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Research on the Formal Description of Emergency Plans

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Abstract

Based on the previous modes and the correlative concepts and ways of other fields, this paper presents the total construction scheme of the formalizing description ways of emergency plans according to the latest classification of the emergency. We have finished the formalizing description way of emergency plans with high adaptability on the basis of the frame of the emergency response mode. We explain the detailed process of the extraction of the entity set, the construction of the relation set and the mapping of the relations of the entity set, and finally show the implementation flow of the formalizing description way of emergency plans. We design a template system of emergency response. This system provides formalizing description of emergency plans and the using for the knowledge of emergency plans. After the system formed, the tasks related to certain problems can be found timely when facing the emergency.

Keywords: Formalization, Emergency Plans, Emergency, Mode

1 Introduction

Recently, many kinds of emergencies take place frequently. How to solve the emergency properly has been an important aspect to test the administrative ability of the government. The solution of the emergency is a systematic engineering and the starting and executing of the emergency plans is a key process. Emergency plans describe the domain knowledge of emergency, and it is the basis of high-efficient emergency response.

There are few researches on the analysis of emergency plans and formal descriptions. Mors [1] described the depending relations between the assignments in the emergency by the event-based task frame. Grathwohl [2] applied formal logic to accident emergency management. It describes relevant emergency knowledge and builds the logic models of emergency plans using the formal logic. M. Hoogendoor discussed the formal modeling of emergency plans in [3]. IIoonendoorn[4] described the organization structure and dynamic characteristic of emergency management system by TTL. Canos [5] described the emergency plans through multimedia, three-dimensional model and computer animation in order to make them easily understood by others. It represents the emergency response process in the form of graphic description which is like workflow. Mak [6] applied the workflow technology to emergency management. Grathwohl [2] and Mak [6] described the limited relations between the assignments in the emergency. Dyer [7] pointed out the programming based on the process template that can reduce the complexity and uncertainty and improve the disposal efficiency greatly.

Considering the diversity of the emergency and the pertinence of the solutions, the same emergency, while happened in different time and locations, may cause different problems to be solved and distinct measures to be adopted. This state confuses greatly many decision-makers of emergency responses when facing some emergencies. As a result, it leads to the process delay of the emergency response and needless losses. This paper presents the formalizing description way of the emergency plans which describes the emergency plan in formalizing way through the frame of emergency mode. We can use such formalizing description way to control the process of emergency.

2 Total construction scheme of the formalizing description ways of emergency Plans

Through the researches on response mechanism

in different emergencies, we presented a general framework for emergency response. By analyzing and identifying the knowledge required in the framework, we proposed a method of quick response to knowledge pieces by reorganizing the knowledge contained in the government documents, and then we discussed the contents and main steps of the knowledge reorganization for quick response [8].

Based upon the researches we have done, this paper will analyze further general construction process of dispatching command in the typical cases[9]. We can draw the conclusion that four hierarchies can be abstracted from the process of response and the relations between these hierarchies can be made. We associate the emergency plans with the emergency information systems so as to supply emergency management with information technology. Therefore, it is necessary to describe the emergency response modes by formalizing style. Namely, we should abstract the emergency business processes from the real world, representing them in a formal and computer-processable way.

After plentiful analysis, we abstract the emergency response modes and four kinds of entities and one mapping relation set. So, the mode of the emergency response is represented by 5-indexes as follows[10].

$$p = \{E(4), R(1)\} = \{\{D,O,T,P\},M\} \quad (1)$$

The mode denotes the subject, object, task and solution sets in the process of response and the relationships between them. While D, O, T, P ,M respectively stands for the subject sets, object sets, task sets, solution sets and map sets.

In order to obtain the emergency response modes in the emergency plans, we should extract the knowledge which is relevant to the two kinds of abstractive sets in the modes. A single emergency plan has many paragraphic topics, so it is unstructured. The minimum partition of the emergency plan is character, but such division is meaningless for the requirement of emergency response. Although paragraphs can represent definite meanings and describe the knowledge requirements of emergency response modes completely, redundant information can easily disturb the decision makers' thoughts.

