

A Dynamic Service Model of Think Tanks based on Knowledge Element and Ontology

Wei Fan¹, Zhen Wang²

School of Economics and Management, Xidian University, Xi'an, Shaanxi710071, China

This paper is the research result of the Shaanxi Natural Science Foundation Project "the research on the collaborative indexing and semantic integration of the knowledge element for the dynamic service of the think tank" (Project number: 2016JM7004).

Abstract: ***Objective/Meaning:** There is a lack of effective research on the dynamic service of think tank under the ubiquitous information environment. The knowledge element method is introduced into the dynamic service of think tank, and a dynamic service model of think-tank is proposed. **Method/process:** First, it combines the domain experts to analyze the user's requirements, and then filters the relevant information resources in the mass data environment. Finally, the knowledge element method is used to collect and mark the resources preprocessed, construct the knowledge element library, and combine the ontology theory into the semantic knowledge network with the knowledge element as the node, forming the knowledge warehouse. According to the three level mapping of "demand resource knowledge", it realizes the service mode of think tank based on knowledge element. **Results/Conclusion:** This method provides the control unit of the think tank service from the literature of coarse grained to the knowledge unit of fine-grained, which is based on the knowledge element, and provides the service of knowledge organization in the unit of knowledge element.*

Keywords: think tank; knowledge element; ontology; dynamic service

1. Introduction

Think Tank refers to the Advisory Research Institute, which is composed of experts from various disciplines, advising the decision-makers on dealing with economic, political, cultural, social, military and diplomatic issues and providing the best ideas, theories, methods and strategies, [1]. In the critical period of the new round of economic growth and social contradiction, in the third Plenary Session of the 18th CPC Central Committee, the Party issued a decision on "strengthening the construction of a new think tank for Chinese characteristics and establishing a sound decision-making consultation system", providing policy support for the rapid development of our think tanks. In October 27, 2014, the sixth meeting of the Central Leading Group for Comprehensively Deepening Reforms discussed and adopted 《Opinions on strengthening the building of new think tanks with Chinese characteristics》, General Office of the CPC Central Committee and General Office of the State Council printed and distributed it in January 2015. The opinion points out: "we should make an overall effort to promote...the think tank harmoniously development, forming... The new think-tank system with Chinese characteristics focuses on building a number of high-end think tanks with great influence and international influence, and attaches importance to the construction of specialized think tanks. [2] "At present, the analysis of China's think tank is mainly based on qualitative analysis, and there is a lack of objectivity and decision support. It is urgent to go deep into the quantitative research of independence and professionalism.

The think tank usually realizes the generation and reengineering of knowledge in the form of real-time service. In addition to think tank mines knowledge from the resources of the professional database, it still separates knowledge from the massive and real-time data resources

provided by the large data environment. Therefore, the service of the think tank shows the dynamics in the data environment. And the improvement of data semantics and complexity makes the theory and method of knowledge management need to turn to a more fine-grained unit. As Ma Fei Cheng proposed, "knowledge expression and organization must be converted from the physical level of the document unit to the knowledge unit or the information unit of the cognitive level" [3]. Knowledge Element is a basic unit with relatively independent and complete knowledge expression. Through accurate indexing and effective integration of knowledge elements, the explicit and recessive knowledge relationship between the same or different disciplines can be excavated [4]. In view of the lack of fast and accurate decision support in domestic think tanks, this paper introduces knowledge element into the think tank service, and realizes the automatic integration of knowledge from independent digital resources by using knowledge element to establish a kind of think-tank dynamic service model of think tank, providing a research idea for the theory development of the think tank.

2. Related Research

At present, domestic and foreign scholars have a relatively unified understanding of think tank services. In regard to the way of the service of the think tank, Wu Yuliang and so on elaborated the library information service of the Social Science Institute based on the think tank concept from the aspects: information resources collection, the information service mode, the promotion and evaluation of the think tank and the achievement, and so on [5]. Yang Youqing discussed the consulting service mode of think tanks [6]. Paper [7] has responded to the differences between academic public intellectuals and ideas from experts. Pop explored the service needs of think tanks and NGOs, and put forward some suggestions for building think tanks, [8].

Nachiappan has studied the characteristics of the think tank service in China, and pointed out that its policy dependency is too strong [9].

In the construction of knowledge base, Xu Xin, on the basis of the comparison of the services of two well-known think tanks RAND and SWP, proposed a general process for the construction of the knowledge base of the think tank [10]. In addition, there are a lot of research on the construction of general knowledge base, such as papers [11-14], but these studies can only be used as a reference for the construction of the think tank knowledge base, which is not fully applicable to the ubiquitous data environment of the think tank.

