

Research on Knowledge Management of Aviation Manufacturing Industry Based on Association Rules

Xin Ai

Mechanic and Electronic Engineering
Xi'an Technological University, XATU
Xi'an, CHINA
E-mail: 280996215@qq.com

Yu Bai

Mechanic and Electronic Engineering
Xi'an Technological University, XATU
Xi'an, CHINA
E-mail: 8640375@qq.com

Jiang Du

Mechanic and Electronic Engineering
Xi'an Technological University, XATU
Xi'an, CHINA
E-mail: 469337759@qq.com

Hang Liu

Mechanic and Electronic Engineering
Xi'an Technological University, XATU
Xi'an, CHINA
E-mail: 921947116@qq.com

Abstract—[Purpose/Meaning] Aim at the two Safeguard measures to strengthen the China's industrial infrastructure capabilities proposed by "Made in China 2025" plan and the real Product development requirements of China's aviation industry, the method to provide high quality and efficient knowledge management and information service for the China's aviation manufacturing industry are researched in this paper[Method/Process]. The knowledge elements contained in the Aviation manufacturing industry standard literature and the explicit or the implicit relation rules among them are firstly analyzed based on the current national and industrial standards of aviation manufacturing field, then the knowledge association network model of aviation technology standard is established according to the provided knowledge elements and their relationships[Results/Conclusions], the research can not only provide good technical support for information service of aviation manufacturing industry, but also to further promote the Intellectualization Process in the Design and manufacturing field of the aviation manufacturing industry.

Keywords-Association Rule; Aviation Technical Standard; Aviation Manufacturing; Knowledge Management

Knowledge is a kind of intelligent resource, the capital of independent innovation of enterprises, and the weapon for enterprises to gain competitive advantage. In the era of knowledge economy, "submerged in data, but hungry in knowledge" is the main problem faced by people, knowledge-based work. It is not only the characteristics of emerging information technology companies, but also the characteristics of all organizations in all fields[1]. Knowledge association is the basis for carrying out knowledge activities and knowledge management. As a carrier of aviation industry technology, aviation technical standards contain a large amount of technical knowledge information and are important carriers for recording the knowledge generated in the design, production and manufacturing of the aviation industry.

Due to the complex structure of the aerospace industry, the large number of components, the complex manufacturing

process and the different materials, the knowledge used and produced by the aviation industry in design, manufacture and production involves many fields and is scattered in various storage media. The complexity of aviation industry knowledge makes it extremely difficult to manage knowledge[2]. The aviation manufacturing knowledge management model based on the knowledge element association rules provides a theoretical and methodological basis for constructing aeronautical technology dynamic management system for aviation industry information design, production and manufacturing from the domain knowledge level. Knowledge-based network description model based on knowledge elements to establish aviation technology standards, effective knowledge management, sharing and reuse, as to effectively manage aviation technical knowledge.

I. ANALYSIS OF AVIATION TECHNOLOGY STANDARD CORRELATION MODEL

In the knowledge association research of aviation technical standards, the association of standard documents is further deepened to the knowledge element level, which can make each knowledge element form a system of knowledge association network, discover its potential logical relationship, and help to strengthen the aviation technical standards. Utilize, to facilitate users to quickly and accurately obtain technical knowledge in technical standards.

In the objective world, all things are interrelated, and the universal connection between knowledge is bound to be projected onto the knowledge carrier. Some scholars in China have studied knowledge association. Wen Tingxiao et al[3] studied the connotation, characteristics, types and measures of knowledge association. Chen Huawei et al[4] proposed a product knowledge clustering integration model based on knowledge association. Zhou et al[5] studied the knowledge-related system for knowledge innovation from the aspects of information and cognition.

The knowledge association between standard documents refers to the sum of various relationships existing between the knowledge elements of each standard document, and has

the characteristics of mutuality, universality, transitivity, implicitness, structure and accumulation[6]. Analysis of the relationship between knowledge systems is conducive to the management of knowledge systems.

A. Explicit association

As a carrier of technical knowledge in industrial production activities, the technical documents of aerospace manufacturing enterprises are achievable, open and dynamic. They are commonly used, replaced, mutually revised, cross-referenced and technically regulated among standard documents. The patent relationship of patents constitutes a dominant association between standard documents[7]. For the explicit association of the standard literature, the co-citation relationship can also be used to represent[8]. When two unrelated standard documents jointly reference (use) the same technical standard or technical regulation or patent, this co-introduction relationship can constitute a total network can be used to reflect the explicit association of standard document content through the network.

B. Implicit association

In addition to the explicit associations of mutual references and adoptions, the standard documents in the aviation manufacturing industry can also be linked by logical relationships such as technical problems described in the literature to form undiscovered implicit associations. By analyzing the implicit associations between standard documents, a large amount of potentially hidden knowledge can be obtained, making the standard literature more valuable. The implicit association between standard documents is the logical relationship implied between standard documents. It is mainly the knowledge association of technical dimensions, including cluster association, reasoning association and technical knowledge association.

