

# SYSTEMIC VISION TOWARD THE STUDIES OF *WU-LI SHI-LI REN-LI* SYSTEM APPROACH

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## ABSTRACT

Since the *Wu-li Shi-li Ren-li* system approach proposed by Jifa Gu and Zhichang Zhu at the University of Hull in November of 1994, the studies on WSR system approach undergo continual development. As an oriental system approach, WSR is mainly based on systems practice in China. With a collection of literatures relevant to WSR system approach, we apply the iView, a supporting technology toward qualitative meta-synthesis, to those literatures to show a systemic vision towards the studies on WSR system approach. The scopes, especially the practical areas are detected. Moreover, the main themes and expansions of topics are detected at different periods. The results are based on computing and visualized for better understanding and exploratory analysis. Such a study not only shows the development of WSR studies, but also exhibits that the iView analysis is an effective technology to support such kind of qualitative study.

**Keywords:** *Wu-li Shi-li Ren-li* system approach, iView analysis, qualitative meta-synthesis

## INTRODUCTION

The system rethinking tide since 1970s took place with the limitations of analytical thinking dealing with human and organizational elements on system design and mathematical modeling for unstructured messy problems. A variety of system approaches had been proposed, such as Ackoff's interactive planning, Checkland's soft system methodologies (SSM), Mason and Mitroff's strategic assumption surfacing and testing (SAST), etc. (Tomlinson and Kiss, 1984; Flood and Jackson, 1991). To be distinguished from those analytical modelling for problem solving which are regarded as hard approaches, some also called those system approaches soft OR or problem structuring methods (PSMs). Problems tackled by those approaches are also referred as "wicked" problems. Those approaches are quite successful toward strategic decision making which also leads to a multi-methodology trend to deal with the wicked problems, such as Wisdom (Mackenzie, et al., 2006).

Besides western scholars' endeavours in systems thinking, oriental researchers also made contributions. *Wu-li Shi-li Ren-li* (WSR) systems approach is one of them. The name of WSR was coined and proposed by Jifa Gu and Zhichang Zhu at the Centre for Systems Study, University of Hull in November of 1994 and thus got western attentions, while its root and practice are all in China.

During the past years, both Gu and his students in China and Zhu in UK studied WSR from different perspectives. Almost 17 years passed. What is the situation about WSR, especially its development? Seems differentiation took place along the WSR research, some people may be confused with WSR (Ing, 2009). Then what kind of problems or practice have WSR been engaged in? We need some answers for easy understanding and a sustainable development of WSR. In this paper, we make a try based on an early collection of some papers on WSR and related studies (Zhu, Song and Gu, 2008) and a

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collection of Chinese literatures collected by CNKI (China National Knowledge Infrastructure) till 2010. Instead of traditional comprehensive survey analysis, we apply the iView, a supporting technology toward qualitative meta-synthesis, to those literatures to show a systemic vision towards the studies on WSR system approach. At first we briefly address the WSR approach, its origin and background.

### ***Wu-li Shi-li Ren-li* System Approach**

The *Wu-li Shi-li Ren-li* approach is an oriental system approach. The Chinese terms, *Wu-li* (Theory of Physics), *Shi-li* (Theory of Doing or Managing) and *Ren-li* (Theory of Humanity) are often used to reflect those laws or rules followed in practical activities under different situations.

### **The Origins of *Wu-li*, *Shi-li*, *Ren-li* and WSR System Approach**

Since the end of 1970s systems engineering (SE) people in China began to discuss those terms. In 1978, a paper titled *Technology for Organizing and Management - Systems Engineering* written by Xuesen Qian, Guozhi Xu and Shouyun Wang was published in one Chinese newspaper *Wen Hui Bao* (Qian, Xu and Wang, 1978). That paper firstly addressed that operational research (OR) could also be denoted as *Shi-li* to refer the way of doing and managing regarding that *Wu-li* described the movement of physical world. Professor G. Z. Xu also wrote a specific paper on *Shi-li*; his opinion was consistent with the view that OR research includes OR theory, OR mathematics and OR practice (Xu, 1981). Later Professor Qian introduced their understandings on SE in a letter to a MIT professor Li Yao Tsu, who agreed with the concepts of *Wu-li* and *Shi-li*, and suggested adding *Ren-li*, which specifically meant motivation. However, the saying of *Ren-li* had not got enough attention in the circle of Chinese SE scholars at that time. J. F. Gu began to put three terms together in the middle of 1980s and proposed a saying as “knowing *Wu-li*, sensing *Shi-li* and caring *Ren-li*” (Gu, 1988); while did not think from a methodological level. From the middle of 1980s to the start of 1990s Professor Gu had engaged in several practical projects: Beijing regional development, global climate change, various evaluation projects and water resource management, etc. Some perplexities were confronted when dealing with human relations, decision makers’ behaviours and interdisciplinary knowing among those projects. Gu found that most of those existed western hard or soft system methodologies were difficult to solve those kinds of troubles due to special Chinese cultures and social backgrounds.

