Information Advising System for Safe Fleet Operations

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***Abstract*—Safe fleet operations requirest the implementation of a large number of documented rules. When preparing a vessel for a voyage or directly during operation, there is often a need of actual information concerning safe operation regulations in effect, which volume can be quite considerable. Help for the users can be provided through automation of search and extraction processes.**

The article deals with an approach to the design of information advising system on safe fleet operations, based on semantic technologies. System users and their main informational needs are described. The problems, solved by the system are determined. Functional blocks of the system are highlightened. The requirements for the informational and documentational supply are set. Such a system will fasten and simplify relevant information acquisition.

***Index Terms*—information advising systems, semantic technologies, precedents search, safe fleet operations**

I. Introduction

Maritime transportation is a kind of human activity, involving a great number of risks, both for people working on vessels and environment. There are a lot of rules sets, conventions and other kind of orders, regulating any aspects of this activity to provide safe fleet operations. A vessel can be operated, in particular allowed to enter an international port, only after the fulfillment of all the regulations and rules has been checked. To search for the particular data and verify all orders and constraints to be fulfilled, one should analyze large volumes of information, quite a difficult, and what's more important, time-consuming process. One possible solution for this kind of problems, related to the automatic search over document corpus, is based on the use of information advising intellectual systems and semantic technologies.

A vessel represents a complex autonomous engineering system, operated by the minimum required for navigation number of crew members. For the cargo handling operations to be done in ports the vessel should come through the vetting procedure, i. e. get a permission from a certified specialist. Vetting is carried out by independent experts according to strictly determined parameters, established by international rules and conventions.

Safe fleet operations problem includes the following main aspects:

- Route working out including national border crossing, domestic waters of foreign countries, traffic through neutral waters and regions with regulation restrictions.
- Vessel operation during interrepair period: life boat drill schedule, equipment inspection, health and safety regulation compliance on the board, environmental discharge norms, etc.
- Crew training: crew members certification, medical examination and training preparation.
- The berth take up in host country.

The above aspects are strictly regulated and described in various normative documents. In order to work effectively in these cases, it is necessary to search for the necessary information, which may take a long time depending on the complexity of the issue or the number of regulating documents. For example, when navigating a complex route through a large number of regions with different regulations in action, to verify that the ship's equipment meets all regulations becomes quite a time-consuming process. This problem's solution is based on precedents search and identification of similar situations. To increase efficiency of relevant documents search automation of this activity is required.

II. System concept

A. Users

Let's define systems users. Broadly speaking, main user is represented by the shipping company, interested in the possibility of vessel operation with commercial or any other purposes, and thus interested in respecting rules, regulating such an operation. As mentioned above, norms compliance check is carried out during vetting process, which results unified register forms companies activity assessment, its reputation and expertise level. Nevertheless, systems interface focuses on terminal users – persons, implementing ship operation. Let's identify users, according to the described typical situations, requiring informational support.

While route working out, two main system users can be distinguished – logistic specialists and navigators. The former accomplish preliminary route working out

according to existing rules for a specific vessel. Often situations arise (precedents) when ships do not come up to ecological standards, taking place in some regions, which is why such ships should choose alternative routes. Logisticians have to conduct complex analysis of all the norms in action so that to find an optimal route, with possible additional ship preparation or if it is not possible due to design or any other features, a route with norms that are already come up by the vessel.

In addition, due to weather or other conditions it may not be possible to follow the planned path. The navigator choosing a detour route needs information support in such situations. In this case, it is sufficient to analyze only those rules that apply in a particular area or several areas.

As the ship is operated by its crew, different crew members may use the system for information support according to their areas of responsibility. In contrast to the first situation, the questions listed are governed by fewer strictly defined rules, and in this situation it is not so much the analysis of all sources that is important but the responses to specific requests. In addition, the system is useful to the master at this stage. Since the master is responsible for the crew actions, he needs to check the integrity of the work even in areas where his competence is limited. The advising system effectively performs such checks by searching only for important information without the necessity for the mater to analyse a large amount of data.

While the preparation and certification of crew members, the system provides substantial assistance both to crew members checking or deepening their knowledge in certain areas and to certifying persons to check crew knowledge. In addition, at this stage the user can be also represented by a shipping company that monitors what competencies the crew should have in accordance with current international and local standards.

Finally, in order to moor a ship, it is necessary to prepare it according to the rules of the host country. For this purpose, the system is used by both crew members and representatives of the shipping company responsible for preparing the vessel for the voyage.

B. Goal and tasks

The main purpose of the system is to provide information that responds to a user request, which contains a description of a certain problem situation or specific question. To achieve this goal, it is necessary to solve the tasks of analyzing the request, formalizing the situation corresponding to the request, searching for a precedent for such a situation and relevant regulatory documents. If there is no such precedent, it is necessary to refer to the entire body of the regulatory documents.

