# CHAPTER 3

# METHODOLOGY

This thesis is divided into two parts. The first part is in-cooperate research with CMU research team in project named *Research Potential and Direction Survey for Setting Research Policy of Chiang Mai University*. The objectives of this project are identifying the expertise and research direction of CMU and formulating strategy and policy for CMU research management. In this project found some problems. Consequently, the new framework was designed in the second part for correcting those problems by using semantic web technology. Finally the developed framework can increase the achievement of research management.

Rough steps of the first framework are

1. Exploration for key researchers by collecting research results of candidate key researchers, which are counted as intellectual capital from CMU repositories.

2. Then use outputs of the first step to design root ontology that is called CMU research ontology commitment.

3. After that analyze CMU research ontology commitment to find out who are key researchers

4. Establishing research clusters by analyzing CMU research ontology commitment to find out social network of key researchers for building research clusters

5. Formulate strategies and policies to develop research management of CMU

The first framework was done by applying database management system and manual card sorting. But some complicate conditions could not be solved. For example key researchers in universities point of view might be different from faculties and departments point of view. So the second framework was developed by applying.

Protégé, predicate logic and inference process. The detail of all frameworks is as following:

### 3.1 First Part: In-cooperate Research with CMU Research Team (Pilot Project)

The pilot project of this study is cooperating with CMU research project. The name of this project is *Research Potential and Direction Survey for Setting Research Policy of Chiang Mai University*. This research granted by Thailand Research Fund in 2007. The objectives are 1) to set up direction and expertise of research in CMU 2) to set up multi-discipline research clusters 3) to formulate strategies and policies for supporting and utilizing research 4) to develop reliable management system of CMU. Team of this project composes of

1. Assoc. Prof. Dr. Daoroong Kangwanpong, CMU Vice President of Research Affairs.
2. Assoc. Prof. Jakkapan Sirithunyalug , Assistant president for Research and Information Technology.
3. Dr. Nopasit Chakpitak, Director of College of Art, Media and Technology.
4. Assist. Prof. Darunee Smavatkul, Vice Director of College of Art, Media and Technology.

5. Thanapun Kulachan, Doctoral student.
6. Mr.Thammanoon Noumanong, Official of Research Administration Center.
7. Miss Kanokwan Sriuttha, Official ofResearch Administration Center.
8. Mr.Achayasit Rugyati, Official of Research Administration Center.
9. Miss Priraya Rithaporn, Official of Research Administration Center.
10. Mr.Attachai Kosanasanti, Official ofResearch Administration Center.
11. Mrs. Sukanta Yardmidhnund, Official of Research Administration Center

The processes of the project are divided into 4 steps as follows:

3.1.1 Exploration for *key researchers*.

3.1.1.1 Identify *candidate key researcher*.

At first, *candidate key researcher* list is created through heuristic approach by interviewing the Research Deputy Deans and Research Institute Directors of CMU with structured question. Those administrators are belong to one of three different areas—Health Sciences, Science & Technology, and Social Sciences & Humanities.

Health Sciences encompasses six faculties and one research institute. The Science & Technology area encompasses five faculties and one research institute. The Social Sciences & Humanities area encompasses seven faculties and one research institute.

Altogether then there were 21 interviews. The purpose of identifying the candidate key researchers is heuristically to reduce the amount of work associated to the gathering and processing of data.

3.1.1.2 Review candidate key researcher list by CMU research team.

After the candidate key researcher list is finished, team of CMU research team reviews it together. Upon completion of the interviews by the CMU project team, some names are added to the list, based on academic title or name-recognition to complete the list.

3.1.1.3 Identify *key researcher criteria* by CMU team.

Key researcher criteria are the conditions use to judge researchers who are key researchers. *Key researcher* is researchers who have high capability in research, widely recognized, and enable to lead university to a research university.

At first key research criteria are formulated by CMU research team and then revise it again by the Research Deputy Deans and Research Institute Directors.