Consequently, we need extract the knowledge which is relevant with the two kinds of abstractive sets in the modes and build further the emergency response modes. We will realize the formal descriptions of emergency plans through the emergency response modes. What we have discussed above is the general concepts of formal description methods of emergency plans.

The general scheme of extracting the entity E(4) and relation set R(1) of formula 1 from emergency plans will be discussed as follows:

Step 1: Filtering the contents of emergency plans.

Emergency plans mainly contain six aspects. Since some demonstrative materials such as application scope, objects and principles of plans are not related to concrete operations of emergency response, we should first delete such contents, but hold the organization structure, operation mechanism and emergency guarantee.

Step 2: Abstracting entities.

Based on the analysis of emergency response mode's frame discussed above, entities E(4) contains four kinds of sets, which are subject set (E(1)=D), object set (E(2)=O), task set (E(3)=T) and solution set (E(4)=P).

After the two steps above, we finish the abstracting process of entity (E(4)). From the next step, we will begin to build relation set R(1).

Step 3: Building the relation mapping of entities.

According to the six kinds of relations we have summarized, we will realize the relation mapping of entities which are abstracted in the second step.

We have finished the whole process of formal description of emergency plans. The frame of general construction scheme is shown in figure 1.

3 The implementation flow of the formal description way of emergency plans

We mainly focus our attention on the second step and the third step of the whole process. The second step, which is abstracting entities, includes four parts.
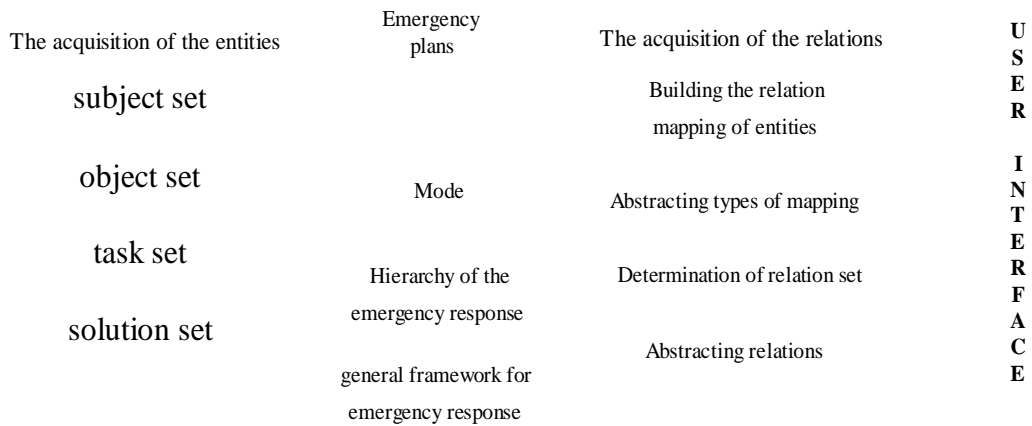
The acquisition of the entities	Emergency plans	The acquisition of the relations	U S E R I N T E R F A C E
subject set		Building the relation mapping of entities	
object set	Mode	Abstracting types of mapping	
task set		Determination of relation set	
solution set	Hierarchy of the emergency response	Abstracting relations	
	general framework for emergency response		

Figure 1. The frame of general construction scheme

(1) Abstracting subject set. E(1) equals to D, which is the task executor. It mainly exists in the organization system of emergency plan.

(2) Abstracting object set. E(2)=O, which represents the phase process of emergency response, and exists in the form of catalog of emergency plan, not including the demonstrative catalogs such as making purpose and making basis.

(3) Abstracting task set. E(3)=T, which describes the detailed work of subjects when facing objects. It exists in the paragraphs of emergency mechanism, not including the demonstrative catalogs such as making purpose and making basis.

(4) Abstracting solution set. E(4)=P, which mainly describes task solutions. It exists in the paragraphs of emergency mechanism, not including the demonstrative catalogs such as making purpose and making basis.

The third step of the general scheme contains three parts.

(1) Building relation set. It includes two processes. Process 1 is abstracting relations, where verb clusters of plans is abstracting objects. Process 2 refers to confirm relation set, including the treatment of verb similarities and summarization of verb types.

