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The Research to the Framework of National Defense Project Risk Management System

Na YIN, Jinlin LI

***Abstract*—National Defense Projects suffer from risks in technical challenges, unstable system requirements, missing schedule milestones, unpredictable funding and cost overruns. A national defense project risk management system (NDPRMS) is a risk information-centric system which is used to avail the National Defense project manager of the project management process. Based on the work flow of national defense project experts' risk analysis process, we are developing the design guidelines for the risk management engineers and domain specialists. Specifically, we discuss NDPRMS mission objectives and lay out some key techniques associated with the development of functional module, such as knowledge representation, case based reasoning, matching case from the case database. Finally, we relate NDPRMS operational mechanism to user's work flow, and propose computerized steps of risk management.**

I. INTRODUCTION

THERE are many rapid progresses which have been made in the field of national defense project management, but it still remains blanks in the establishment of project management principles or rules, especially in the aspect of risk management. Researches nowadays on national defense project risk management are sparsely distributed; moreover, they can't come into being a set of feasible executive system. The purpose of this paper is to define a framework called national defense project risk management system (NDPRMS) and explore the engineering disciplines.

We will define NDPRMS as a risk information-centric system. It consists of 5 fundamental elements: data base, knowledge base, method base, model base, case database, and above all the bases, 9 functions are designed to support users making the decisions. Key techniques guarantee the system to be validated and accepted.

II. NATIONAL DEFENSE PROJECT EXPERTS RISK MANAGEMENT PROCESS

Experts in national defense are keeping the principles illustrated in Fig.1 when executing risk analysis process.

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Na YIN is with the School of Management & Economics, Beijing Institute of Technology, Beijing 100081, P.R.C (corresponding author, phone: 8610-68912482; fax: 8610-68912482; e-mail: yinna@bit.edu.cn).

Jinlin LI is with the School of Management & Economics, Beijing Institute of Technology, Beijing 100081, P.R.C (e-mail: jinlinli@bit.edu.cn).

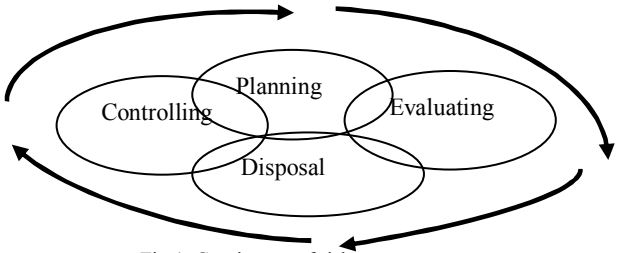


Fig 1 Continuum of risk management

From Fig.1, we can see the 4 integrants of risk management (risk management planning, risk evaluating, risk disposal and risk monitoring) are forming a series of closed-loop system (continuum), moreover, they are dependent after the original risk planning.

Risk planning: it is the process of "developing and documenting an organized, comprehensive and interactive strategy and methods for identifying and tracking risk areas, developing risk-mitigation plans, performing continuous risk assessments to determine how risks have changed or what new risk exists." (GSAM, 2000, 6-11). Planning for adequate resources is vital to implementing a risk management plan throughout the entire lifecycle of the national defense project.

Risk evaluating: this section includes risk identification and risk analysis. Risk identification begins by compiling the project's risk events. Examining each Work Breakdown Structure (WBS) product and process element in terms of the sources or areas of risk most easily identifies risk events. Moreover, analyzing the risk events (including subdividing and integrity) and considering the simulation. After this, the team leader will have a general portrait to the project risk level.

Risk disposal: adopting avoidance, transfer, mitigation or acceptance to handle the major risks.

Risk monitoring: Risk monitoring is the continuous process of tracking and evaluating the risk management process by reporting. The process involves evaluating how current and past risk handling actions compare with previously established risk management principles.

From the above, we know that purposes of NDPRMS are:

1) To computerize the risk management process: storing the experts experiences, history cases, project information, risk analysis method and risk classifying principles through appropriate structure;

2) To design feasible module by which can call the stored information and execute risk analysis.

III. THE FRAMEWORK FOR NDPRMS

A. Major Problems In Developing NDPRMS

When we were doing requirement analysis and system designing, we found that it was a bottleneck to computerize risk analysis according to the principles of field experts, and therefore the below 3 aspects are becoming the most important problems in our system:

1) The thinking ways, methods and process of field experts executing risk analysis;

2) How to computerize, allocate and manage field common sense and experts knowledge in NDPRMS;

Experts' approaches of solving problems occurred, such as inference technique.