3.1.1.4 Collect research information of *candidate key researchers*.

Research information such as research performance of all candidate key researchers is collected. This information is from many sources for cross-checking.

a.) Questionnaires: This step uses structured questionnaire. Its format is designed using intellectual capital model as a frame. When focus on one researcher, there are many intellectual capitals created. These intellectual capitals are valuable to universities. Thus they can be used to evaluate all researchers. Intellectual capital model used in this study is Skandia model as shown in figure 3.1. This model is chosen because the model divides intellectual capital into subgroups exhaustively and clearly. After that, the questionnaires are given to the candidate key researchers.

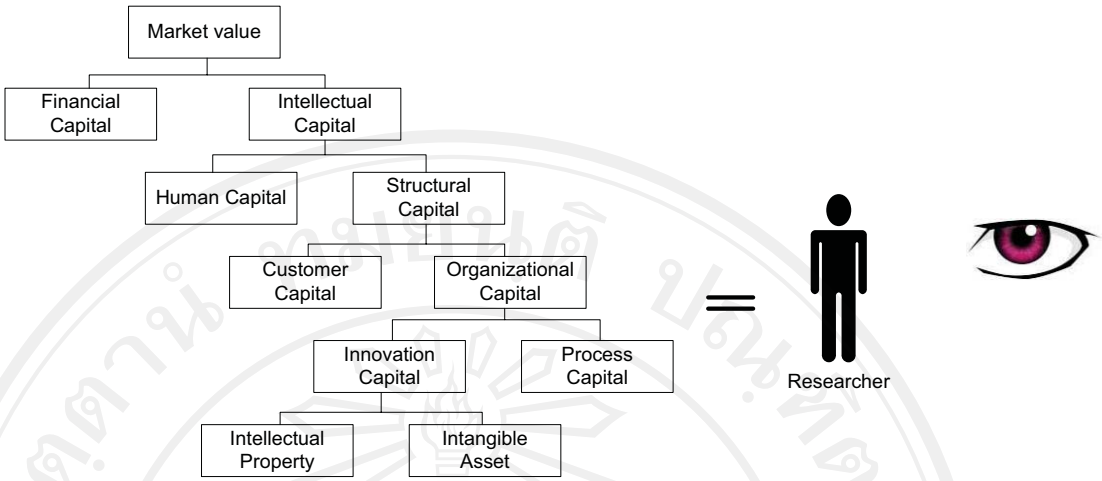


**Figure 3.1** The Skandia model apply to judge candidate key researchers

b.) MIS personal records of all faculties: Research information is stored scattering in many databases and MIS systems in all faculties including CMU center database. This process is done by manual to complete the information in obtained questionnaire.

c.) CMU internal documents: Some research information is printed format such as patent register reports, research award announcement.

d.) Electronic databases: Many researchers of CMU published their research results in term of paper in academic journals, which are accessible via electronic databases or online databases. This study uses only two electronic databases because the limitation of time. These two databases are SCOPUS and ISI Web of Science. The reasons are these databases cover many disciplines and give both Impact Factor value and citation value.

e.) Book database of CMU: Some research result might be in term of book composed by researchers especially researcher in Social Sciences and Humanities discipline. Book database of CMU named CMUL OPAC is used.

3.1.1.5 Design research database system.

For the sake of analysis, all research information has to store in the same place. Therefore database system is designed to aggregate collected information. On implementation step, Microsoft Access is chosen due to its user friendly interface, uncomplicated utilization, and variety options.

3.1.1.6 Input data into research database system.

All researchers' information collected is input into the database. The input data includes *key researcher criteria* as well. These criteria uses for designing query to evaluate researcher performance to find out *qualified researchers*.

3.1.1.7 Identify *key researchers* from *qualified researchers*: CMU research team consider list of qualified researcher list together and identify key researchers from that list through heuristic approach.

3.1.1.8 Public hearing with representative of *key researchers*: CMU research team arranges public hearing meeting with representative of key researchers. All are they come from one of three disciplines -- Health Sciences, Science & Technology, and Social Sciences & Humanities. The objective of this meeting is final validation of *key researcher criteria* and list of *key researchers.*



3.1.2 Identifying expertise and research directions of the *key researchers*.

3.1.2.1 Collect keyword explaining the expertise and research direction of *key researchers*.

Keyword identifying expertise and research directions of key research is obtained from questionnaire given to candidate key researchers. In case of researchers do not return the questionnaire, CMU research team has to ask them by phone.

