

Research on Ontology based Military Knowledge Development Methodology

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Abstract: Military system is knowledge-rich system. Military knowledge development is a vital part of its engineering process, and also a difficult part. An ontology based military knowledge development methodology is proposed in this paper, and its idea, development process, and ontology built method discussed. Ontology based military knowledge development methodology can effectively increase knowledge creditability, reusability, sharing and facilitate military knowledge management.

Key-Words: Military knowledge, Ontology, Structural description, Formal representation.

1 Introduction

Military knowledge development is important to military system development, since military systems are typical knowledge rich system.

Military knowledge development has been a difficult part of military system development for a long time. A ready thought way of solving this problem is regarding military system as kind of software system, and ideas and methods of software engineering are pick up on the sly to develop military knowledge. Military knowledge is acquired as part of system requirement through communication of military experts and developers.

Problems occurred when military experts and developers communicate, for military domain has special terminology which may be difficult for developer that lacking military background to understand, and traditional software engineering methods lack technology analyzing complex domain such as military domain.

Traditional software system development methods focus on tasks and problem-solving method, domain knowledge is usually bind to problem-solving knowledge [1]. Knowledge reusing and sharing is difficult under this situation.

An ontology based military knowledge development methodology is proposed and its realization discussed. Ontology based military knowledge development methodology distinguishes military domain knowledge from problem-solving

knowledge, can effectively increase military knowledge creditability, reusability and sharing, facilitate military knowledge management., and promote military system interoperability.

2 Relative Research

In 1995 Modeling and Simulation Office of US Department of Defense (DMSO) proposed Conceptual Model of the Mission Space (CMMS) as one important components of its vision in Modeling and Simulation Master Plan (MSMP) [2].

In MSMP, CMMS is defined as simulation implementation-independent functional descriptions of the real world processes, entities, and environment associated with a particular set of missions. CMMS is the common starting point and eventual real-world base for consistent and authoritative M&S representations. DMSO CMMS specified related technology framework, management procedure and toolset. From then on, military knowledge development has been paid much attention.

CMMS have an insight into trying to specify knowledge development of individual programs from high level standard, but it also has weakness. CMMS provides technical framework instructing what should do to meet this goal, but it is doubtful whether developer can do according to it, for the technical framework lacks detailed implementation specification. CMMS doesn't explicitly distinguish domain knowledge and task knowledge, for its Entity-Action-Task-Interaction (EATI) [3]

description framework still adopt method of use case decomposition, immingling common military domain knowledge and problem special knowledge. Thus it is hard to implement reusability and effective management.

In fact, since the CMMS' establishment in 1995 it is found not so satisfying and has been gradually replaced by other initiatives such as Functional Descriptions of the Mission Space (FDMS) in 2000 and later Knowledge Integration Resource Center (KIRC) [4].

3 Ontology Based Military Knowledge Development Methodology

In philosophy, ontology is the study of the kinds of things that exist. In knowledge management, ontology defines a common vocabulary for researchers who need to share information. Uschold [5] concluded ontology's values from three aspects: communication, interoperability, and system engineering, the last contains four facets: reusability, knowledge acquisition, reliability and specification.

A basic idea of ontology is distinguishing domain knowledge from special problem-solving knowledge, so it can also be used in military system development, thus leads to ontology based military knowledge development methodology.

Following will discuss thought of ontology based military knowledge development methodology, its process, and construction of a skeletal ontology of military domain.

3.1 Basic Idea

Ontology based military knowledge development try to divide military knowledge into common military domain knowledge and problem-solving knowledge, which are developed by different methods.

Common military domain knowledge is static knowledge in military domain and independent of special task or problem. Common military domain knowledge can be reused in related systems and shared by different agents. An ontology based development methods could improve knowledge quality and accordingly increase its usability and reusability, and facilitate knowledge management and sharing.

Problem-solving knowledge is related to special task, which can be rarely reused. This kind of knowledge can be acquired by problem analysis

based on domain knowledge.

Domain knowledge is specified by ontology technology and lays a stable foundation for knowledge verification, reusability, management and sharing, decreases complexity and promotes interoperability.

3.2 Development Process

A two phases development process is proposed based on military domain characteristics.

Military operation is countermeasures between peoples, affected by lots of factors such as mission, organization structure, doctrine, equipment, environments and so on. There isn't a simple linear relation between those factors, so military expert must participate in knowledge acquiring. On the other hand, military experts can't development knowledge by themselves, for military experts usually lack technology background. So development process is divided into two phases: structured description and formal representation. At structured description phase, military experts write knowledge in form of diagram or tabulation, organized according to structural relations and constraints. While at formal representation phase, technical expert formalizes structured knowledge using ontology technology. These two phases are relatively independent, military experts and technology experts can work independently but unified by military domain ontology.

3.3 Military Domain Skeletal Ontology

Military domain skeletal ontology is very important in military domain ontology building. EATI description framework provides useful reference. Based on EATI, we propose a framework of Entity-Task-Process (ETP), which shifts from domain static knowledge to domain dynamic knowledge.

Entity is static object in military domain, used to analyze military domain static knowledge, which can be reused through different military operation.

Task is used to descript military operation knowledge, which varies with military organization, but it can also be reused in different scenario.

Process is realization of task, which differs in different scenario. Different scenarios will produce different events which affects temporal relation of

tasks.

Military domain ontology can be built by concept definition, description, specification, classification and association based on skeletal ontology.

3.4 Bidirectional Engineering

There exists bidirectional engineering between military domain ontology building and military knowledge development. Military domain ontology provides military knowledge development with initial concepts and relations, improves start point of knowledge development. On the other hand, New concept, relation and instance may be introduced in knowledge development, those concept, relation and instance can be added into ontology library, and improve ontology integrity. This bidirectional engineering is valuable to military knowledge development activities.

4 Advantages

Contrast to traditional military knowledge development methods, ontology based methodology has following advantages.

Explicitly point out military knowledge development is an independent phase, and divide it into common military domain knowledge and problem-solving knowledge.

Ontology based two phases development methodology increase knowledge reusing and sharing, facilitate knowledge automatic verification and increase knowledge credibility.

5 Conclusion

An ontology base military knowledge development methodology is proposed, and its basic idea, process is also discussed in this paper. A military domain skeletal ontology of ETP is built, and bidirectional engineering between military ontology development and military knowledge development is also analyzed. Contrast to traditional military knowledge development method, ontology based method which can greatly improve knowledge credibility, reusability, management and sharing, has important meaning to military system development.

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