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A.V. Rugain, PhD
(National Aviation University, Ukraine)

Conceptual approaches to the design of aircraft maintenance system educational ontology

Conceptual approaches to the design of ontology, which can be used to describe the system of aircraft maintenance for educational purposes, is considered

All civilized states and their institutions are constitutionally interested in ensuring the proper level of effectiveness of the country's education system. Measure this level can be different, for example, on the achievements of students in basic disciplines, on the percentage of successful graduates training, or by how much their profession is in demand. Other aspects relate to the impact of knowledge, judgment, understanding and values. Thus, the effectiveness has a quantitative and qualitative aspect that must be considered against the background of different contexts, input resources and processes through which the education system functions.

As indicators that reflect the quality of the learning process can be used to analyze the success of training in accordance with the educational standards [1].

Presentation trained holistic knowledge of the subject area in the form of formal descriptions is one of the most difficult processes in the analysis of the quality of education. To effectively solve this problem is urgent task of forming an algorithm for constructing a particular domain.

In this paper, the aircraft maintenance system is considered as the subject domain.

To describe this system, it is proposed to use the ontological model of representation of knowledge [2].

Nowadays ontologies are becoming increasingly popular because they provide a semantic framework for the rapidly developing technology.

The main advantages of the ontological approach:

- ontology is a holistic, systemic approach to a specific subject area;
- knowledge of the subject area are presented uniformly, which simplifies their perception;
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On the other hand, ontology forms the most general idea of the object of research, fixes the categorical apparatus of its design concept. [3].

This paper discusses conceptual approaches to the design of ontology, which can be used to describe the system of aircraft maintenance for educational purposes. The classification criteria of the subject area are taken into account by the type of the maintenance knowledge area (table 1) [4], by types of maintenance (fig. 1), as well as functional features of the aircraft maintenance support system (fig. 2).

At the formal level, an ontology is a system consisting of sets of concepts and statements about these concepts, based on which you can build classes, objects, relations, functions, and theories. Practically all models of ontology contain certain

concepts, properties of concepts (attributes, roles), relationships between concepts (dependencies, functions) and additional restrictions that are defined by axioms. Concept can be a description of a task, function, action, strategy, process considerations etc.

Table 1.

Types of knowledge circulating in the field of maintenance

#	Type of knowledge	Kind of professional activity
1	WHAT FOR-knowledge	STRATEGIC ANALYSIS: the purpose and functions of the maintenance system
2	HOW MUCH -knowledge	ECONOMIC ANALYSIS: maintenance costs, required resources
3	WHAT-knowledge	CONCEPTUAL ANALYSIS: basic concepts of maintenance, the relationship between them, the conceptual structure
4	HOW-knowledge	FUNCTIONAL ANALYSIS: hypotheses and models used in the organization of procedures and maintenance work
5	WHY -knowledge	CAUSE-AND-EFFECT ANALYSIS: diagnosis of causes and identification of appropriate types of maintenance
6	WHEN-knowledge	TIME ANALYSIS: the timing and duration of maintenance
7	WHERE-knowledge	SPATIAL ANALYSIS: location of maintenance
8	WHO-knowledge	ORGANIZATIONAL ANALYSIS: distribution of functions in the group of specialists performing maintenance

