The 9th International Symposium on Knowledge and Systems Sciences

Jointly with

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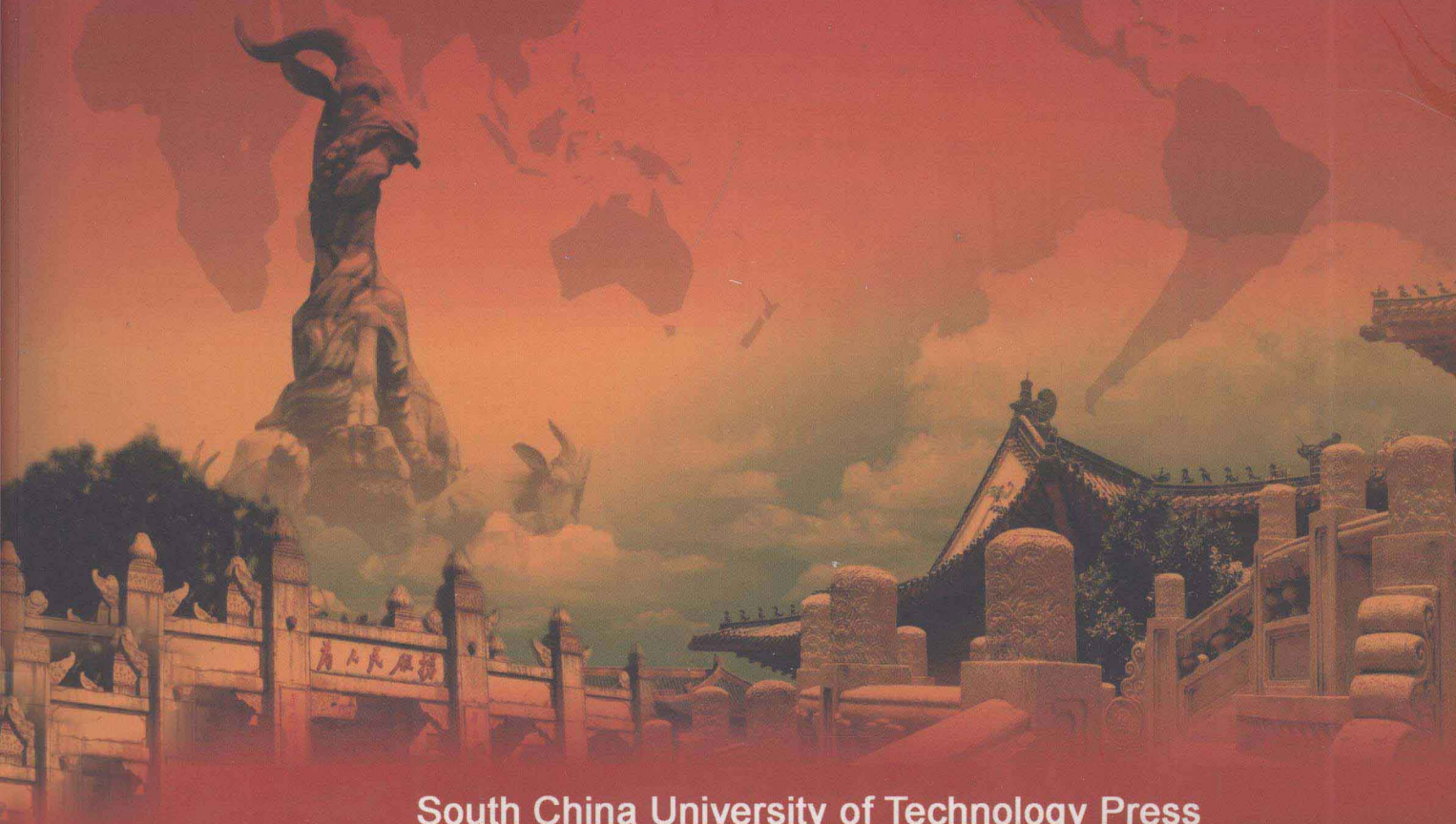
Dec.11–12, 2008, Guangzhou, PRC

Editors in Chief
Guilong Zhu, Jiangning Wu, Wei Han



South China University of Technology Press

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Message from the Co-chairs

The significant feature of knowledge sciences development is the interdisciplinary program on an international scale. We need to promote the exchange and interaction of knowledge across disciplines and borders to explore the new territories and new frontiers. In the present stage, attempts to strictly define the knowledge science may be too ambitious, but a very tolerant, broad-based and open minded approach to the discipline can be taken.