B. The Integrants Of NDPRMS

NDPRMS includes Data Base(DB), Model Base(MB), Knowledge Base(KB), Case Base(CB), Inference Engine (IE), Explaining Engine(EE) and Human Machine Interface (HMI). The above 7 integrants and the relationship between them are illustrated as Fig.2.

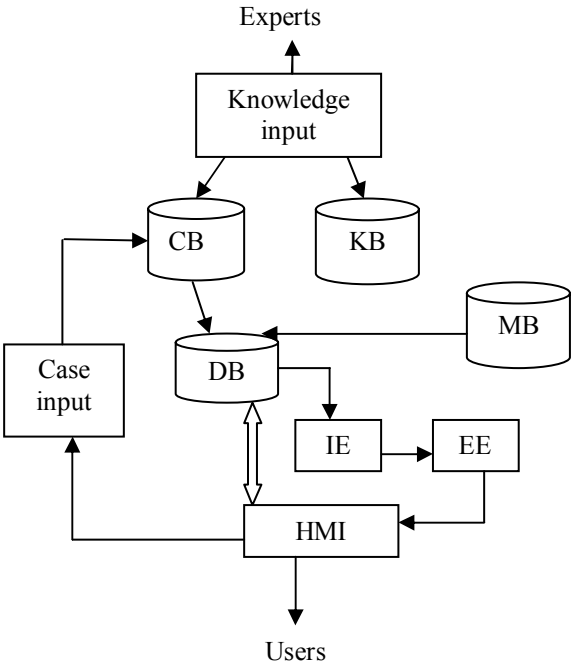


Fig.2 The frame of NDPRMS

1) DB: It includes database and its management system. Data Base is used to store project initial information, middle computing results and the final results.

2) MB: Method Base is to store and generate the models used in risk management. Such as the risk factors identification models, risk estimation models, risk assessment models and risk forecasting models. There are typically multiple ways to analyze risk information, therefore, MB management system can complete the operation like: creating, maintaining, calling, running, testing, requiring and searching.

3) KB: In the National Defense field, the data categories can be list as following but not limited to them: common sense, field basic knowledge and expert experience. For example, general work flow and work content, constant risk events and areas. Knowledge Base is to simulate the experts thinking ways during risk management. First of all, knowledge acquisition(KA) is defined as:

① Manual acquisition: risk administrator will gather knowledge and experiences from experts, and save them according to data features.

② Auto acquisition: adopting artificial intelligence (AI) and filtering useful data from the cases

③ Semi-auto acquisition: its running mechanism is among ① and ②. Field experts tell the system some principle information, and the rest work is done automatically according to the expert's hints.

4) CB: Casebase and case base management system constitute Case Base. In CB, we organize cases according to its own lifecycle terms such as conceptualization, planning, execution and termination. Among all the information, the system assigns much more resources to the risk basic data, risk evaluation results, risk analysis models, risk handling measures and impact……CB work flow is illustrated as Fig.3.

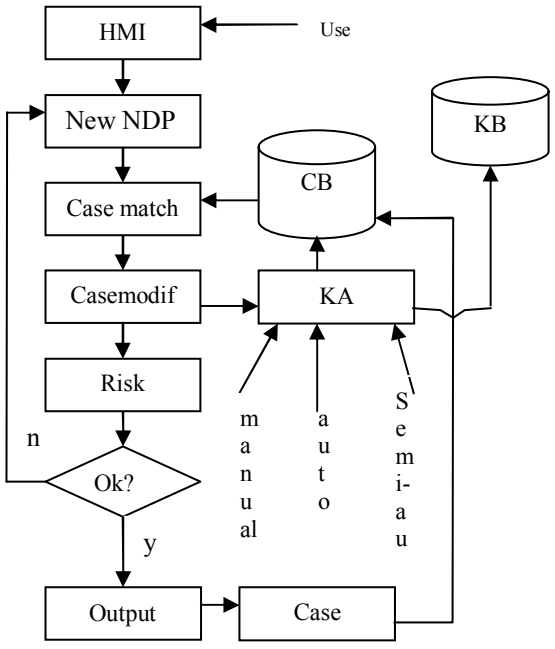


Fig.3 Work flow of case base

5) Inference engine. It will be called by all the three major module (risk identification, risk estimation and risk assessment) Inference engine needs several parts to complete the inference mechanism, they are: the problem basic information in DB, solving principles set and methods

set in KB, certain models in MD, history risk identification result and disposal suggestions in CB.

