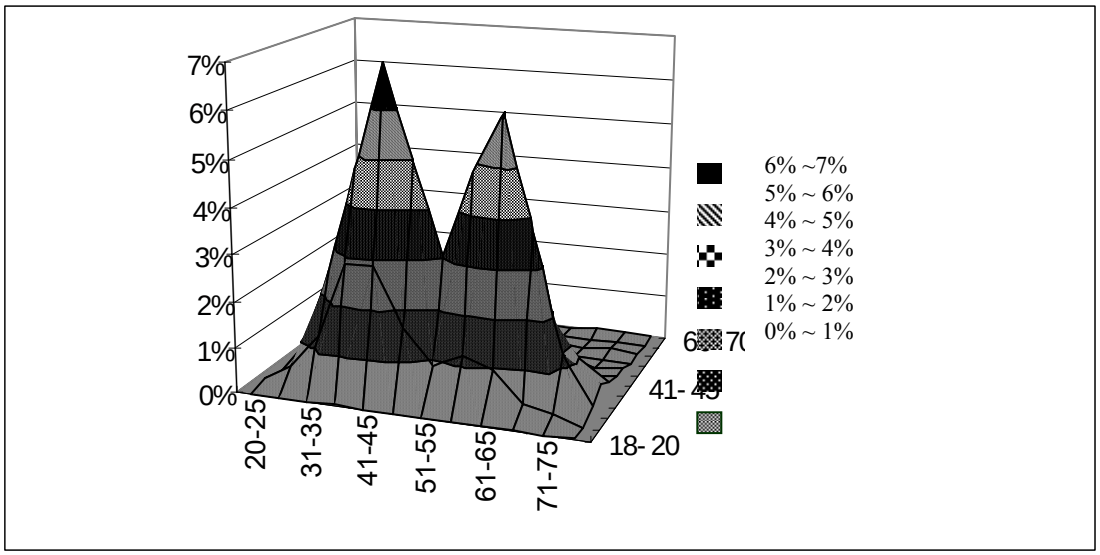

Figure 3. Age mountains of co-authors

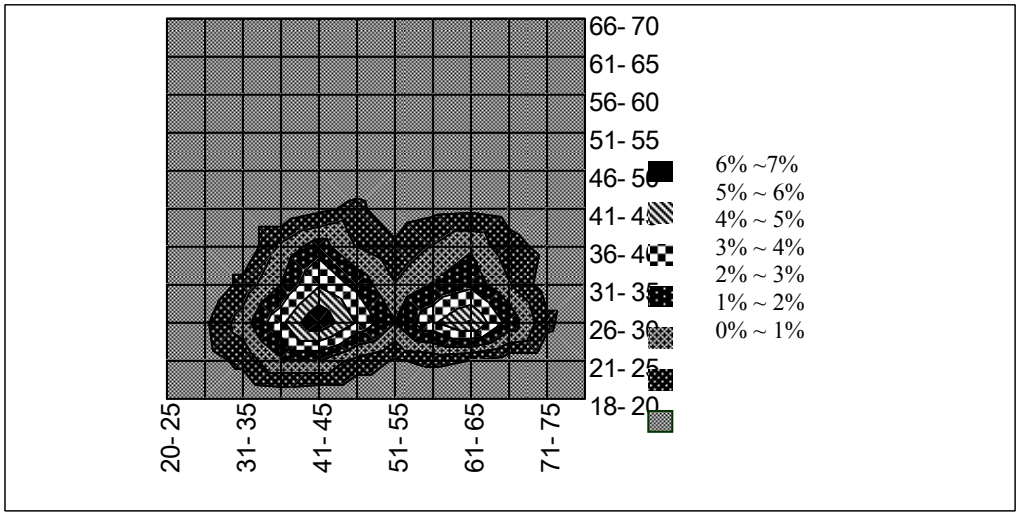

Figure 4. Two dimension graph of age mountains

Two co-author mountains are clearly shown in Figure 3, which is transformed in Figure 4. We found in management science, the collaborations occurred more frequently between the scholars of 26-30 and 41-45. The scholars of 51-55 form a valley between two peak points, which means an age "fault age" to collaboration in management science. From these two figures we conclude that in Chinese management science, the younger scholars at the age of 26-30 tend to collaborate with others.