In regard to the service mode of the think tank, this article only introduces the relevant papers referred to this article: Zhang Xu and so on, divided the information service mode of the University Library think tank into the leading mode, the cooperative model and the auxiliary mode [15]. In addition, other scholars apply different theories and methods to put forward various service models of think tanks. Such as Gong Huaping and so on, pointed out that functional library think tanks include three kinds of service modes: research orientation, think tank intermediary and data monitoring, and divide the basic structure of think tank into four layers: user management layer, control layer, business logic layer and data layer [16]; Chen Hua and so on introduced the related data technology to explore the service mode of think tank, and put forward four kinds of service mode including resource collection, reference consultation, information push and evaluation feedback [17]. Document [18] has investigated more than 30 well-known international think tanks, and has generated three main information resource service models through the induction of service elements. To sum up, the research on think tank service has already formed a certain scale, and the research has different focuses, but there still remain some problems. For example, most studies only involve the category of artificial think tanks, and there are few studies on automatic / semi-automatic acquisition and generation of knowledge. There is no research on the dynamic service process of think tanks under ubiquitous information environment. Think tank services only involve subjective knowledge acquisition at the literature level, but do not go deep into fine-grained knowledge element level. It is obvious that the dynamic service of the think tank is difficult to meet the fragmented and refined knowledge requirement of the user. In this paper, the knowledge element method is introduced into the dynamic service of the think tank to solve the automatic / semi-automatic acquisition and generation of knowledge from a smaller granularity.

3. A dynamic Service Framework for a Think Tank under the Ubiquitous Knowledge Environment

The ubiquitous knowledge environment is proposed by the Daniel Atkins of University of Michigan in the United States. It refers to the comprehensive knowledge

environment, which is composed of network facilities, hardware, software, information resources, and human beings. The comprehensive knowledge environment is fully played by the elements [19]. Under the ubiquitous knowledge environment, higher challenges for fragmentation, fine-grained and refined services of think tanks are put forward. Therefore, it is necessary to extend the control unit of think-tank service from literature unit of coarse-grained to knowledge element of fine-grained.

3.1 Structure description framework of knowledge element

At present, scholars at home and abroad take the concept of knowledge element as the starting point of research, most of which focus on its concept, characteristics, classification, model and technology (extraction, indexing, integration), and so on. Although knowledge element is generally regarded as the smallest and indivisible basic knowledge unit. Due to the lack of standardized description of knowledge elements, features and attributes, knowledge element is still an abstract and ambiguous concept [20]. To solve this problem, we draw lessons from ontology's multiple group description method for information resources. A knowledge element entity object three tuple description framework is proposed, such as table 1, which constructs knowledge element description structure from terms, metadata and relational descriptions.

- 1) The terminology group: A set of special vocabularies that denote universal concepts in professional fields is used to represent abstract summarization of semantic contents of knowledge elements.
- 2) Metadata group: The related attributes of knowledge element are revealed, including access identifier, topic, knowledge element type, source document, subject scope and responsible person.
- 3) Relation description group: It points out the relationship between knowledge elements or knowledge elements and resources.

On the basis of establishing the three tuples description framework of entity object, the element information of knowledge element is extracted from information resources for preliminary indexing, and the knowledge element is set up in the knowledge element library.

Chart 1: Structure description framework of knowledge element

Description level	Description
The terminology group	Special vocabulary for subject areas
metadata group	Related attributes of knowledge elements
Relation description group	Relationship between knowledge elements Relationship between knowledge elements and resources

3.2 Semantic retrieval Foundation of knowledge element

Knowledge element is lack of semantic expression and description, so it can not support semantic integration well.

Therefore, ontology (Ontology) can be applied to semantic link of knowledge element, so that the computer can "understand" the semantics of knowledge element and can be integrated automatically. As early as in 1960s, ontology was used in the field of computer, but there was a lack of view of the unity of the ontology. From 1993 to 1997, on the basis of Gruber, Borst and others, Studer and others considered that ontology was "a clear formal specification of the shared conceptual model". The generally accepted definition of [21] indicates that ontology describes the interrelationship between concepts and concepts in a professional field, thus forming a word list of internal concepts in the field of discipline and a clear hierarchical relationship between concepts.

The object of ontology is to standardize the understanding of concept semantics by users and computers, express clear conceptual level and semantic relations, establish semantic relations between concepts of isolated knowledge, and get the relationship between concepts through inference relations, thus eliminating the ambiguity of human and computer to semantic understanding.