6) Explanation engine. It records the middle results and operating tracks during the analyzing process. Explanation engine can answer the user's questions about how output comes.

IV. Functional Modules of NDPRMS

Based on the description and analysis to the framework of NDPRMS, we will design the functional modules of this risk information-centric system as the following 9 items illustrated in Fig.4: (1)creating a new National defense project module; (2)project information input module, (3)NDP case importing module; (4)risk identification module; (5)risk estimation module; (6)risk assessment module; (7)risk controlling module; (8)risk monitoring module and (9)system search module.

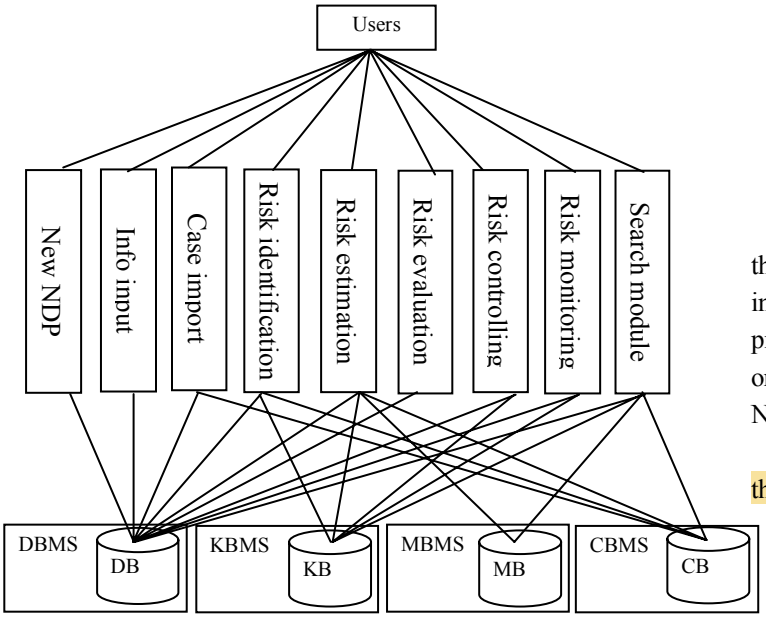
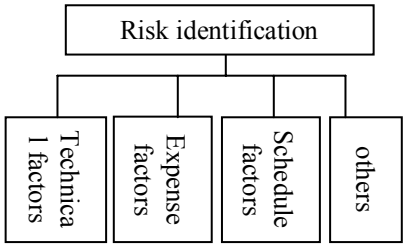
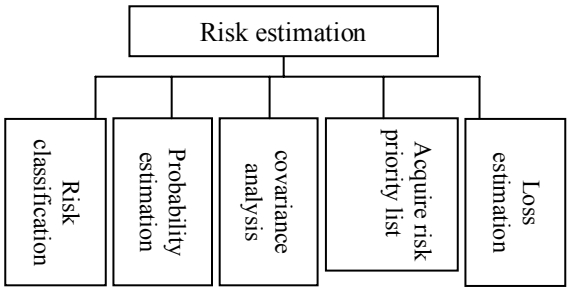


Fig.4 main functions of NDPRMS

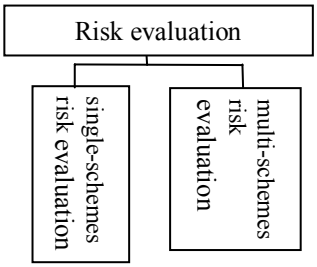
Among all the functions, Risk identification, Risk estimation and Risk assessment are the core risk analysis integrants. When we probe deeper, we can subdivide them as following (a), (b) and (c):



(a)



(b)



(c)

Fig.5 functions of risk identification, risk estimation and risk appraisement

V. Key Techniques Supporting NDPRMS

A. NDPRMS Knowledge Representation Structure

Each kind of NDP has its own lifecycle and milestones; throughout the whole process there are large amount of information such as field common sense, expert knowledge, project attributes, risk information…so on and so forth. In order to make full use of knowledge to inquire and to infer, NDPRMS adopts the structure of "knowledge-object"

"Knowledge-object" structure defines the knowledge in the context of project management, it also defines the priority of knowledge(compare common sense as axiom; expert knowledge as theory, so on and so forth) . This objective knowledge structure makes quicker in knowledge search, inheritance and generation than knowledge texts.