Knowledge science and systems science can be used as methodologies and tools. Around these disciplines, the first International Symposium on Knowledge and Systems Sciences, initiated and organized by Japan Advanced Institute of Science and Technology (JAIST), was held in September 2000 at the JAIST (KSS2000), then KSS2001 at the Dalian University of Technology (Dalian, China), KSS2002 at the University of Shanghai for Science and Technology (Shanghai, China), KSS2003 at the South China University of Technology (Guangzhou, China), and KSS2004 at the JAIST Ishikawa, Japan. KSS2005 was held at the International Institute for Applied Systems Analysis (IIASA) Austria, KSS2006 in Beijing, and KSS2007 at JAIST.

This year, the KSS2008, jointly with the "4th Asia-Pacific International Conference on Knowledge Management" (KMAP2008) co-organized by Dalian University of Technology, Xian Jiaotong University and The Hong Kong Polytechnic University and hosted by South China University of Technology, will be held in Guangzhou from 11 to 12 December, 2008.

The objective of KMAP is to explore the multi-dimensional issues among practitioners and academics. Papers of KMAP illustrate knowledge impact in organizational, governmental and social contexts bridging technological, behavioral and cognitive issues.

The serial KSSs were co-organized by International Society for Knowledge and Systems Sciences which was formally established in the year of 2003 during the Fourth International Symposium on Knowledge and Systems Sciences (KSS2003, November 29 – 30, 2003, Guangzhou China). Now, members of the Society spread over ten countries. The overall purpose of the Society is to promote the development of knowledge science and systems science, as well as collaboration between these sciences.

This proceeding includes papers accepted by KSS2008 and KMAP2008 and covers the scope of theory and application of knowledge and systems sciences in different aspects. We would like to thank all the authors who have submitted papers and all the program committee members for their helps to make the joint conference a scientific success.

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CONTENTS

Expert Mining and TCM Knowledge*

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ABSTRACT

Expert mining is a new emergent theory and technique, which is different with data mining, text mining, web mining and expert system. It is useful for collecting the ideas, experiences, knowledge and wisdom from experts. The source for mining mainly comes from live experts, the methods for mining will use various methods for collecting opinions, computer and group exchange by using computer and some special tools. We had applied expert mining to solve some problems related to social system and knowledge system. Just two years ago we wish use it to support for collecting the knowledge from a special kind of experts-TCM Master.

TCM (Traditional Chinese Medicine) Masters accumulated a lot of useful knowledge in medicine from ancient China. In recent years China pays a lot of attention to collect and maintain the idea, experiences, knowledge and wisdom from elder and famous masters in TCM. For that purpose a large project for collecting and maintaining the idea, experiences, knowledge and wisdom from 100 elder and famous masters in TCM supported by Ministry of Science and Technology of China, State Administration of Traditional Chinese Medicine had been run during the Tenth Five-Year Plan (2002—2006) and has been continued in the Eleventh Five-Year Plan starting from 2008. In this large project not only these masters'experiences and theories had been collected and recorded directly from them, stored in data base with the help of their students, but also some subprojects has been established by using the advanced IT technology, Artificial Intelligence, Knowledge Science and Systems Science etc. to analyze and express masters'experiences and theories in depth. One of these subprojects running by our group tries to use expert mining and other techniques to analyze both individual and group ideas and knowledge. This paper just describes some results and future plan in running this subproject. And this paper also will introduce the main methods and tools for expert mining.