In view of the application of ontology in computer science, there are many formalized definitions of ontology. On the

basis of reference related research, this paper presents a formal definition of five tuples (C, A, R, I, X). The letter C is a set of concepts. A is the attribute set of the concept. R is a relational set. I is a set of instances, X is a set of axioms.

3.3 The representation of the dynamic service model of the think tank

The process of dynamic service in think tanks is essentially the matching process from natural language problem to resource set, and it can also be interpreted as constraint satisfaction process. This paper decomposes natural language problem into variable (knowledge element). The abstract constraint condition is a finite function, The matching of variables to resource sets is understood as constraint satisfaction process. The concrete implementation flow chart is shown in Figure 1.

To sum up, knowledge elements are defined as $KE = \langle Ct, M, Rk \rangle$. Ct, M and Rk are terms, metadata and relational descriptions. Definition ontology is: $O = \{D|C, A, R, I, X\}$, where D is a non empty set in a subject domain, C is a set of concepts, A is a set of attributes, R is a set of relationships, I is a set of instances, X is axiomatic set.

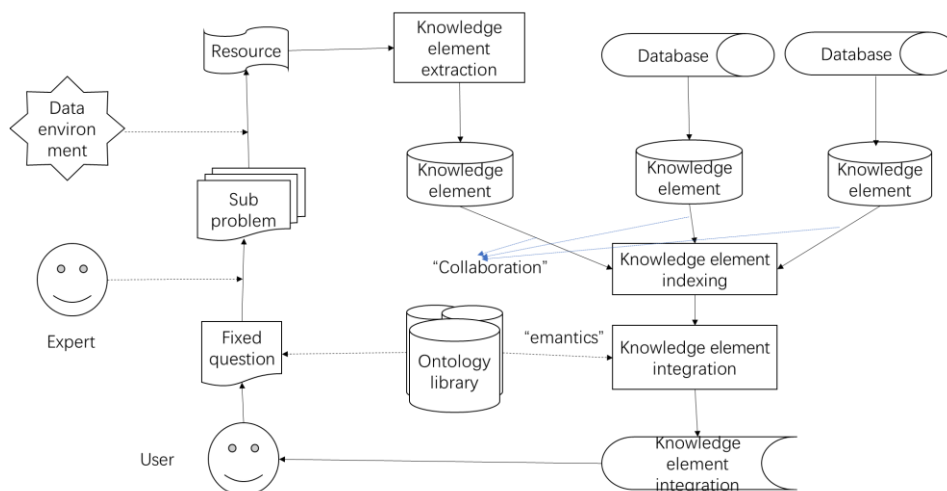


Figure 1: Think Tank Dynamic Service Process

The resource set of the think tank is defined as $TK = \{(O, KE_i), CPs (Cp_t)\}$, (I, s, t are finite natural numbers), CP is the resource node. Define the natural language: $Q = \langle QV, QC \rangle$, where $QV = \{q_{vi}\}$, $QC = \{q_{ci}\}$, ($i=1, 2, \dots, N$) are the set of problem variables and the set of problem constraints respectively. In this way, the dynamic service model of think tanks can be expressed as: $Max\{Q \rightarrow TK\}$.

4. The Way of Knowledge Organization based on Knowledge Element

Combining the knowledge element ontology theory and method, Think tank will realize that resources are included

in the semantic web With knowledge element as the nod, Technical ideas as shown in Figure 2, First, resources collected from massive data need standardize, according to the knowledge element description framework and pre established rules of knowledge element extraction, take shape initially Knowledge element repository; Then, according to ontology establishment of experts in the field, it realize semantic link of knowledge element, so as to construct the knowledge warehouse. The process includes knowledge element extraction and semantic annotation of two key modules.