(2) Abstracting the relation mapping types between entities. Based on the analysis of relations between entities in the plans, and according to the relations in the Knowledge Net, we build six kinds of mapping types which can be seen in figure 2.
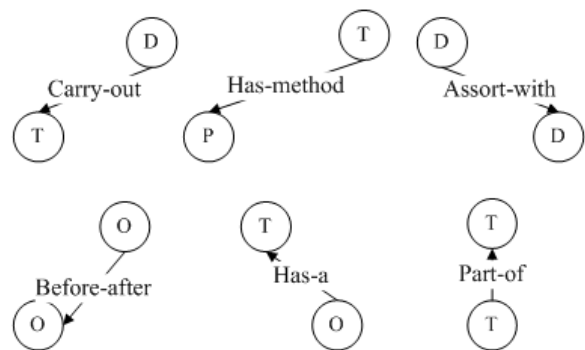
Figure 2. Six kinds of relations

(3) Building the relation mapping between entity sets. According to the analysis of emergency plans, emergency plans relations between objects, between objects and tasks, between tasks, between task and schemes, between subjects and tasks, between subjects, the whole process of emergency plans is composed of all the relations above. We have built the minimum tree of mapping relations which is shown in figure 3.
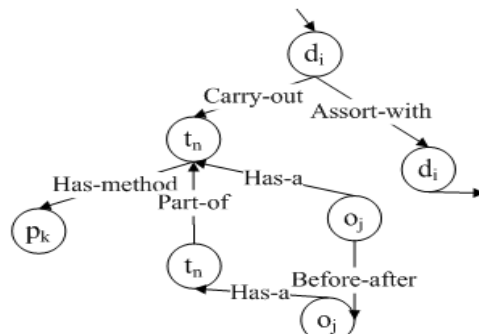
Figure 3. A minimum structure knowledge tree of the standard-mode

The sizes of trees are different according to

different problems. Through different combinations, we will get many kinds of solutions which aim at different emergency problems. There are two ways of formal methods of plans based on minimum tree extension.

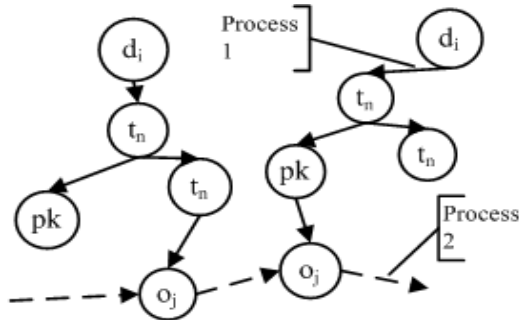（1）Dendriform structure which makes subject set as root node.

Figure 4. Top-Down Method

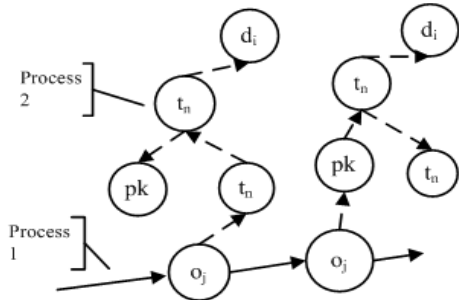（2）Dendriform structure which makes object set as root node.