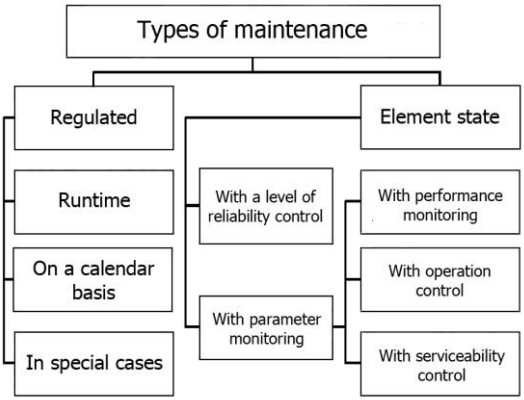

Fig. 1. Classification of maintenance types

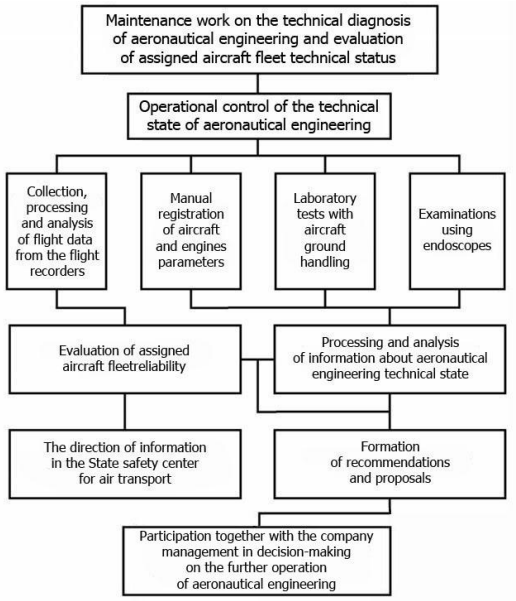

Fig. 2. Functional diagram of the aircraft maintenance system

Ontological analysis usually begins with the compilation of a glossary of terms, which is used when discussing and studying the characteristics of the objects and processes that make up the system under consideration, as well as creating a system of precise definitions of these terms. Furthermore, documented basic logical relationships between the terms concepts introduced. The result of this analysis is a glossary of terms, their exact definitions and interrelations between them.

Thus, the ontology contains a set of terms and rules, according to which these terms can be combined to build reliable statements about the state of the system in question at some point in time. In addition, on the basis of these statements, appropriate conclusions can be made to allow changes to be made to the system in order to increase the efficiency of its operation.

The process of building an ontology consists of five basic actions:

1. Studying and systematizing the initial conditions - this action sets the main goals and contexts of the ontology development project, and distributes the roles among the project members.
2. Collection and accumulation of data - at this stage, the necessary initial data are collected and accumulated for ontology construction.
3. Data analysis - this stage consists in analyzing and grouping the collected data and is intended to facilitate the construction of terminology.
4. The initial development of ontology - at this stage a preliminary ontology is formed on the basis of selected data.

5. Refinement and approval of ontology - the final stage of the process.

There are two main categories of objects of perception in any system: the objects that make up the system, and the interrelations between these objects, which characterize the state of the system.

At the initial stage of ontology construction, the following tasks should be performed:

- creating and documenting a glossary of terms;
- description of the rules and restrictions, according to which, on the basis of the entered terminology, reliable statements describing the state of the system are formed;
- construction of the model, which is based on the existing statements, allows you to create the required additional approval.

The methodology of ontology creation and the practical methods for its development include:

1. Definition of the classes in the ontology;
2. The location of classes in the taxonomic hierarchy (subclass - superclass);
3. Definition of slots and description of allowed values of these slots;
4. Filling in slot values of instances.

After that, you can create a knowledge base by defining individual instances of these classes, entering a value and additional restrictions for a slot in a particular slot.

Getting to the design of the maintenance system ontology, first of all it is necessary to rely on its structure (fig. 3) [5].

Fig. 3. The generalized structure of the aircraft maintenance and repair system

When constructing the structural elements of ontology, it is also necessary to take into account the current trends in the development of the subject area. Obviously, the traditional retroactive (Reactive) ideology of the service system built on strict adherence to regulatory requirements and the implementation of preventive recommendations developed as a result of an investigation of the events that have occurred, has exhausted itself.

Therefore, ICAO has developed a fundamentally new ideology for the prevention of accidents and incidents, called “safety management”.

Such an approach to accident prevention was named Proactive. In essence, proactive maintenance assumes the same reactive approach as maintenance by state with the control of parameters, but as diagnostic signs, such system parameters are selected, the observation of which allows you to control the root causes of the degradation of system stability factors (fig. 4) [4].

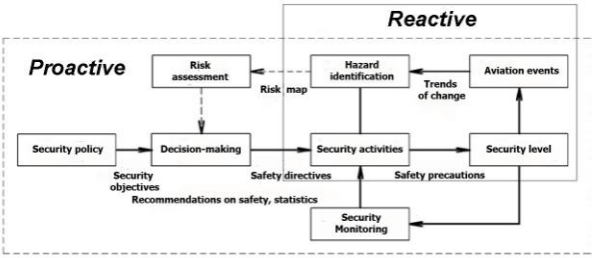

Fig. 4. The structure of the proactive maintenance system

There is no one correct way to model a subject area – there are always viable alternatives. The best solution usually depends on the intended application and the expected extensions.

Ontologies play a crucial role in the knowledge description model, without which, according to experts, entry into any subject area is prohibited. Designing an ontology is a creative process, and therefore potential applications of ontology, as well as the developer's understanding of the subject area, and his point of view on it, will undoubtedly influence decision-making.

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