3.1.2.2 Classify keywords in groups.

All keywords of researchers are divided into three groups -- research area, application, and methodology. Methodology includes technology, techniques, and tools using by key researchers.

3.1.2.3 Find expertise and research direction of key researchers.

This step initials by analyzing vocabularies or keywords of key researchers via card sorting technique. The card sorting technique processes are as follows.

a.) Build card and specify each keyword in card (one keyword per card). Then add more information about researcher own that keyword to the card i.e. researcher name, researcher academic position, and researcher faculty. There are three types of card depend on type of keywords (research area, application, and methodology). The example of keyword card, shown in figure 3.2.

***Research Area Card:***
*Associated Medical Sciences*
*Assoc. Dr. Watchara Kasinrerk*
***Biotechnology***

**Figure 3.2** Example of keyword card



a.) Identify important research clusters correspond to CMU administrators' vision. This process focuses on setting up research clusters e.g. biotechnology,

infections disease, and local history & tourism. Then write name of all clusters in cards.

b.) Classify all cards into groups by taking all keyword cards related to the same research clusters into the same group.

c.) Create sub-cluster card under main cluster cards.

d.) Put cards under sub-cluster card related to keyword on card.

e.) One card might be under more than one cluster.

f.) The result of this process is *CMU research ontology commitment*.

g.) Set up the meeting with key researchers of all disciplines to confirm list of key researchers under each cluster.

3.1.2.4 Use *river diagram* to identify research direction and researcher potential.

All data collected in database is summarized in group of research clusters. This data is research output of researchers such as publication, patent, research award, etc. After that the river diagram is draw from summarized data. This diagram presents the comparative of researchers' potential in each faculty in the same research cluster. This technique can use to identify research direction and researcher potential in faculty and university perspectives. Further river diagram also help administrators for planning to reduce gap between researchers in each faculty in the same domain.

3.1.2.5 Find academic social network among researchers.

Collect researchers' name from publications collected from electronic databases. Then transform them to be graphs. This graph represents social network between CMU candidate key researchers and researcher both inside and outside CMU. For

extracting researchers' name from electronic databases, Perl language is used. For creating graph, Cytoscape version 2.2 is used.

3.1.3 Establishing research clusters.

3.1.3.1 Form CMU research clusters.

This step considers *CMU research ontology commitment* to be road map for setting special research clusters, COE, and multi-discipline research groups among various faculties.

3.1.3.2 Set up the priority of each research cluster: This step applies Thailand Competitiveness Matrix (TCM) to ontology commitment for assessing how interesting of each research cluster.

TCM is adopted from Boston Model launched by the Boston Consulting Group. Boston model (alternatively called the BCG Matrix) is a tool informs users of the competitiveness and the attractiveness of various industrial groups in the world market ("BCG matrix", 2006). Thailand has applied this model to Thailand industry groups and the result is TCM as shown in figure 3.3. From the model, the business is divided into six groups. Each group is categorized how attractive is the area in world markets and how competitive are Thai producers. The meaning of each region in TCM is shown in figure 3.4 ("Economic Restructuring", 2004).