KO Name
{Basic information group
Father objects
Son objects
Rule group
In-out method
Module interfaces
Computing group
Activation
Limitation }

B. NDPRMS Inference Engine Based On Case Base

External items of the NDPRMS would be such characters as experts, risk administrator, team leader, and

decision-maker. They input data related to environment, project info, staff info, and risk info according to system's hints. NDPRMS inference engine will call the data needed and the module needed to compute. Outputs generated by NDPRMS are risk factors list，probability-influence matrix, risk response plans. The outputs that are passed to these external characters are requests for more detail or more frequent updates.

We adopt case-based reasoning (CBR) to complete the inference engine mission which is illustrated as Fig. 6.

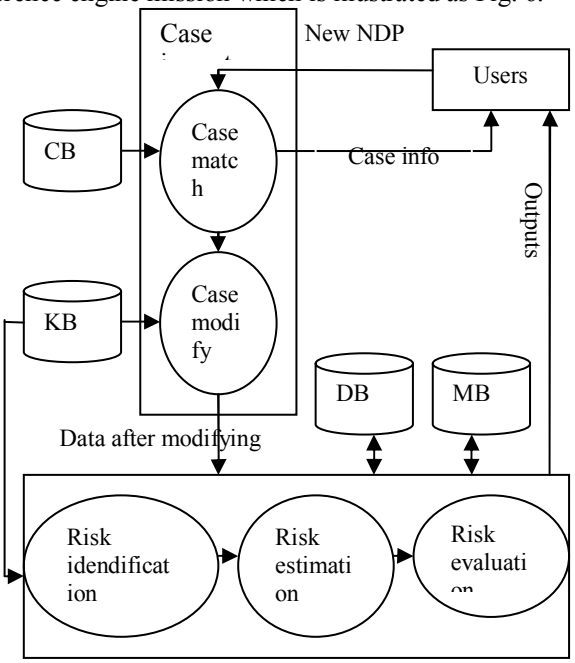


Fig.6 Reasoning mechanism based on case base in NDPRMS

C. NDPRMS Case Match Module

Three sub-processes are included in case match module: (1) feature identification; (2) preliminary matching; (3) the optimum selection.

Feature identification is to distill the features out of the project basic information. The system will question the users according to the context and the certain model, then reduce the search range step by step, hence optimizing the search result.

Preliminary matching is defined as follows: searching the case base and get the most similar cases set by using the nearest neighbor strategy. Before we raise the simulation function formula, we review something about distance:

$$F_1(C_t^i, C_l^i) = \left| C_t^i - C_l^i \right| \qquad (1)$$

$$F_2(C_t^i, C_l^i) = \sqrt{(C_t^i - C_l^i)^2} \qquad (2)$$

$$F_3(C_t^i, C_l^i) = \left[\left| C_t^i - C_l^i \right|^q \right]^{1/q}, q > 0 \qquad (3)$$

We can choose one of the upper F to complete the formula(4):

$$Sim(C_t, C_l) = \sum_{i=1}^{n} w_i * F(C_t^i, C_l^i) \qquad (4)$$

Where C_t : objective case,

C_l : Cases in the case base,

n : Total number of attributes belonged to a certain case,

$F(C_t^i, C_l^i)$ is the function of computing the distance between case C_t and C_l when considering the attribute i,

w_i is the weight of attribute i given by experts.

VI. NDPRMS WORKING MECHANISM AND WORK FLOW

(1) The risk administrator, decision-maker or team leader should input the information after NDPRMS requirements and hints. All the data should be stored in the correspond base and be called for function modules;

(2) Identify and classify the risk factors according to the risk guideline in KB, then output the risk list;

(3) Based on the weights given by experts and the history cases in CB, the major risk's probability and influence matrix are computing.

(4) NDPRMS CBR and output the risk disposal plan.

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