Keywords: expert mining, TCM, knowledge science, system science

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1. INTRODUCTION

In the middle of 1980's when Gu dealt with some problems related to the regional development strategy system for Beijing, besides of collecting the data , information and knowledge and constructing a series of mathematical models we found that the expert opinions are very important for solving the problems. In order to determine the objectives, constraints and possible alternatives for development strategies we had designed a detailed questionnaires and sending to 400 experts for collecting their opinions about the objectives, constraints and possible alternatives for development strategies in Beijing[1]. The selected 400 experts consisted from the top leaders from Beijing municiapality (20), carderes with middle rank from Beijing municiapality (180), experts from research institutions and experts from universities and others (200). After data processing we had obtained the statistical resultes about development strategy in line of Delphi method. But when we submitted the final results to the top leaders from Beijing municiapality, results were not accepted by them. After then we wished to find the reasons, Gu had asked his graduated student to run a cluster analysis for all responders in 400 questionnaires, finally we found that with the

decreasing of the λ there appeared one large clusters and two small clusters. The large cluster consisted of carderes with middle rank from Beijing municiapality and experts from research institutions, whose consideration were more practical The first small cluster of experts came from universities, whose considerations were more academic and the last small cluster from the top leaders from Beijing municiapality, whose considerations were more political and applicable. It was understandble that the top leaders had their own considerations on base of more higher political perspective and more practical managerable manupilation. Since then we think the more justic Delphi method for all experts maybe inpractical we'd better use the weighted summuation to use our data statistic, it means we should give different weights to peoples with different rank.

In the 90's we had met with some technical system with heavy human factors, the first case related to the water resource management in Qinhuangdao city. When we wish to establish some satisfaction criterion to determine what level of water in reservior will be better for operation. The criterion function we chosed had five parameters which were very difficult for us to estimate, finally we ask an appropriate expert who gave the estimation for three parameters directly according to his experience[2]. The second case was how can we construct the diagram of standards of commerce on base of a little number of existed standards. In paper[3] we proposed a set of methods to collect the expert's opinions., such as Brainstorming, Delphi, AHP, cluster analysis etc. The brainstorming stage we usually invited 4 – 8 experts in giving the framework for our study and designing the questionnaire. We invited 30 experts from different department stores to fill the questionnaire. Finally we convened the expert meeting with different knowledge background from department sores, research institutions and management organization around 20 persons and we used the majority principle and decision power from higher leaders in making final decision.

In 2004 Gu started involve in studying the social harmony problems. The social system is an open giant complex system. There are three kinds of channels to obtain information: formal society, informal society and network society. In order to collect and process useful information we have to use different mining techniques: data mining, text mining, web mining, model mining, psychology mining, and expert mining: The first four mining techniques deal with mainly the explicit data and information. The later two techniques mainly deal with the tacit information. In recent years we pay much attention to develop the expert mining[4,5].

Just two years ago we involved in the study of Traditional Chinese Medicine (TCM) from the system science and knowledge science view. The main aim is to accumulate and carry forward the experience and thoughts from elder and famous TCM doctors and try to find their good knowledge and find some new knowledge, here again we wish use the expert mining to fulfill this task. The total number of elder and famous TCM doctors are 100. This time the quality of knowledge and wisdom in these experts are obvious, so then we call these experts as Masters in deferentiating with general experts and TCM doctors[6,7].

2. EXPERT MINING

The terminology of expert mining appeared just in recent five-ten years around. We wish use expert mining to collect, analyze and use expert's opinions, thoughts, idea, knowledge and wisdom for accumulating, carrying forward their useful knowledge, especially for solving the realistic complex problem. With the development of data mining, text mining and web mining people find that to mine the live, tacit and unstructured thoughts, idea, knowledge and wisdom from experts become more challenged but important affairs. To facilitate expert mining, the new theory and methods have to developed. The computerized tools for mining expert's ideas and group work will be applied.