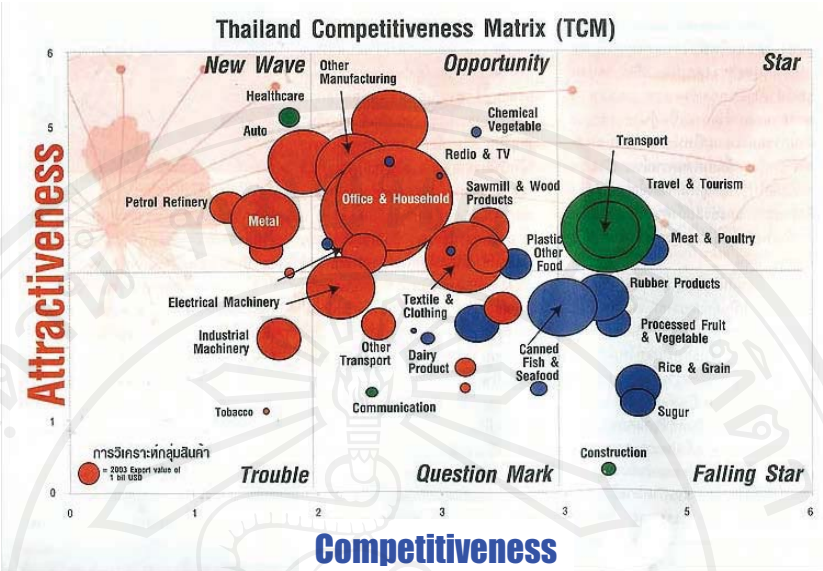


**Figure 3.3** Thailand Competitiveness Matrix (TCM)

("Economic Restructuring", 2004)

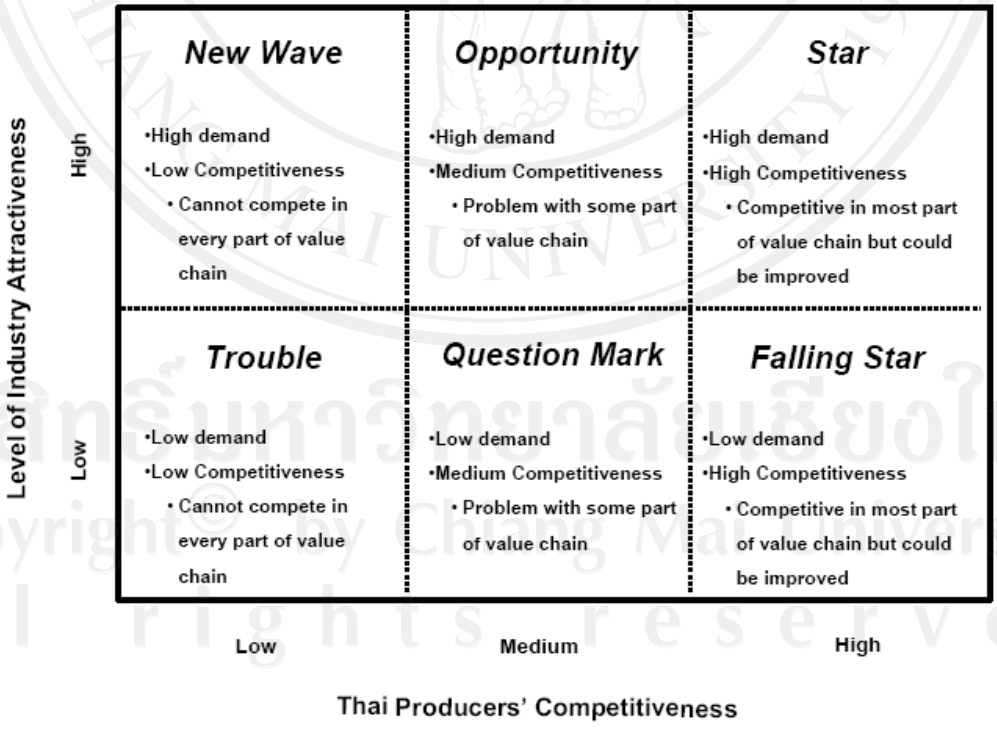


**Figure 3.4** The meaning of Thailand Competitiveness Matrix

("Economic Restructuring", 2004)

This study uses TCM matching CMU research clusters to industrial groups of Thailand. The result represents how interesting of each research cluster and then this result can use to set the priority of CMU research clusters.

TCM comprises six regions: *Star*, *Opportunity*, *New Wave*, *Falling Star*, *Question Mark*, and *Trouble*. Research clusters in *Star*, *Opportunity*, and *New Wave* groups are desirable applications for world markets. But the competitiveness in these groups are different—*Star* group has higher competitiveness—so research clusters that falls into this group should be promoted. However, research clusters in the *Opportunity* and *New Wave* groups, which have medium and low competitiveness respectively, should be well-supported, in order to raise competitiveness.