In 1994 Professor Gu took a 2-month visit to the Centre for Systems Study, University of Hull. He compared those western system methodologies with oriental ones based on his exchanges, observations and his own SE experiences. He had discussed with Z. Zhu (who was a doctoral student at that time) seriously about his own experiences and perplexities during his SE practices in China. According to the western experiences in formulating system methodologies they together proposed WSR as an oriental system approach whose basic framework including main contents, philosophy, principles and working process were addressed at a research report and later in a paper for the 1st China-UK-Japan System Methodology Workshop held in Beijing (Gu and Zhu, 1995). By using the adjective “oriental” they emphasized the differences between eastern and western cultures. Simultaneously, a close-finish project on regional water resource management in north of China became an available successful application of WSR approach (Gu and Tang, 1995; Tang, 1995).

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### Basic Points of WSR, and More on *Ren-li*

The *Ren-li* (Theory of Humanity) may refer to the knowledge on human effects on the system or how we deal with human interrelation. It is easier to sense how *Ren-li* works than to define what is *Ren-li*. *Ren-li* may be experiences or the art that managers cope with the interrelation between their subordinates and bring all into a harmony. The aim of *Ren-li* is to initiate human's creativity, enthusiasm and participation, and to explore the human wisdom. *Ren-li* can also affect the results of *Wu-li* and *Shi-li*. In Japan, the local residents could finally veto the construction of another nuclear power plant even though nuclear energy was declared better for a resource-lacking country. That is the power of *Ren-li*. Basic and relevant knowledge on *Ren-li* may be taught at social sciences or management schools in universities, while more can only be sensed from system practices.

System practice activities are constituted by the dynamic unification of physical world, system organisation and human beings. All inquires and interventions are expected to cover all three aspects and their dynamic interconnection so as to get a comprehensive scenario of the concerned issue and then to find a satisfactory and feasible result. Basic knowledge can be taught in classroom, while knowing about three *li*'s comes from practices. Table 1 lists the basic contents of WSR.

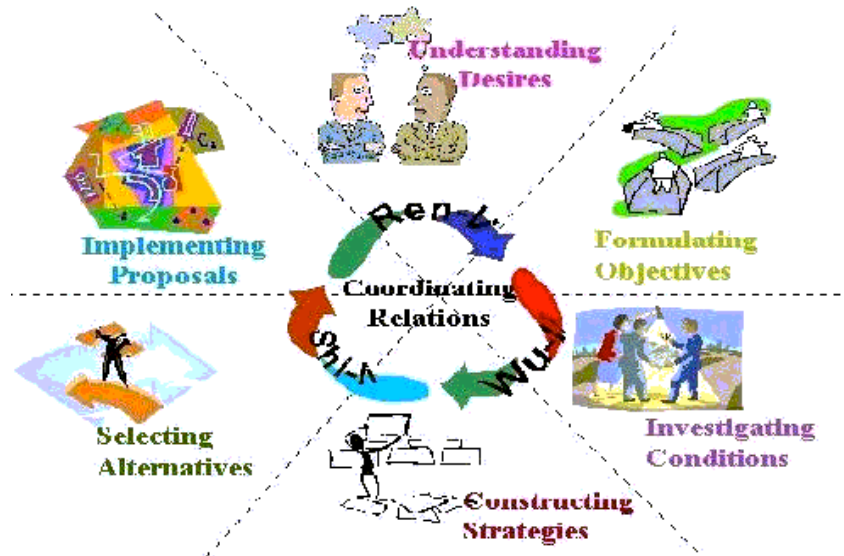
**Table 1: Contents of WSR System Approach** (Gu and Tang, 1995; Tang, 1995)

	<i>Wu-li</i>	<i>Shi-li</i>	<i>Ren-li</i>
Meanings	Theory of physical world, laws, rules	Theory of managing, ways of doing	Theory of humanity, social norm
Objects	Objective matter world	Organizations, systems	Human, groups, culture, ethics, religion
Focus	<i>What is...?</i>	<i>How to...?</i>	<i>Shall we...?</i>
Principles	Honesty, truth, as correct as possible	Harmony, efficiency, as feasible as possible	Humanity, effectiveness, as flexible and reasonable as possible
Knowledge needed	Natural sciences	Management science, systems sciences	Social sciences

In short, *Wu-li* explains the mechanism of what is concerned, *Shi-li* points out the framework of the managerial tasks of making the best use of everything, and *Ren-li* is to make the best possible of human beings and to manage in exploring available potentials for a satisfying or reasonable result of whole activities. The original working process for WSR approach has 7 steps: understanding desires, formulating objectives, investigating conditions, selecting models, making recommendations, coordinating relations and implementing proposals (Gu and Tang, 1995). Explorations of WSR approach itself had always been done with applying WSR approach to a variety of practical problems in China (Gu, 2000). Among those practical projects, **caring *Ren-li*** does not only mean the coordination between groups with different benefits or playing politics addressed by Zhu (2000). Those relation-coordinating endeavors aim to facilitate implementing feasible *Shi-li* based on right *Wu-li*. If with wrong *Wu-li* or infeasible *Shi-li*, more endeavours in *Guan-xi* still cannot ensure a satisfying end of the project. Then the 6th stage of WSR approach in system practice can refer to coordinating relations between three *lis* at each stage, to coordinate relations between desires, objectives, conditions, strategies,

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alternatives and proposals, and to coordinate the relations between input, output and outcome of system activities. A modified WSR working process is as shown in Figure 1.