The average age of the eldest authors in coauthors decrease from 54.47 to 47.81, the average age of the youngest authors decrease from 34.47 to 30.17. The co-authors are becoming younger in Chinese management science.

All of these results support the opinions that in the collaboration group of management science, scholars at the age of 61-65 are still the academic leaders; scholars of 51-55 are the age fault age due to the culture revolution in China; the middle aged scholars of 41-45 are becoming the academic leaders; and the younger scholars of 26-30 are the most active new forces.

The City Distribution of the Co-authors

Much research of collaboration is focused on the papers co-authored, few directs to region collaboration at present.(Liang Liming et al. 2002) Strengthening collaborations between different cities is an important factor in a national innovation system. In this section studies on the collaboration

phenomenon between different cities in management science by quantitative analysis and the collaboration strength are presented to reveal the city collaboration rules in China.

Collaboration strength is an indicator to express the collaboration degree between different regions, Wang Zheng and his colleagues have given the definition on the mutual effect strength between two points in the knowledge net (Wang Zheng et al. 2001), which stresses the theory analysis. The simple formula can be expressed as $T_{ij} = \frac{S_{ij}}{x_i + x_j}$,

$x_i + x_j$ —— the number of papers produced from city *i* and city *j* respectively;

S_{ij} ——the number of papers co-authored, and the authors comes from city *i* and city *j*;

T_{ij} —— the *co-authorship strength* in management science between city *i* and *j*.

Those cities from which the published papers are less than 100 in management science are excluded from our research because of the small statistic sample. 23 cities (Table 2) were selected to be research subjects. Based on the above equation, the collaboration strengths of 23 cities were calculated (Appendix3) as demonstrated in figure 5 and figure 6.

Table 2. Number of papers on management science in some cities

Beijing	**Tianjin**	**Taiyuan**	**Jinan**	**Qingdao**	**Zhengzhou**	**Xian**	**Shanghai**
2848	1065	108	151	112	179	1281	2088
Nanjing	**Hangzhou**	**Hefei**	**Wuhan**	**Changsha**	**Shenyang**	**Dalian**	**Changch-un**
1147	829	439	968	575	609	365	127
Haerbin	**Fuzhou**	**Xiamen**	**Shenzhen**	**Guangzhou**	**Chendu**	**Chongqing**	**Sum**
493	109	276	116	317	420	246	14868