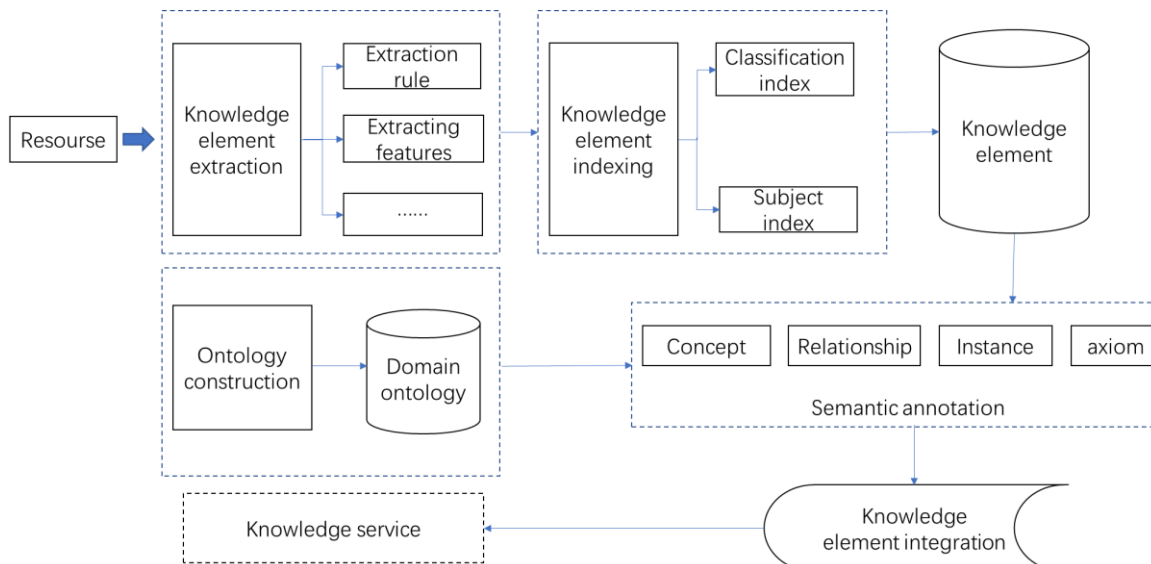


Figure 2: Knowledge integration based on knowledge elements

4.1 knowledge element description and extraction

On the basis of defined level structure of knowledge element, according to the rules established beforehand composition of knowledge element are extracted from the collected resources, independent knowledge element can be obtained, which can make preparations for the work of semantic annotation.

4.2 The semantic annotation of knowledge element based on ontology theory

Knowledge element extraction and knowledge repository construction have been completed The semantic annotation is that semantic relations in the knowledge element are established based on domain ontology library structured by experts, which take shape semantic network can be identified by computer, generate and reconstruct knowledge according to the needs of users.

Semantic annotation mainly includes two key steps, first of all, knowledge element wait for mark can be described with three tuple object description framework mentioned above. Secondly, In the process of annotation, the term is the abstraction of individual in the real world, as the elements of knowledge element, expresses semantic abstract representation of knowledge element, other elements reveal the side of knowledge element from different angles. Therefore, on the one hand, the term from knowledge element is marked as concept and example of ontology, which requires a combination of semantic similarity calculation and field experts, as for terms that did not reach the threshold for semantic similarity, the experts in the field need to define them by as new concept, add them to the ontology in semantic web and remark. On the other hand, the other elements from knowledge element are marked as corresponding attributes of ontology.

4.3 The dynamic service level of think tank

Think tanks provide automatic / semi-automatic knowledge service model to meet the needs of the user fast knowledge needs, in this mode, the unit of knowledge organization was refined to the knowledge element, knowledge element set. Thus, based on the fine-grained knowledge element and through the analysis of user needs, think tank service model collect resources from the massive data and add them to semantic knowledge network with knowledge element as the node, which come into being "demand - resources - knowledge" three level mapping.

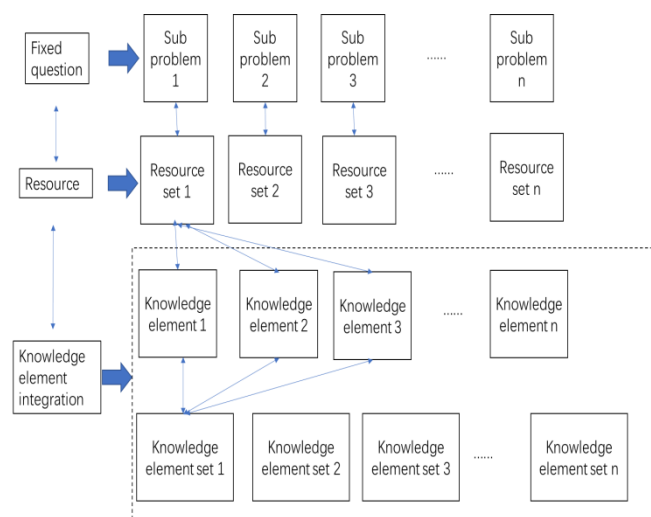


Figure 3: "Demand - resources - knowledge" three level mapping

Epilogue

This paper presents a think tank service model based on knowledge element. It will serve as a reference, think tank service model will realize that knowledge organization from literature of coarse-grained to the knowledge element of fine-grained, combining with the theory of semantic ontology, it can establish links among knowledge element and form a knowledge network of nodes based on

knowledge element, providing knowledge service for users. But this method still stay in the theoretical level, need to deepen the practice in the follow-up study.

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