**Figure 1. The Working Process of WSR Approach (revised) (Gu and Tang, 2002)**

Emphasis on *Wu-li* and *Shi-li* and negligence of *Ren-li* may lead system practice to be too mechanical and lacking communication and versatility. While only playing *Ren-li* and ignoring *Wu-li* and *Shi-li* may eventually leads to failure or disasters, such as many failed projects hastily run for big memorial days or the will of some senior administrative officials in China. Then **knowing *Wu-li*, sensing *Shi-li* and caring *Ren-li*** is the ultimate doctrine of WSR approach.

As Professor Gu and his colleagues have applied WSR approach to a variety of practical projects (Abe, 2001; Gu, et al, 1997; Gu et al, 1998; Gu and Tang, 2000; Gu and Tang, 2004; Tang, 1999; Tang and Gu, 2001; Yamamoto, 2001; Zhao, 1997; Zhao, 2000), discussions about WSR and relevant practices also started in China by other researchers. Gu and Tang (2006) published a Chinese book on WSR and its applications, which at first time address WSR comprehensively.

On the other side, Dr. Zhu also developed WSR from his own serious thinking and communications with people in the west and the east. Big difference exists between the two streams. In this paper, we do not intend to address those differences into details. Instead we do a so-called qualitative meta-synthesis study based on collections of a variety of WSR publications and expect to acquire a systemic vision of WSR by computing ways. Such a systemic vision may be helpful to people who want to quickly get a rough image of WSR, its meaning, principal ideas, and possible topics and avoid dilemmas from the start.

Next we address the qualitative meta-synthesis and one of its supporting technologies, iView analysis.

### Qualitative Meta-synthesis and the iView Analysis

Qualitative meta-synthesis is one type of meta-synthesis, which is a system approach toward complex problem solving proposed by Chinese system scientist Qian Xuesen and his colleagues over 20 years ago (Qian, Yu and Dai, 1990). Another two types of meta-synthesis denote qualitative-quantitative meta-synthesis and meta-synthesis from qualitative understanding to quantitative validation, which actually indicates a working process of MSA to complex problem solving.

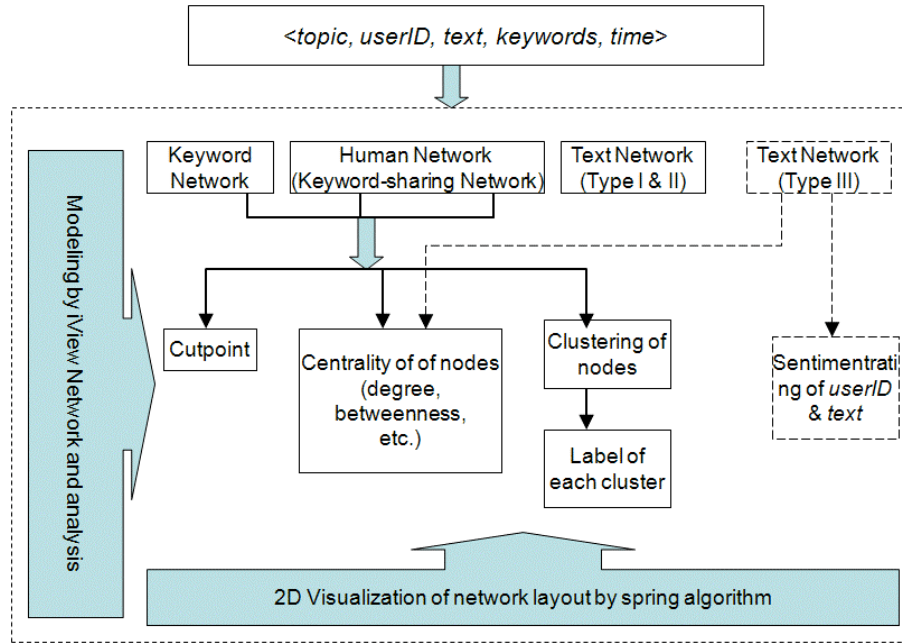
Gu and Tang (2005) discussed how to achieve three types of meta-synthesis by a synchronous-asynchronous-synchronous process while each type of meta-synthesis can be achieved at the respective phase. Activities held in Synchronous Stage I denote to achieve qualitative meta-synthesis, i.e. perspective development or hypothesis generation for meta-synthetic systems modelling. Divergent group thinking is the main way at that stage. Methods oriented to acquire constructs or ideas toward the concerned problems are considered as qualitative meta-synthesis methods. Thus problem structuring methods can fulfil qualitative meta-synthesis. If a variety of publications on WSR can be regarded as divergent ideas from different authors on the same theme, then the collection of those publications is the collective ideas of a WSR community. Thus we undertake qualitative meta-synthesis to those collective ideas relevant to WSR is reasonable and helpful to find the structure of WSR topics from the diverse ideas.