Figure 5. Bottom-up Method

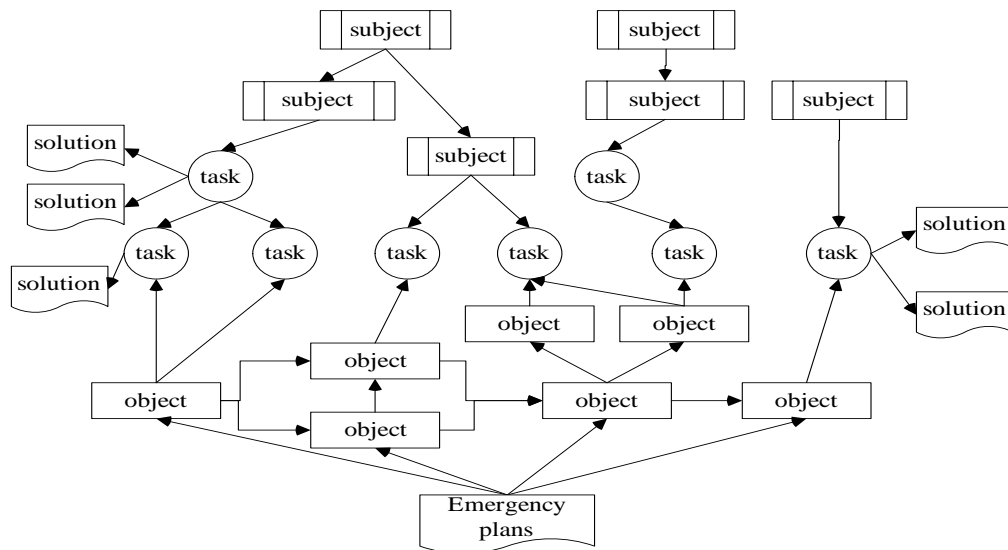We have finished formal description of emergency plan after the steps above. The result is is illustrated in figure 6.

Realization process of formal description is shown in figure 7.

4 Realization of the response mode of emergency system

In order to help decision-makers grasp the knowledge of emergency when dealing with it, a response mode of emergency system should be realized.

In this RMES, four kinds of emergency plans are collected. They are national, provincial, municipal and the other emergency plans about the public health event. We can find the standard-modes extracted from these plans in the background of RMES. Figure 8 is an example of the graphical interfaces of standard-mode

XML is a framework developed by the World Wide Web Consortium (W3C). It is a markup language for structural documents and semi-structural documents. It is an effective way of sharing data for applications and computers. So we organize these standard-modes with XML. Meanwhile, a tool of store and search about standard-modes has already been developed by us. Using this tool, you can get all about knowledge pieces based on the standard-mode of the emergency response quickly. And then, the result of the search will be represented for you in the form of graphical interfaces. Figure 9 is the result of search about bird flu diagnosis.

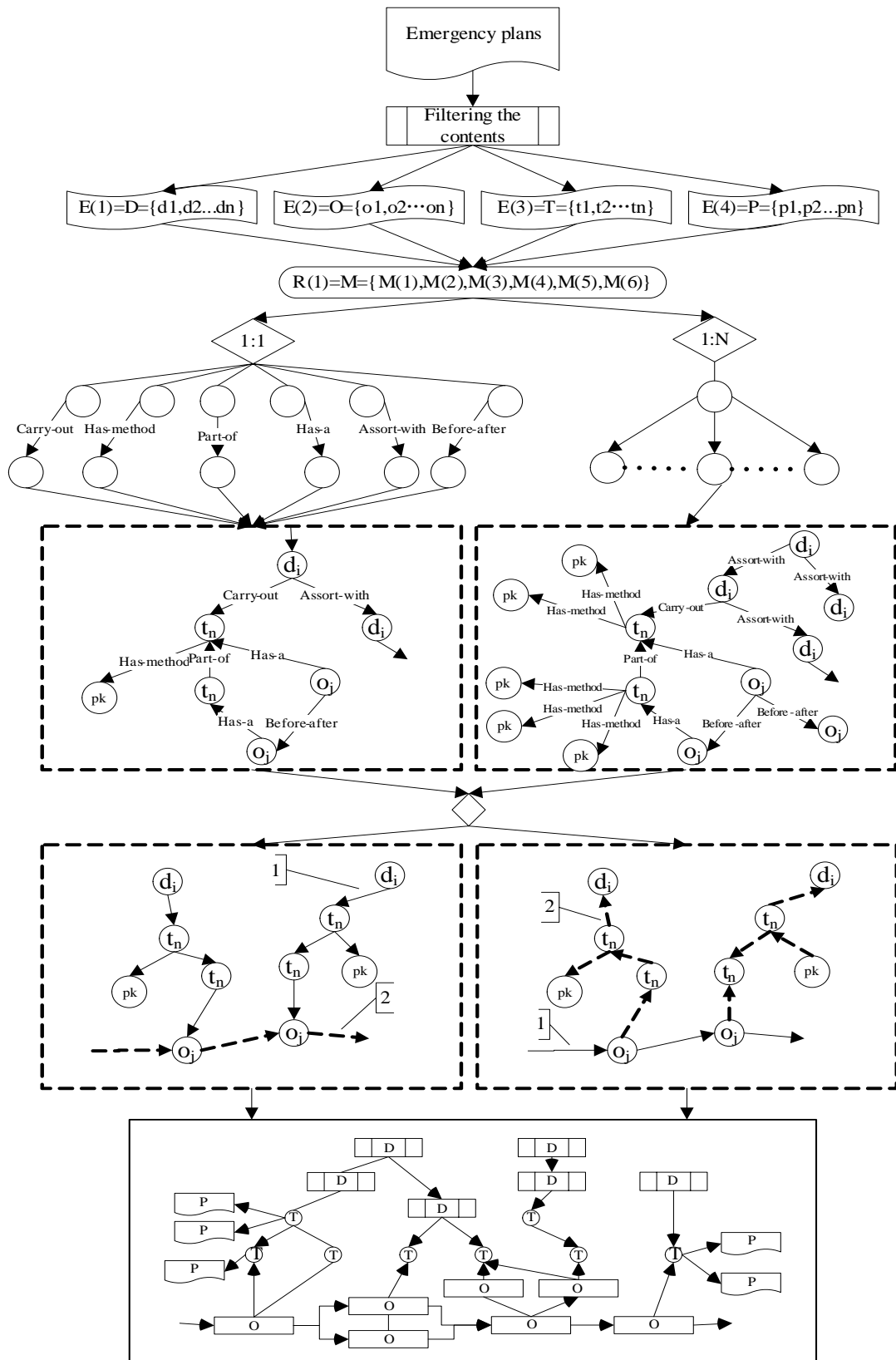Figure 6. Result of formal description way of emergency plan