2.1 What is Expert and Expert Mining?

For solving some problems the people who may contribute their opinion, knowledge and wisdom to us is expert. We may differentiate experts into different dimension, such as the number of experts, the degree of education, title of job, the domain of knowledge, which more related to the problem solving. The one dimension is the number of experts: ① if we wish deal with the number of experts with huge amount (say, $10^3 \sim 10^6$), the each expert just looks like one sample in population, in this case usually we often use statistical methods, we care the opinions from experts just their trends and some simple values in some attributes we are interesting; ② if we wish deal with the number of experts with middle amount (say, $10^2 \sim 10^3$), in this case we will care the trends and some insights; ③ if we wish deal with the number of experts with few amount (say $10 \sim 10^2$), in this case we will care the trends and more insights, we will care of not only the opinions they express explicitly, but also tacit, their knowledge background and their benefit delegated. Especially some of experts we may call them Master, it means their knowledge are much wider and deeper compared

with the common experts; ④ if we wish deal with the number of experts just several, one, two or three, in this case we will care their specific insights and wisdom, such experts we may call them Guro, great leader. Another dimensions we may list, like the degree of education, title of job etc.

Expert mining is a method and tool for collecting, storing, analyzing opinion, thoughts, experiences, knowledge and wisdom from the experts and extracting useful and innovative knowledge and idea by using IT technology, computing technology, human-computer interaction and group discussion. It not only cares the explicit knowledge and thoughts, but also the tacit and unstructured knowledge and thoughts behind experts. Usually the experts express their knowledge and thoughts in several types: speak explicitly (language, word) -explicit; speak implicitly-tacit; express by gesture (expression in eyes, gesticulation, tone); speak on Web-web; speak lie (speak insincerely, false intelligence, rumour) -intelligence. In different cases we shall use different methods and tools.

2.2 Some Ways to Expert Mining

We wish mention some ways going to expert mining:

1. From data mining to expert mining

(1) Kovalerchuk et al (Department of Computer Science, Central Washington University) assumed: Traditional numeric statistical data mining methods have relatively limited applicability in IA, because data are often not numeric and have a very asymmetric pattern representation. For instance, there are only a few terrorism messages in the stream of normal ones. New relational data mining and link discovery have significant potential to address these challenges. Also, relational methods have important advantages over traditional methods for linking, integrating, and conflating images of different resolutions, sensor modalities, viewing angles, and geometric projections. Especially during solving the medicine diagnostic they use the terminalogy-expert mining[8-10].

(2) Frank Lemke et al (Script Software, Germany) Self-organizing data mining technologies in medical data analysis have to select automatically useful knowledge for medical decisions, such as diagnosis of heart disease. "Knowledge Miner" was designed to support the knowledge extraction process on a highly automated level. Implemented are 3 different GMDH-type self-organizing modeling algorithms to make knowledge extraction systematically, fast, successful and easy-to-use even for large and complex system such as one of the most complex systems: the human[11].

2. From web mining to expertise oriented search

(1) Jie Tang et al (Department of Computer and Technology, Tsinghua University) proposed Expertise Oriented Search, which aims at providing comprehensive analysis and mining for people from distributed sources. They give an overview of the expertise oriented search system (ArnetMiner). The system addresses several key research issues in extraction and mining of the researcher social network. The system is in operation on the internet for about one year and receives accesses from about 1, 500 users per month. Feedbacks from users and system logs also indicate that users consider the system can really help people to find and share information in the web community[12].

(2) Quan T. T. et al (School of Computing Engineering, Nanyang Technological Univ., Singapore) proposed a web mining approach for finding expertize in research areas. Indexing Agents search and download scientific publications from web sites that typically include academic web pages, then they extract citations and store them in a Web Citation Database. In addition, researcher information is also saved into the Researcher Database. Data mining techniques are applied to the Web Citation Database on citation keywords and authors to form document clusters and author clusters. The Multi-Clustering technique is proposed to mine the combined information of document clusters and author clusters for information on expertise in specified research areas[13].