### The iView Network and iView Analysis

The iView analysis aims to implement qualitative meta-synthesis for acquiring structures of collective thinking and confident hypothesizing. The input data is with a meta-data as  $\langle \text{topic}, \text{userID}, \text{text}, \text{keywords}, \text{time} \rangle$ , which indicate the corresponding *userID* submits one piece of *text* (e.g. one comment, one blog, the title of a paper, a reply to one question) with a set of *keywords* under the *topic* at the point of *time*. By word segmentation and filtered feature keywords used in text summarization, or even human's judgment, ideas and opinions can be transferred into such a structured representation. The keywords for a blog may also denote the labels or tags of that blog. The keywords are articulated as attributes of the *userID* or the *text*.

Figure 2 shows the essential analytics of the iView analysis. Tang (2008; 2010), Tang, Zhang & Wang (2008) present the mechanism in details.

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**Figure 2. Analytics of the iView Analysis**

The central concept of the iView analysis is the iView network which denotes 3 kinds of topological networks, *keyword network*, *human network* and *text network*. In a keyword network for iView analysis, the link between the vertices (keywords) denotes the co-occurrence of keywords among all *texts*. Such a network is referred as an *idea map* contributed by all authors. This topological network is a weighted undirected network where the weight of edge denotes the frequency of co-keywords. In a human network, the link between vertices denotes keyword-sharing between authors. The strength between two authors indicates the number of different keywords or the total frequencies of all the keywords they share. All three types of text networks are directed networks. The directed link from text *j* to text *i* in Type I text network indicates text *j* cites keyword(s) which originally appear(s) in text *i*. In the text network Type II, the link denotes to cite the closest text including the concerned keyword. In the text network Type III, the semantic meaning of link expands to a variety of attitudes, e.g. oppose, support, etc. instead of the citation of keywords in both Type I & II text networks, then the meta-data needs to include 2 more elements, i.e. *attitude* and *reference*. Text network may help to show how the ideas grow and spread. Different algorithms are applied to the text network Type III due to the different semantic meanings of the link. As a matter of fact, the iView network may be regarded as the different projections of a tripartite (text, users and keywords) network. After the projection, we get 1-mode network and apply methods of graph theory or social network analysis (SNA) to network analysis. The mechanism of those methods can be easily found in one book on graph theory or SNA.

The main aim of the iView analysis is not to concentrate on the exact methods in graph theory or SNA, but to acquire a structure of the concerned topics or unstructured problems via a variety of analysis by adoption of a series of algorithms or methods so as to

- give a rough imagine of the issue;

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- draw a scenario of the issue using clustering analysis to detect the structure; meanwhile, an optimal of clusters is achieved;
- extract concepts from clusters of ideas. Thus, a category of concepts instead of a mess of diverse ideas may be acquired step by step.

Moreover, the visualization of the analyzing process facilitates human's understanding and sense-making along the structuring process. Next we apply the iView analysis to WSR literatures.

### The iView Analysis toward WSR Publications

Zhu, Song and Gu (2008) have undertaken analysis of WSR publications by manually collect the WSR and relevant publications. Through the databases including CNKI, CQVIP (Chinese Scientific Journals Fulltext Database online), Springer, ISI Web of Knowledge and EI, they found 225 papers (97 English papers, 125 Chinese papers and 3 Japanese papers) published from 1994 to March 2007. With those data, they conducted basic statistic analysis, application domain analysis of WSR approach, the interested group by co-author network and citation analysis by citation network. Thus not all the 225 papers were on WSR study, since those citations either cite WSR or are cited by WSR were added by analysts. The application domain analysis of WSR is based on subjective judgment of the analysts. The keywords are not considered by computing ways, even almost half of those data lack keywords.

From this previous study, we know research on WSR is neither quite hot nor quite cold before 2008. There was a peak in 2000, above 20 publications in that year, and then fall till 2004. After 2004, publications gradually increase.

### What kind of Data for the iView Analysis?

In this paper, not all data in the previous study are included. Some citations which are not on WSR papers are excluded. Papers with no keywords are also ignored. Thus less than 50% data are qualified for a quick iView analysis. Publications data from 2005-2010, including more journal papers (from CNKI), more theses and Ph.D. dissertations are added, all the publications for this study have keywords. A large number of papers are added. Table 2 gives a glimpse of the publications for the iView analysis. Different from the previous study, we consider two important events. One is 1999 when Professor Gu moved to JAIST, Japan. Another is 2004 as Professor Gu come back Beijing, the finish of a NSFC project on meta-synthesis. We can see publications that during the 1999-2004, the publications are less than half of those in 2005-2010. The move may be one of reasons. That is a difference from this study and the previous study.