For research clusters in the *Falling Star*, *Question Mark,* and *Trouble* groups, the demand in world markets is low. However *Falling Star* has high competitiveness, being a niche market in Thailand. Research clusters in this area should look for new markets in order to increase its attractiveness. Researchers in this area should seek other partners and try to cooperate with researchers in other countries. For example, in rice-related research, CMU can cooperate with China. For the *Question Mark* group there are two options. If research clusters in this group can find new market, research clusters in this area can be continued; otherwise, research clusters in these application areas should be reduced or stopped. For the *Trouble* group, research clusters should be closed except for that research clusters that is conducted for public or social purposes.

3.1.4 Formulate strategies and policies to develop research management of CMU.

Strategies and policies of research management is formulated by using results from previous steps including research strategy of CMU in Educational Development Plan phase 10th in 2007 - 2011.

## 3.2 Difficulties from the First project

In the first part there are some difficulties that are the barriers to CMU research team as follows.

3.2.1 Research information is so dynamic. Many researchers may change their research interest and topic s from time to time due to many factors, for examples their supportive fund, their research resources, and new academic trends.

3.2.2 Research's information in database is rarely incomplete because:

3.2.2.1 Researchers do not recognize any benefit of giving their research information

3.2.2.2 Researchers are reluctant to fill up the research database.

3.2.2.3 Researcher could not remember some of their information.

3.2.2.4 Researchers have no time to fill out information.



3.2.3 It is quite hard to identify who are the key researchers in many reasons

3.2.3.1 What is the suitable factors should be used in key researcher criteria

3.2.3.2 Different level of management (department, faculty, and university) requires different key researcher criteria

3.2.3.3 Different disciplines (Health Sciences, Science & Technology, and Social Sciences & Humanities) require different key researcher criteria

3.2.3.4 Different subject in the same discipline requires different key researcher criteria.

3.2.4 Establishing research clusters by card sorting technique is suitable method but it does not efficiency enough. Thus some technique should be purposed to increase efficiency of this step.

3.2.5 Analyze interesting of each research cluster with TCM should be done automatically to reduce time consumer.

## 3.3 Second Part: Research Management Framework

Framework of the first part can write as shown in figure 3.5. On the left hand side of framework shows methods using in first part. There are 8 steps – 1) interview researcher deputy dean 2) collect research result of candidate key researchers 3) develop research database system 4) identify key researchers 5) setup research clusters 6) analyze expertise and research directions 7) analyze interesting of each research cluster 8) formulate research policies and strategies. On the right hand side shows tools, technique, and technology using in each step. For example at the first step, interview with structure questions and heuristic approach are used as technique. The arrows point from each block of the methods, represent the output of each step.

For example, the outputs of first method are list of candidate key researcher and key research criteria.