(3) From synthesizing expert's opinion to expert mining. Dai et al run a large project under the support of National Natural Science Foundation of China (NSFC), titled " Man-Computer Cooperated HWME Supporting Macro-Economy Decision-Making ". The one of key problems in project is how to synthesize the opinions. For this problem Gu and his colleagues had proposed the various methods for synthesizing the expert opinions, the concepts and theory of consensus building, the tools for collecting, analyzing and visualizing the expert's opinion-Electronic Common Brain (ECB), Group Argumentation Environment (GAE) and Attributed Directed Graph Model. Especially in Institute of Systems Science, CAS we develop the expert mining and run a series of experiments[14-20].

(4) Ontology-based approach to expert mining. Zhang et al proposed complex multi-agent systems to combine the MAS and expert agent to discover knowledge of heterogeneous experts. An ontology-based approach for knowledge and expert mining in hybrid multi-agent system is introduced[21].

2.3 Some Basic Ideas for Mining the Expert Thoughts

We may list some basic ideas for mining the thoughts:

(1) Transferring expert knowledge from tacit to explicit (SECI model);

(2) Combining abilities of human and machine;

(3) Complementary using 6 mining (Data mining, Text mining, Web mining, Psychology mining, Model mining, Expert mining);

(4) Using Metasynthesis approach to integrate various data, information, model, experiences, wisdom and computer capacity.

2.3.1 Metasynthesis of opinions

1. Metasynthesis of Opinions by text

① Simple survey (narrative); ② Meta-analysis; ③QualitativeMetasynthesis

2. Metasynthesis of Opinions by meeting

Expert meeting could serves as acquire more information from human experts directly.

(1) Types of meeting

a) *brainstorming type* for collecting the vivid and frank opinions;

b) *studying type* for collecting and studying some opinions on the base of deep investigation;

c) *decision type* for concentrating the opinions. In order to obtain the consensus from experts we also studied different methods, tools for getting the consensus.

(2) Three new discussion types

a) Syntegration (Beer);

b) meeting on Web (WebScope);

c) Nominal Group meeting.

(3) Ba, Facilitation, Mediation

(4) DMTMC-system

(5) M-A-M' (Meeting I-Analysis-Meeting II)

3. Metasynthesis of Opinions by interview deeply: Psychology mining[26].

4. Metasynthesis of Opinions by modeling: Multi-agent simulation (MAS)[22,27].

Mentioned concepts and theory we had introduced in some other papers here we don't want touch too much detail[4,5,15,18,19].

2.3.2 The comparisons of expert mining with data mining, text mining and web mining

We may compare the main specific features within the data mining (DM), text mining (TM) and expert mining illustrated in Table 1.

Table 1 The comparisons of expert mining with data mining, text mining

	Data mining, Text mining	Expert mining
1.Object for mining	Data and information	Expert's knowledge and expertice
2. Number of samples	Huge amount	Few samples
3. Combination of human and machine	Based on machine mainly	Based on human mainly
4.Thinking method	Logical, image	Logical, image and inspiration
5.Mode of analysis	Quantitative analysis mainly	Combination of qualitative and quantitative analysis, qualitative mainly
6.Expression of knowledge	Explicit knowledge mainly	Tacit knowledge mainly
7.Relation with the feeling and personality	Not related	Related
8. Result of mining	Knowledge and useful information	Systemic knowledge,new idea
9. Psychology and atomosphere around	Not related	Related
10.World view, culture and philosophy	Not considered mainly or just a few	Need to consider

2.3.3 Combination of expert mining and other different methods for mining

We may use the data mining to analyze a huge amount of data to discovery some useful knowledge.

We may use the Text mining to extract some useful textual information from many texts in documents.

We may use the Web mining to extract useful information from the internet, intranet etc.

We may use the model mining to obtain some new results which human will obtain only by simple mind calculation with difficulties, e. g. results from calculation derived from complicated equations, result from forecasting model, results for agent-based model simulation etc.

We may use the psychology mining to dig the deep thoughts behind the surface of mind.