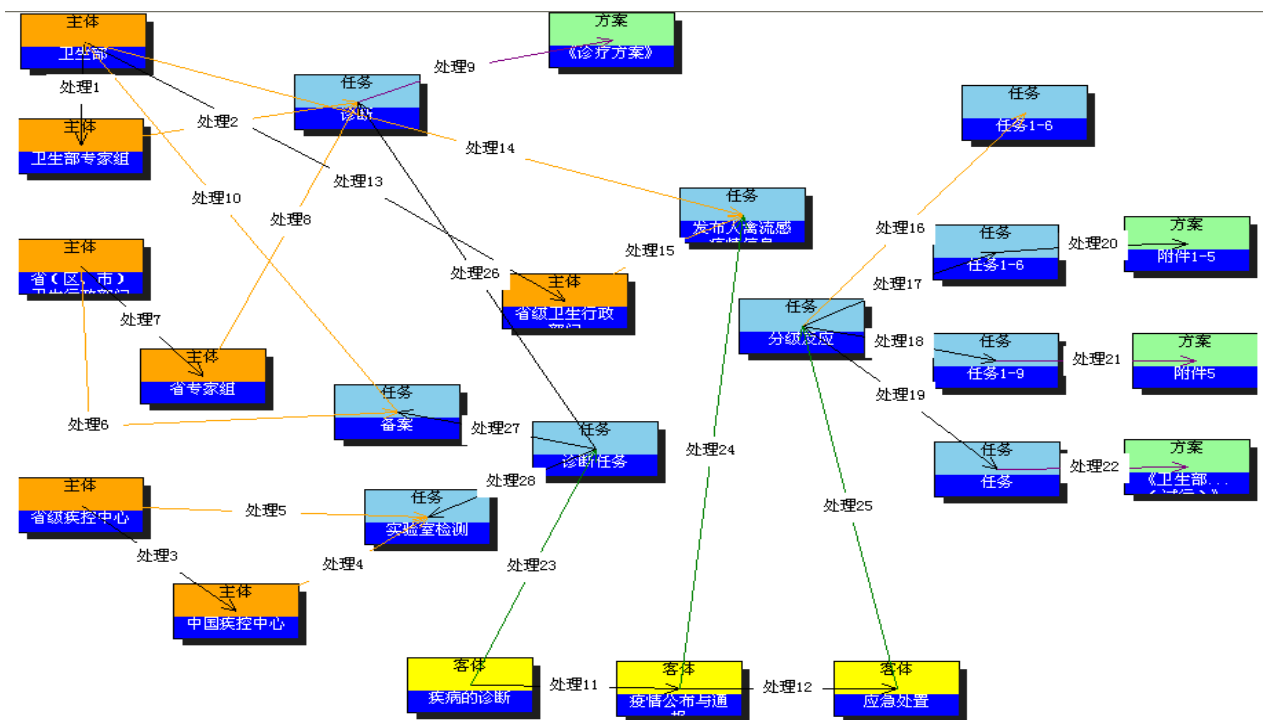Figure7. Realization process of formal description