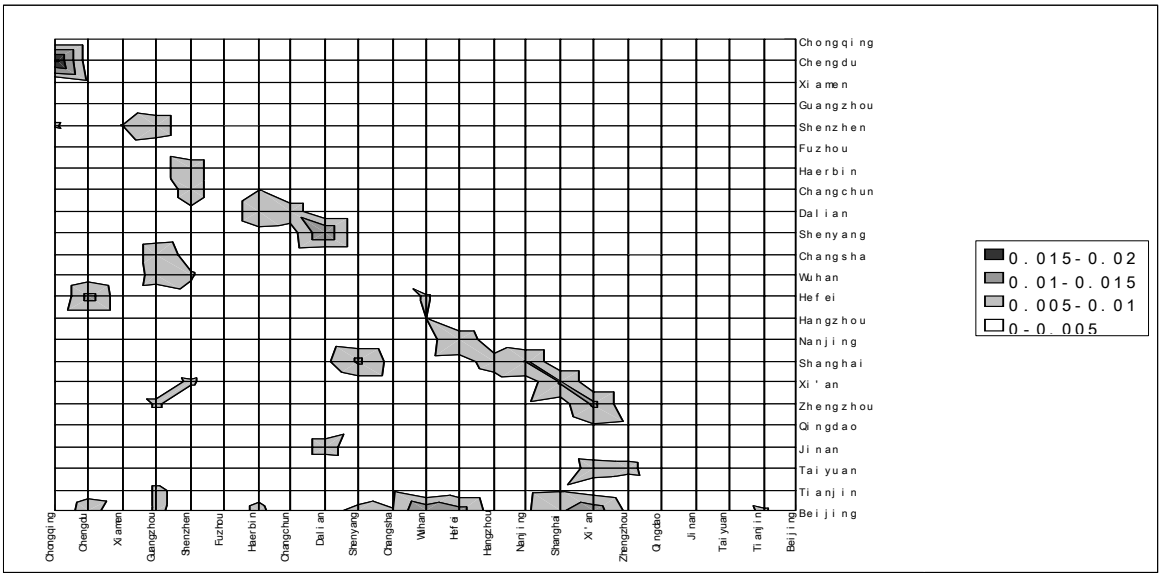

Figure 5 Collaboration strength between different cities

The analysis on region collaboration strength of 23 cities in China shows that the collaboration strength between different cities is not only related with the number of co-authored papers, but also related with the space distance. The higher collaboration strength corresponds with the shorter

distance. However, it can be expected, with the coming of the internet age, the collaboration will lead to virtual knowledge alliance, and the effect of space distance will be weaker and weaker. As seen in figure 5, two co-authorship clusters are being formed, one is Northeast area, the other is the area of between middle and the lower reaches to Yangi River. Generally, the collaboration between different cities will be improved in future. According to the collaboration strength, Chinese cities could be divided into different grades. Beijing and Shanghai are the first grade, which means they are the national centers in management science; Xi'an, Wuhan, Nanjing, Tianjin, Hangzhou and Shenyang are the second grade, which represent the mid-collaboration level and the regional center in managements science; other cities are the third grade.

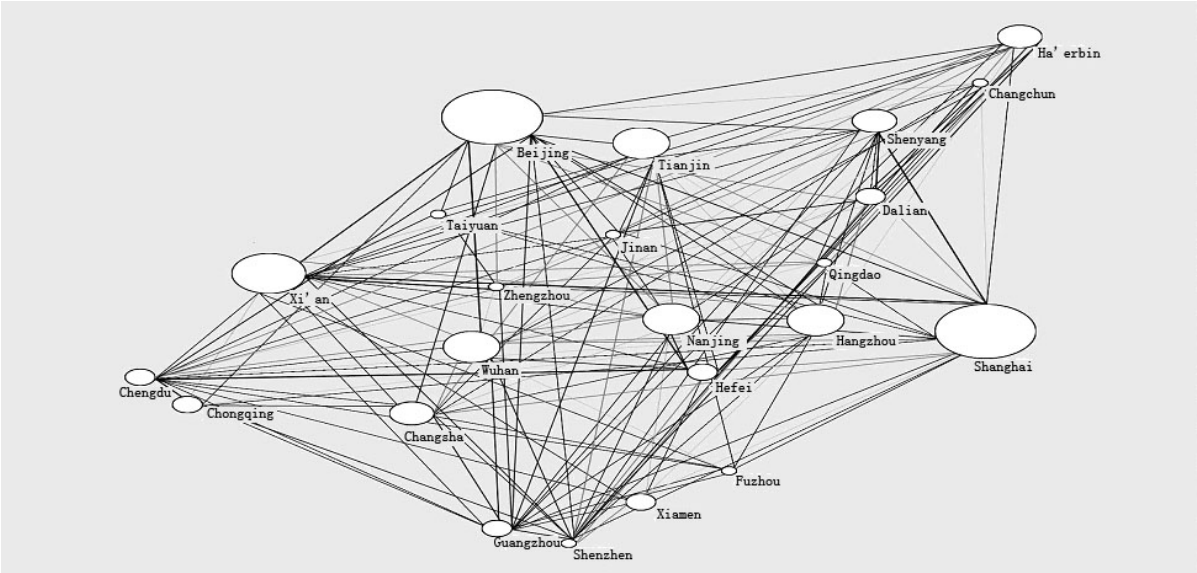

Figure 7 Map of collaboration between different cities in management science

Conclusions and D**iscussion**

The following conclusions can be made on the basis of the quantitatively analysis of 17 high impact journals of management science in China.