Besides of the mentioned five mining we may use expert mining to ask opinion and thoughts directly from experts. Finally after using mentioned other mining techniques we will ask experts to analyze the all results which are sometimes contradicted each with other and also need expert to make final judgment for the obtained results, even more we will ask experts to create some new idea , methods, techniques and theory, new alternatives for decision, it means to use the wisdom to create something which originally does not exist.

2.4 Some Examples for Expert Mining

Ex. 1. Forecasting the GDP growth rate-JAIST test 2003.1 (2003, JAIST) (*Pathmaker*)[19,23].

Ex. 2. Agora test for ISSS (2003. 7, Crete) (CogniScope)[24].

Ex. 3. Forecasting the GDP growth rate under the impact of SARS-IIASA test (2003. 9, IIASA) (*Pathmaker*, *Model integration*)[19].

Ex. 4. Surveying Xiangshan Scientific Conference (2005—2006) (*Web mining*, *GAE*)[19, 25].

Ex. 5. Discussion on social harmony problems-MBA test (2006, 7, Beijing) (*Pathmaker*, *GAE*, *Psychology interview*)[26].

Ex. 6. Taxi test (2007. 7, Beijing) (*Psychology interview*, *MAS*)[27].

Ex. 7. TCM Master test (2007, Beijing) (*Pathmaker*, *GAE*, *Ucinet*, *TCM Master Miner*)[6, 7].

Ex. 8. A collective discussion on the designing the regulation law for research projects (2004, Beijing) (GAE)[28].

Ex. 9. Group Argumentation and its Analysis on a highlighted social event (2005, Beijing) (*GAE*)[29].

3. EXPERT MINING AND TCM KNOWLEDGE

From 2006 year we have engaged in a large project in "the tenth five-year plan" National supported to Science and Technology organized by Ministry of Science and Technology and Administration bureau of Traditional Chinese Medicine in China. This project had collected the academic thoughts and experiences from 100 Chinese masters in TCM based on IT technology and Database. We just analyze these processed primary data further more and got some theoretical and experiment results.

Following the macro philosophy of disease, traditional Chinese diagnostics are based on overall observation of human symptoms rather than "micro" level laboratory tests. There are four types of TCM diagnostic methods: observe, hear and smell, ask about background and touching. "Modern practitioners in China often use a traditional system in combination with Western methods. TCM is considered to require considerable diagnostic skill. This often depends on the ability to observe what are described as subtle differences. This may be contrasted with a straightforward laboratory test, which indicates an unambiguous cause. A training period of years or decades is said to be necessary for TCM practitioners to understand the full complexity of symptoms and dynamic balances.

From September of 2007 Ministry of Science and Technology and Administration bureau of Traditional Chinese Medicine in China started continue the similar project on methods for mining the academic thoughts and diagnose experiences of famous and elder TCM doctors as one project in "Eleven Five plan" National supported to Science and Technology. This new project will be lasted three years and consisted of five subprojects. The four subprojects use such as data mining, machine learning, SVM, implicit structure model, network analysis etc.[30-34], most of them try to find the deep and new knowledge based on the TCM Doctors'experience which are usually stored already in the special database in some structured way. Xiyuan Hospital and Academy of Mathematics and Systems Science jointly run a fifth subproject within them. The more complete title of our project is the study on the mining methods for the analyzing collective law of academic thoughts from famous and elder TCM doctors. Our project is based on the expert mining. We not only pay the attention on the structured knowledge, but also unstructured and tacit knowledge. We will use the information and knowledge from common database, but also pays much attention to the live expert knowledge, so we will use expert meeting with supporting by some computer tool, consensus methods, network analysis and multi-agent simulation. We will study not only individual knowledge from expert, but also their collective law. Since this new project is just undergoing, here we wish only show the roadmap for studying this project (see the Figure 1). In this project we will use brainstorming in Xiyuan hospital and a series of methods for converging the collective thinking from a group of experts with support of consensus methods, network analysis and some visualization tools.