Figure 8. The graphical interfaces of standard-mode about the Emergency Plan of Human Infecting High Infectious Diseases "Bird Flu"
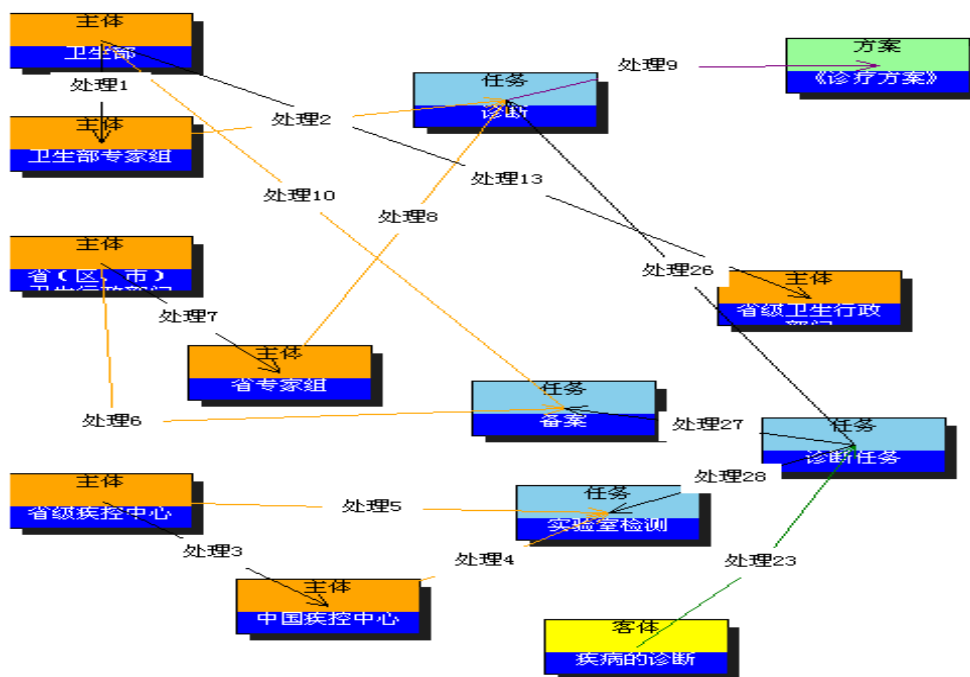

Figure 9. The result of search about bird flu diagnosis

Form the graphical interfaces of the result, we can get all knowledge pieces about bird flu diagnosis, including the subject, object, task and solution sets.

5 Conclusions

According to the latest category of emergency, this paper proposes the formal descriptions of

emergency plans in the basis of emergency plans we have collected. We can direct the process of emergency response through formal descriptions of emergency plans.

The research characteristics of this paper can be summarized in the following four parts:

（1）It has higher theoretical value because the research of emergency response is from the view of knowledge management.

（2）Not focusing on discussing the emergency management from the views of system and mechanism, it aims to propose the frame of emergency response modes and realize a formal description of emergency plans with high adaptability.

（3）The system we have realized is built in the basis of analysis of emergency commonness. Meanwhile, it is based on emergency plans. So it can be used in many emergency response processes.

（4）It provides dynamic and visual graphical interfaces, so it can supply the administrators of emergency management with intuitive knowledge support.

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