**Table 2. A Summary of WSR Publication Data**

Year	Publication #	Author #	Keyword #	Component # in Keyword network
94-99	15	13	36	4
99-04	66	83	150	14
05-10	144	242	360	17
Total	225	324	486	20

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### What are Topics of WSR Research?

The iView analysis is undertaken to different iView's keywords network and keyword-sharing network, i.e. human network. Table 3 shows the main themes detected from the keyword network of WSR-related publications based on 4 analytical methods, cutpoint, centrality of betweenness and degree, and labels of node clustering (as shown in Figure 2), with which we may sense or sort out the structure of the WSR study.

**Table 3. Topics of WSR Study based on iView's Keyword Network**

<b>Cutoint (30)</b>	WSR, systems science, system approach, NGO, decision science, management, water resources management, swarm algorithm, SE, meta-synthesis, knowledge discovery, SSM, complexity, <i>evaluation</i> , competence, index system, economic control, research method, capital management, harmony management, value engineering, model, value meta-synthesis, knowledge management, e-government, methodology, oriental system approach, supply chain management, data mining, Hall 3D
<b>Betweenness (25, &gt;1500)</b>	WSR, meta-synthesis, SE, <i>evaluation</i> , system methodology, complex system, complexity, Shi-li, competence advantage, performance measurement, e-government, informationization, economic control, system analysis, data mining, model, index system, system approach, SWARM algorithm, value meta-synthesis, Hall 3D, value engineering, <i>comprehensive evaluation</i> , Wu-li, Ren-li
<b>Degree (15, &gt;15)</b>	WSR, system methodology, <i>evaluation</i> , meta-synthesis, SE, informationization, system analysis, Shi-li, <i>comprehensive evaluation</i> , Wu-li, Ren-li, SSM, complex system, complexity, performance measurement
<b>Cluster labels (35, Q=0.724); (only lists #&gt;3)</b>	WSR, system methodology, <i>evaluation</i> , meta-synthesis, system analysis, data mining, competence advantage, urban SE, NGO, e-government, index system, harmony, economic control, oriental system approach, systematics, agricultural product brand, Difference Theory, Three Li Harmony, interval number, education informationization, community forestry, virtual enterprise, cause-effect

If observing the publications based on different periods, we may see transition of the topics. Table 4 gives details. Obviously the topics of WSR cover broader scopes gradually, and more oriented to social complex system problems. "Evaluation" is an important topic which is detected among not only at the whole set but also among the all three periods by all the methods. This fact may show the close relevance between WSR and evaluation.

**Table 4. Topics of WSR Study based on iView's Keyword Network by Varing Periods**

Year	Cutpoint	Betweenness	Degree	Cluster Labels
94-98	5; SSM, SE, <i>evaluation</i> , WSR, systems approach	8 (>0): WSR, <i>evaluation</i> , systems approach, Wu-li, Shi-li, Ren-li, SSM, SE	11 (>6): WSR, <i>evaluation</i> , Wu-li, Shi-li, Ren-li, SSM, SE, ill information,	5 (Q=0.683) WSR, SE, Wu-li, sustainable development, systems



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			information quality, system analysis, MIS	
99-04	11: WSR, systems approach, systems science, complexity, <i>evaluation</i> , complexity science, decision science, system methodology, model, value meta-synthesis	16 (>35): WSR, complex system, system methodology, complexity, <i>evaluation</i> , SSM, meta-synthesis, model, complexity science, value meta-synthesis, SE, decision science, system approach, systems science, IS	13(>8): WSR, system methodology, <i>evaluation</i> , SE, meta-synthesis, complexity, IS, Wu-li, Shi-li, Ren-li, complex system, SSM, model	20 (Q=0.706) (#>3) WSR, system methodology, complex system, evaluation, complexity, optimization, virtual enterprise, value engineering, system integration, interval number
05-10	18: WSR, competence, index system, research method, harmony management, complexity, <i>evaluation</i> , value engineering, Shi-li, e-government, SCM, SE, meta-synthesis, methodology, data mining, KM, oriental system approach, Hall-3D	15 (>1000): WSR, meta-synthesis, <i>evaluation</i> , SE, informationization, performance measurement, competence advantage, e-government, complexity, comprehensive <i>evaluation</i> , data mining, index system, Hall-3D, value engineering	13 (>12): WSR, meta-synthesis, system approach, <i>evaluation</i> , informationization, comprehensive evaluation, supply chain, mode, <i>data mining</i> , system analysis, competence advantage	27 (Q=0.762) (#>3) SR, meta-synthesis, evaluation, performance measurement, data mining, SE, e-government, index system, complexity, research method, oriental system approach, NGO-project-government, systematics, brand crisis management, cause-effect, decision science, 3-li harmony, education informationization, community forest management

As it goes on, technologies, such as data mining, SCM (supply chain management), etc. enter which shows WSR may be more operable. Philosophy-related study also exists especially during 99-04. Figure 3 shows the keyword network between 1999-2004 for a better understanding. More practice happens after 2004.