(1) In management science, scholars at the age of 61-65 are still the academic leaders; scholars of 51-55 are the age fault age due to the Culture Revolution in China; the middle aged scholars of 41-45 are becoming the academic leaders; and the younger scholars of 26-30 are the most active new forces.
(2) Chinese cities could be divided into different grades according to the analysis of the address sources of authors. Beijing and Shanghai are the first grade, which means they are the national centers in management science; Xi'an, Wuhan, Nanjing, Tianjin, Hangzhou and Shenyang are the second grade, which represent the mid-collaboration level and the regional center in management science; other cities are the third grade.

Similar to other disciplines, the study on collaborations in management science should be extended and deepened in order to reveal the basic rules of scientific collaboration. Further studies will be focused on inter-collaboration and collaboration between different disciplines in management science, collaboration between different disciplines in management science and non-management science, the collaboration of leading disciplines in the management science and their evolution, the collaboration trend in frontier management science, the relevance degree between collaboration and results in science.

And further studies will also be focused on the mutual effect between production and ability in science reflected by the phenomenon of scientific collaboration, the organization of collaboration, the character of knowledge alliance, the relationship of teacher-student, student-student in science collaboration, and new scientometrics methods to probe into collaboration problem.

We expect the academic field of collaboration in science and technology pioneered by Dr. H.Kretschmer, specially the COLLNET, would achieve new results in management science collaboration.

Acknowledgment

The authors thank Pang Jie, Yang Mu and Yang Jianxiu for their helps in data collections.

References

Beaver, D. & Rosen, R. (1978), Studies in scientific collaboration, Part. I: The professional origins of scientific co-Authorship. *Scientometrics*, V1, 65 - 84.

Beaver, D & Rosen, R. (1979), Studies in scientific collaboration, Part. II: Scientific co-authorship, research productivity and visibility in the french elite, 1799-1830. *Scientometrics*, V. 1, 133 - 149.

Chen Xiaotian, Jin Bihui, Yang Liexun, Li Ruoyun, Lu Yun & Li Lin (in Chinese, 1999). Select important journals of management sciences in China. *Journal of Management Sciences in China*, Vol.2 No.4, 70-75.

Guo Yongzheng （in Chinese, 2003）. Age structures of scientific collaboration in Chinese control theory. *Journal of Zhejiang Wanli University*, Vol.16,No.2, 21-26.

Jiang Chunlin & Ding Kun (in Chinese, 2004). A statistical analysis on the high qualitative collaboration in management science research in China: a looking into the distribution of first author's ages. *R&D Management*, Vol.16, No.1,73-77.

Jiang Chunlin & Guo Yanhong (in Chinese, 2002). Empirical study on co-published papers in journals of environmental science trend of scientific cooperation. *R&D Management*, Vol.14, No.1,41-44.

Jin Bihui, Li Ling & Ronald Rousseau (2004). Long-term influences of interventions in the normal development of science: China and the Cultural Revolution, *Journal of the American society for information science and technology*, 55(6), 544-550.

Liming Liang, Hildrun Kretschmer, Yongzheng Guo & Donald deB Beaver(2001). Age structures of scientific collaboration in Chinese computer science. *Scientometrics*, Vol.52, No.3 , 471-486.

Leonard L(1976). Age and achievement in psychology: the harmonic mean as a model. *American psychologist,*11,805-807.

Liang Liming, Liu Junwan & Ronald Rousseau(2004). Name order patterns of graduate candidates and supervisors in Chinese publications: a case study of three major Chinese universities. *Scientometrics,* Vol.61,No.1, 3-18.

L. Liang, H. zhao, Y. Wang, Y. Wu (1996). Distribution of major scientific and technological achievements in terms of age group — Weibull distribution. *Scientometrics*,Vol.36, 3-18.

Liang Liming, Zhu Ling & Hou Changhong (in Chinese, 2002). Matthew effect and regional tendency of scientific collaboration between different princes in China.. *Journal of Dialectics of Nature*, Vol.24, No.2, 42-50.

Wu Jiapei(in Chinese, 2000). The development of management science in 20th century. Nankai management review, 6