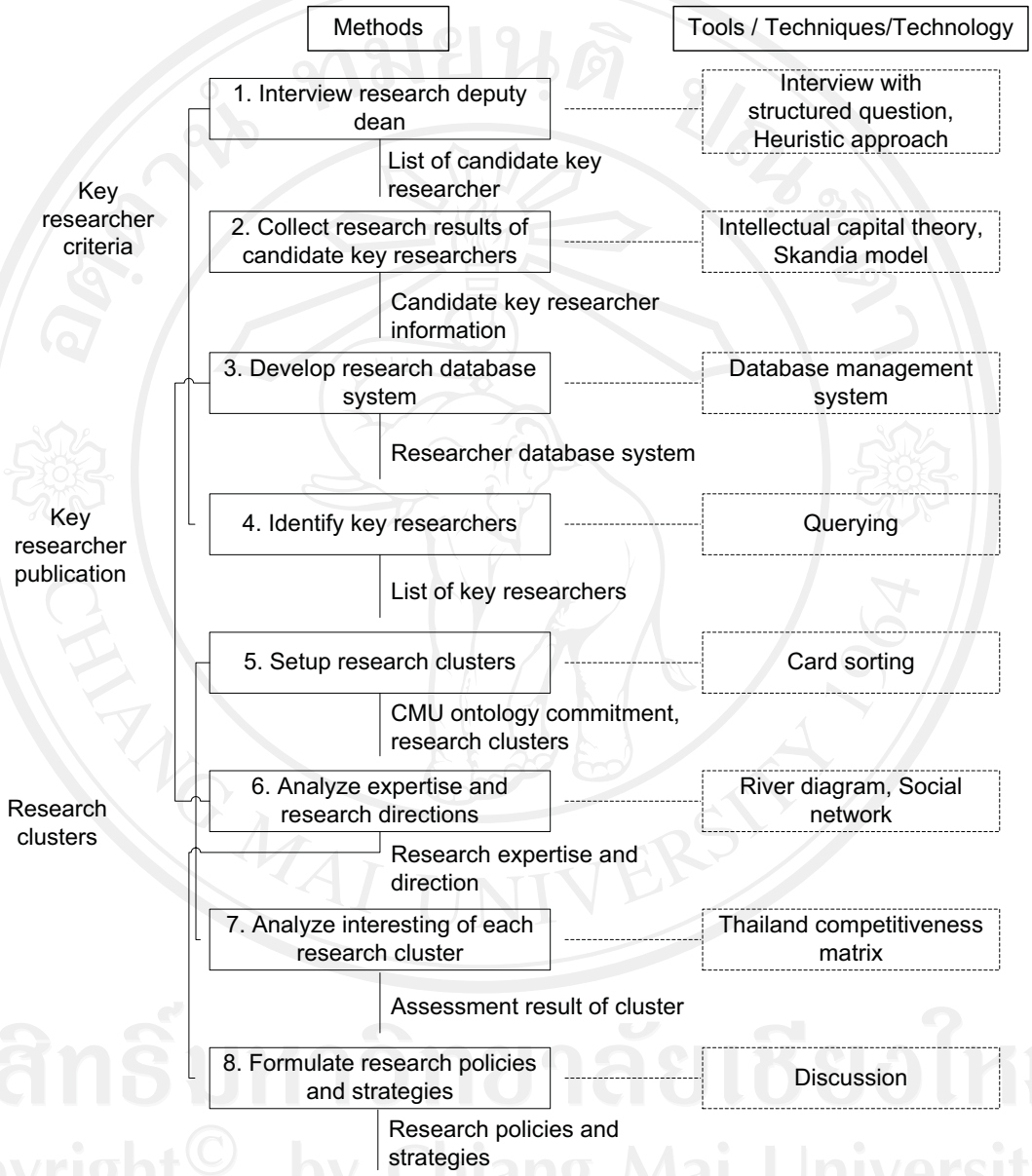


**Figure 3.5** Framework of the first part

In order to reduce the difficulty in 3.2, the second part of study is planed. The framework in the first part is modified to be the framework of the second part as show in figure 3.6.