4. CONCLUDING

Expert mining like data mining, text mining is a good

method and tool for collecting the data, information and knowledge, but based mainly on the tacit knowledge from expert directly. Since the information, knowledge for expert mining usually not so vividly like the explicit knowledge used by data mining and text mining, so it requires some new idea, thoughts and techniques to deal with. We have chance to meet two practical complex systems, social system and human body system in recent years, the practical trouble for finding solution and hard to get the useful information directly force us to use the meta-synthesis system approach and the combination of six mining including the expert mining. Certainly we shall do more research and practices on the expert mining.

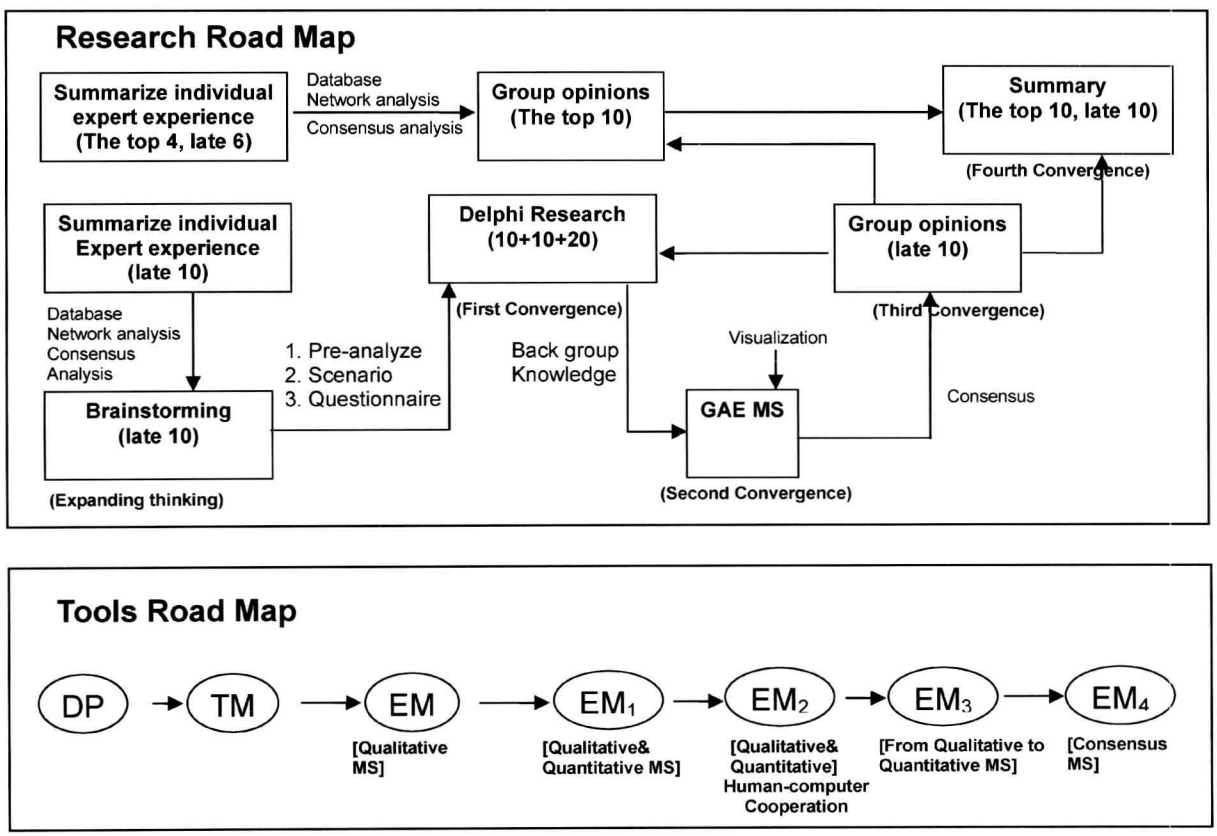

Figure 1 Road Map for TCM project

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