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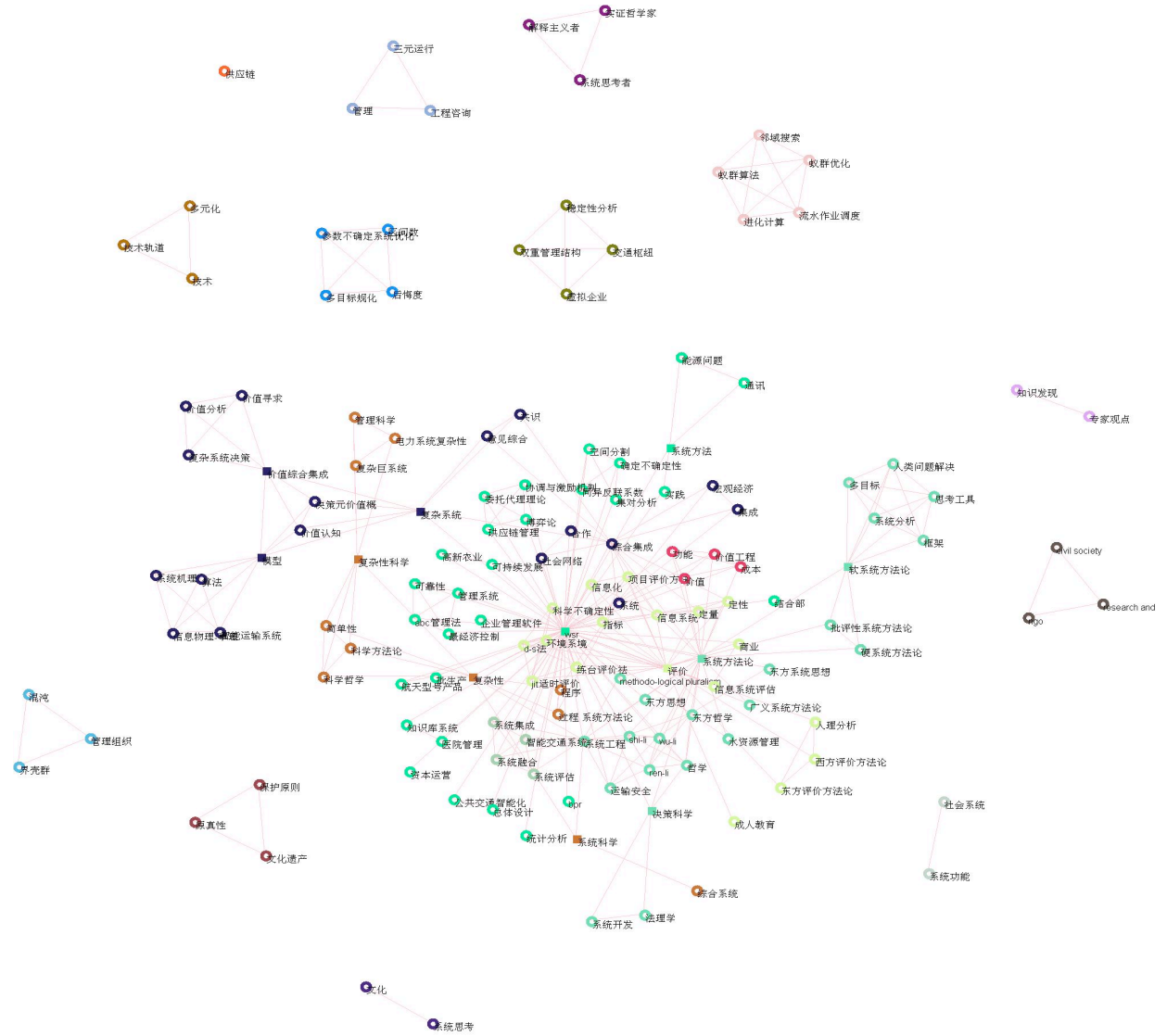
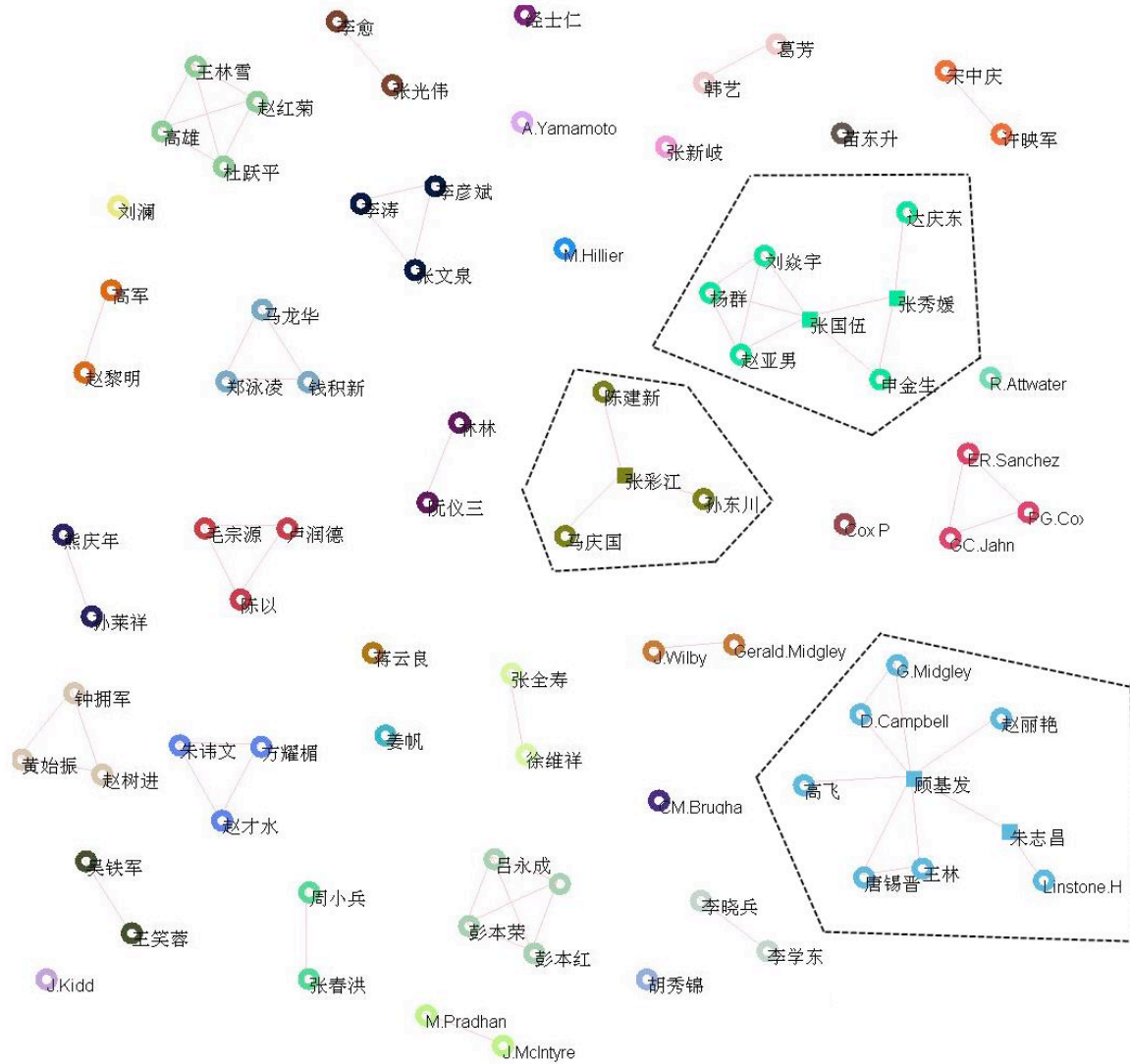