1) Implicit association

The clustering association of knowledge refers to the analysis and integration of knowledge objects according to their attribute classification. The relationship between knowledge clustering and knowledge classification has opposite directions. Unlike knowledge classification, knowledge clustering process will generate new knowledge,[9] The knowledge clustering is divided into six categories: subject clustering, concept clustering, event clustering, clustering, human clustering, and spatiotemporal clustering. The knowledge clustering of the standard literature is mainly based on subject clustering, concept clustering, and clustering. Based on a certain knowledge element, the knowledge group of different dimensions is formed around the knowledge element.

First, the aeronautical technical standard text is preprocessed, word segmentation processing is performed on the text of plain text, knowledge element information is extracted, a terminology matrix is constructed, and an index tag is established. The author uses the Lingo clustering algorithm to cluster the aeronautical technical standards. It can be set up in the knowledge base to have a knowledge element set K , which can be divided into x classes. Since the Lingo algorithm is a clustering method based on the

knowledge element label, the corresponding center is first selected as X , and the membership degree of a certain class corresponding to each knowledge element j is u_{ij} , based on a certain knowledge element attribute feature semantics, in space The similarity calculation is performed for each element, so the objective function is defined:

$$J = \sum_{i=1}^x \sum_{j=1}^n u_{ij}^m \|k_j - x_i\|^2 \quad (1)$$

Define constraints:

$$\sum_{i=1}^x u_{ij} = 1, \forall j = 1, 2, \dots, n \quad (2)$$

Its semantic relevance is:

$$b_k = Sim(x_i, x_j) = \sqrt{\sum_{i=1}^k (x_i - x_j)^2} \quad (3)$$

Wherein, the constraint u_{ij} is between (0, 1), and X_i is a cluster center of a certain group. The cluster center X_i and a certain knowledge element are regarded as two points in the vector space, and the distance in the vector space is $\bar{d} = \|k_i - x_j\|^2$. Therefore, the distance of the knowledge element contained in the knowledge element set K in the vector space can be expressed as:

$$D = \begin{bmatrix} u_{i1}^m \|k_1 - x_i\|^2 & \cdots & u_{ij}^m \|k_j - x_i\|^2 & \cdots & u_{in}^m \|k_n - x_i\|^2 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ u_{i1}^m \|k_1 - x_i\|^2 & \cdots & u_{ij}^m \|k_j - x_i\|^2 & \cdots & u_{in}^m \|k_n - x_i\|^2 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ u_{x1}^m \|k_1 - x_x\|^2 & \cdots & u_{xj}^m \|k_j - x_x\|^2 & \cdots & u_{xn}^m \|k_n - x_x\|^2 \end{bmatrix} \quad (4)$$

Weighting factor: $T = (t_1, t_2, \dots, t_n)$, Introduce constraints and weighting coefficients T into the objective function to construct a new objective function:

$$J = \sum_{i=1}^x \sum_{j=1}^n u_{ij}^m \|k_j - x_i\|^2 + t_1 \left(\sum_{i=1}^x u_{i1} - 1 \right) + t_2 \left(\sum_{i=1}^x u_{i2} - 1 \right) + \cdots + t_j \left(\sum_{i=1}^x u_{ij} - 1 \right) + \cdots + t_n \left(\sum_{i=1}^x u_{in} - 1 \right) \quad (5)$$

According to the semantic label of the knowledge element attribute, the semantic distance between the extended class and the central class in the aerospace domain knowledge semantic space model is calculated, and the clustering model is constructed from different dimensions, node depth and node density. Its cluster correlation expression is:

The knowledge association network of aviation technical standards is not only a network set composed of explicit association and implicit association mutual reasoning, but also knowledge sets with different characteristics are related to each other to form a new knowledge structure, in which the number of knowledge units changes and knowledge The qualitative change of the structure, the two changes promote each other, forming a richer knowledge-related structure. Due to the dynamic development of technology, the process is also a dynamic spiraling process. With the reform and development of technology, knowledge is constantly increasing and changing, and the knowledge-related structure is continuously extended and changed.

IV. SUMMARY

The knowledge association network is the basic problem to be solved by establishing a knowledge model. The author proposes a method based on association rules and ontology theory, constructs a simple aviation technology standard knowledge association network model, and carries out an example verification to provide a unified system for knowledge modeling and knowledge interaction in the field of aviation technology standards. Intelligent retrieval and knowledge reuse provide a guarantee. Build a knowledge base after knowledge modeling to provide technical support for knowledge sharing and reuse. The research on the correlation of aeronautical technology standards has a vital role in analyzing the knowledge content generated by aviation manufacturing design and production activities, and exploring the value of knowledge. Mining potential knowledge links in technical standards documents can not only be from technical standards. Knowledge level forms a good information resource, realizes the conversion of aviation resources from data text to knowledge, provides basic guarantee for the development of information technology services for aviation industry activities, also promotes the sharing, innovation and application of knowledge, and develops aviation manufacturing. Knowledge management services provide good technical support, and can further improve the current aviation technical standards from the information level, and promote the development of industrial production activities in the direction of informationization, intelligence, and service-oriented manufacturing, from the rapid and efficient design and manufacturing activities. A vital role in guiding the knowledge management of aviation manufacturing enterprises.

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