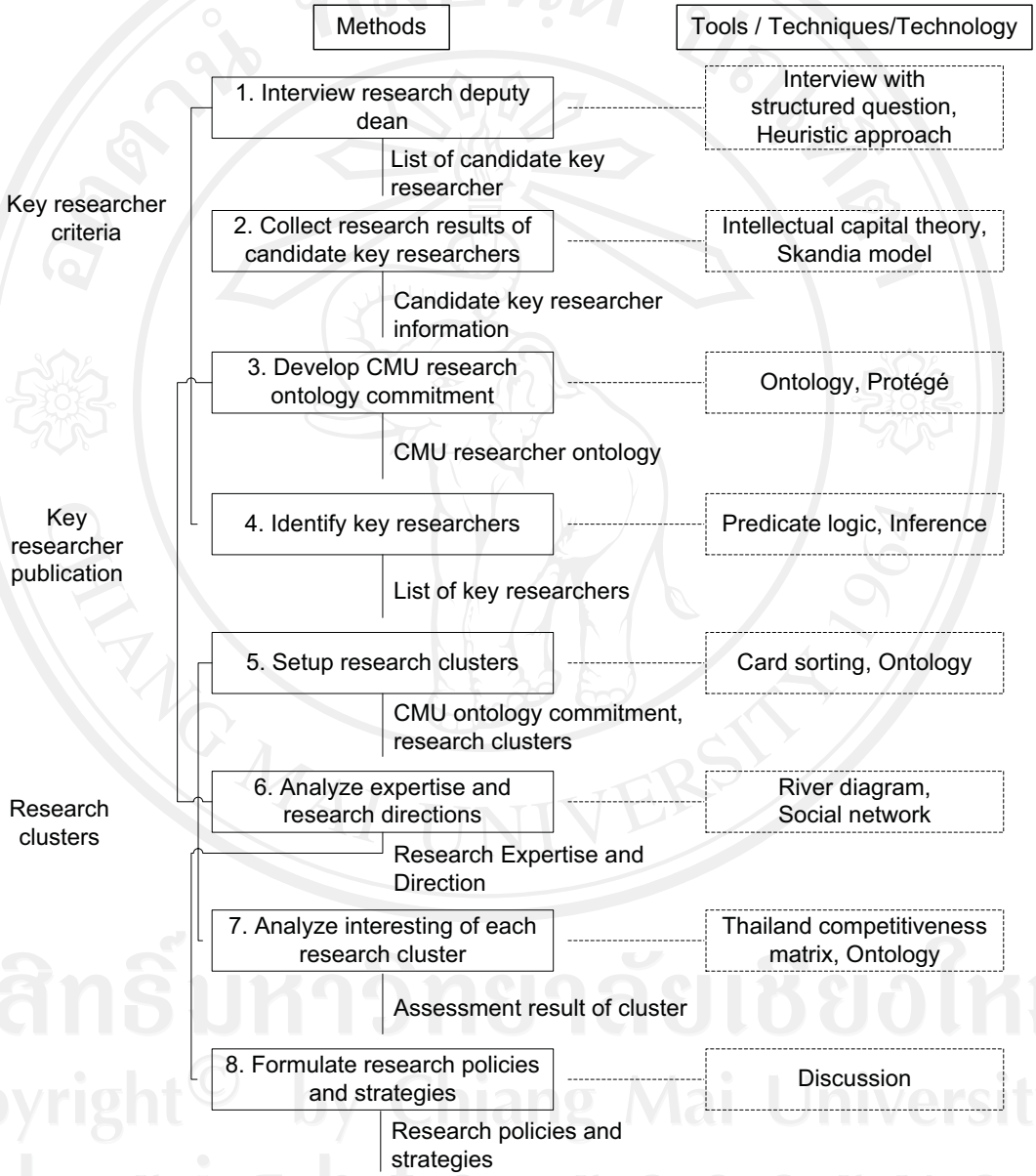


**Figure 3.6** Framework of the second part

The framework in the second part is change *method* in step 3 and *Tools/techniques/Technology* in step 3, 4, 5, and 7 by using semantic web technology such as ontology, predicate logic, and inference engine instead of database system. All four steps are changed as follow.

### 3.3.1 Develop the CMU research ontology commitment

Step 3 is changed from *develop research database system* to *develop CMU ontology commitment*. On implementing the ontology to computer system, Protégé is used. This solution corrects the problem in 3.2.1 and 3.2.2

### 3.3.2 Identify key researchers

On step 4, technique on identifying key researchers is changed from using *querying* with SQL language to using *predicate logic* and *inference step*. This solution can solve the problem in 3.2.3

### 3.3.3 Set up research clusters

On step 5 identify research clusters, technique is changed from uses *card sorting* to use *card sorting* and *CMU research ontology commitment*. This solution can solve the problem in 3.2.4



### 3.3.4 Analyze interesting of each research cluster

On step 7 analyze interesting of each research cluster is changed from use Thailand competitiveness matrix to use Thailand competitiveness matrix (TCM) with CMU research ontology commitment. This solution can solve the problem in 3.2.5

## 3.4 Tentative plan

Tentative plan is designed to proceed, control, and evaluate this study. Detail of tentative plan is show in Table 3.1

**Table 3.1** Tentative plan

| Activity | Month | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 1. Literature Review | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. First part: Pilot project | | | | | | | | | | | | | | | | | | | | | | | | |
| 3. Second Part | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1 Develop CMU Ontology commitment | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 Identify key researchers | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 Setup research clusters | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4 Analyze interesting of each research cluster | | | | | | | | | | | | | | | | | | | | | | | | |
| 4. Conclusion and discussion | | | | | | | | | | | | | | | | | | | | | | | | |