Figure 3. Keyword Network of WSR Publications during 1999-2004

### Who Engage in WSR Study Actively?

At first we construct a co-author network, instead of keyword-sharing network, i.e. author network, to see some special interest groups. Figure 4 is the co-author network during 1999-2004. Three components, each of which has at least one cutpoint author, are considered more active or contribute more in WSR research. The largest one includes the original authors (both Gu and Zhu are cut points), the second largest includes 7 authors, the 3rd one includes 4 authors.

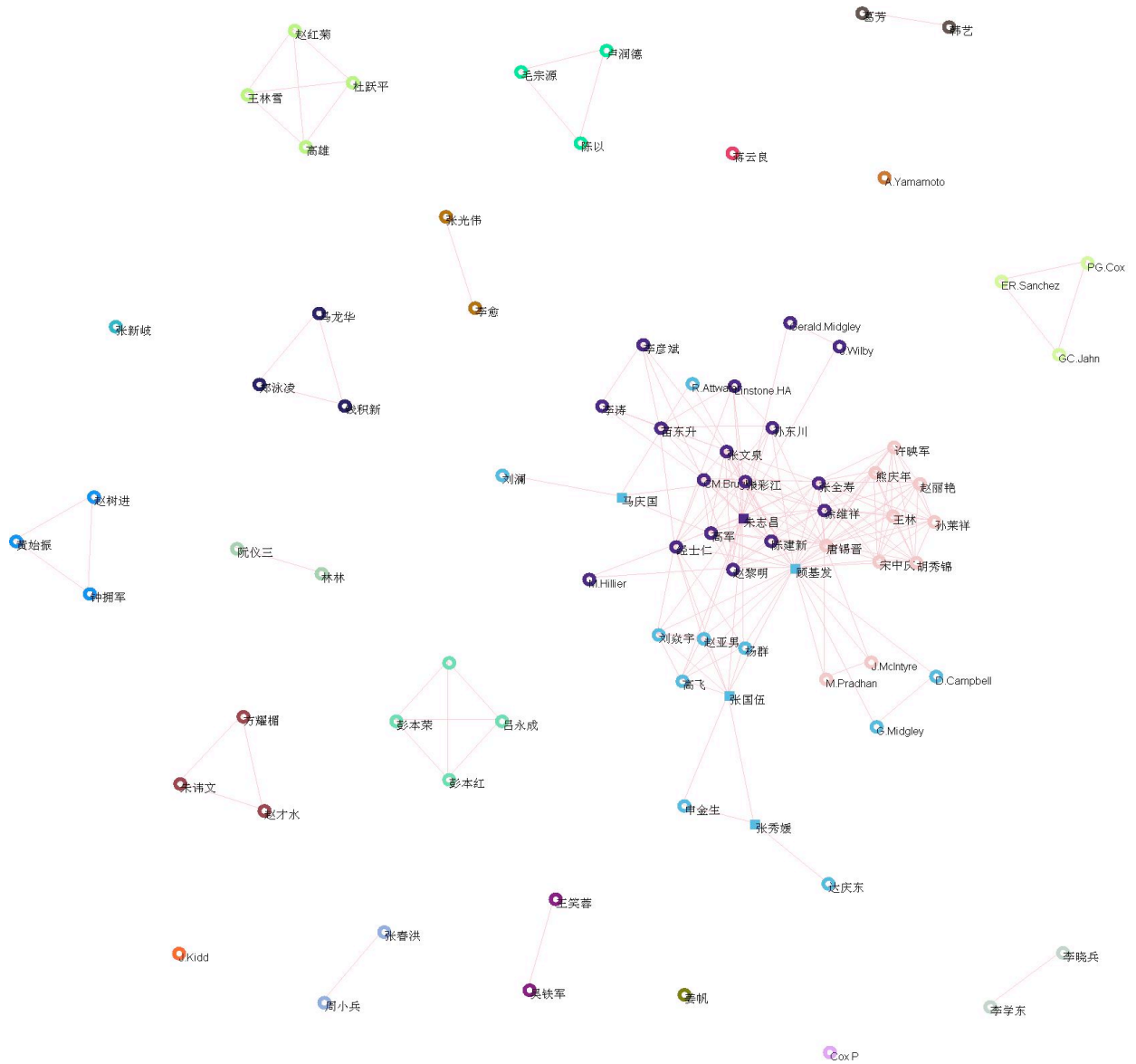
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**Figure 4. Co-Author Network of WSR Publications during 1999-2004**

Then we construct author network, i.e. keyword-sharing network to explore a wider interest-sharing, since WSR research is rather diverse. Since WSR is a common word shared by all papers, then we exclude it to avoid generate a big component of authors. Figure 5 shows the author network of WSR related publications during 1999-2004.

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**Figure 5. Author Network of WSR Publications during 1999-2004**

We can see that the three components of authors in the co-author network are united into one component with a total of 43 authors. The component includes three clusters. Cutpoint authors almost keep same (with one exception). Centrality analysis is done, too. No matter which periods of data analysed, Professor Gu is always the node with the biggest betweenness value, easily understood to be the most influential author in WSR research, even the number of his publications may not rank the top. This analysis exposes more information than that by Zhu, Song and Gu (2008).

More analysis can be conducted. Here we just show some simple cases. Applying network analysis to literature analysis is not new. While constructing appropriate network is key to meaningful results by computing ways. We mainly focus on detecting main topics among those collective WSR studies, in order to draw a rough image of WSR research. Then we see wider scope of WSR practice. WSR research does not decline.

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### Conclusions

In this paper, we take iView analysis toward WSR study so as to acquire a rough image about WSR study. Nowadays, the research on WSR study grows into 2 streams, one is mainly in China, more on WSR application; another is mainly in UK, more on epistemological, social and cultural analysis of WSR even addressing issues in China (Zhu, 2007). At least two different domains are involved. That is why we firstly review the history how WSR was coined and developed into a methodology by explaining the three terms Wu-li, Shi-li and Ren-li separately.

Even different meanings are given to three aspects of WSR, that does not mean other WSR explanations are not considered. As a matter of fact, we do not want to go into the debate. We try to show a systemic vision of WSR study by literature analysis by applying the iView analysis, one kind of supporting technologies for qualitative meta-synthesis for structures of messy problems based on the objective publication. The topics of WSR study based on publications are detected, instead by subjective judgment. Moreover, special interest groups are also detected by keyword-sharing network instead of only by co-authorship network.

The iView analysis is applied to human's behavioural data (authors' publication) actually. It is optimistic that WSR study is not declining. The author component is becoming larger. Qualitative meta-synthesis for a periodic system vision of WSR is expected to be useful for new comers and system thinkers. We hope the underlying links exposed by the iView network may show potential collaboration or new understandings toward WSR and related research.

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