Formally, advice generation task can be posed as follows:

$$D = \langle F, O, X, G \rangle \tag{1}$$

Here F is a task formulation including a description of the problem, definition of the goal and the result form. The task is represented by a user question related to the operation of the vessel and somehow reflected in the regulatory documents. The question is formulated in a limited natural language and the problem is formalized as some semantic structure. In general, the aim of the system will be to find the most consistent answer based on the analysis of the situation, search for a precedent and, if necessary, search in the corpus of all regulatory documents on ship operation. Presentation of the result is most preferable in the form of a coherent answer to a question in natural language with references to the documents on the basis of which this answer is drawn up. In this work we will limit ourselves to present quotations from sources containing an answer to a question with references to documents.

O - a set of possible options from which the choice is made in the absence of precedents, or if there are several similar, but not fully corresponding to the initial situation. Answering the given question the system will carry out search both in set of formalized situations - precedents, and in the whole set of available documents. Therefore, in the broad sense, a set of options will constitute the entire body of texts or the entire knowledge base, in some way formed from such a body.

X - a formalized description of situations - precedents. Since the solution is to search for some textual information, case studies will include semantic structures of texts describing situations as well as structures of documents related to these situations. Semantic design technologies are used in this subsystem.

G - conditions that restrict the search area. An example of such a restriction is the restriction of information sources. In particular, when entering territorial waters, local rules will dominate international rules, which may be temporarily omitted or treated with less priority.

Problematic situations related to the safe operation can widely range both in the extent and content. The main feature distinguishing the problem being solved is the possibility to formulate the question in natural language, which answer is somehow presented in explicit or implicit form in the convention texts. Nevertheless, the question can be both very generic (e. g. “Which scope of competence should the master possess?”), or very concrete and contain a direct answer in the text (e. g. “What length should mooring lap have?”).

C. System functional blocks

Fig. 1 shows the conceptual scheme of the system identifying main functional blocks that implement the described process of developing the council.

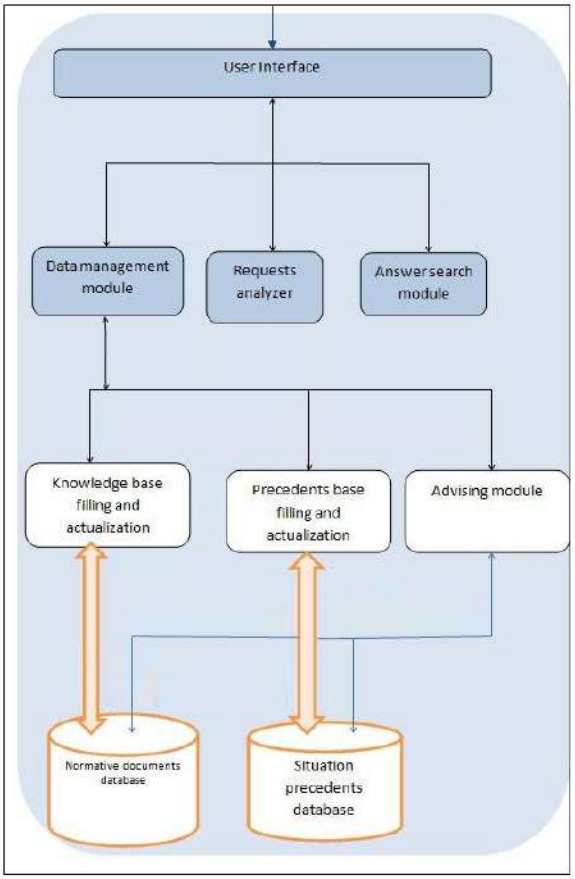

Figure 1. Conceptual scheme of automated system

As the given system co-operates with the user, as well as any similar system, it contains the user interface. The interface problem includes development of communication between the user and the system. The system contains data management module, requests analyzer and answers search module. Each of these modules provides both functioning and support of corresponding knowledge bases, and search and construction of the answer responding to the users request. The requests analyzer aims to perform semantic analysis of a user request presented in a limited natural language, to build request's semantic structure and to search for a precedent corresponding to this request.

Precedents data base and normative documents on ship operation upload is carried put through data management module. It is necessary to store initial documents in the formalized form as some knowledge base on which effective search will be carried out. Besides, as documents are periodically updated, it is necessary to have a possibility of documents verification and loading in a knowledge base. This module converts documents into knowledge, solves the tasks of storing documents, converting them into knowledge and storing transformed data. One of the most important functions of the given subsystem is filling, actualization and support of precedents database according to precedents model.

III. Conclusion

Safe fleet operations is an important task from the point of view of both environmental and human life protection. The importance of the task is confirmed by the abundance of rules and documents regulating this activity. For practical application such volume of data is redundant and brings with it certain difficulties related to analysis of all available information. The application of intellectual systems based on semantic technologies will make it possible to cope with this problem.

The field of application of this consulting system is quite wide. It will allow shipping companies to significantly reduce preparation time for vetting, as well as quickly and easily check compliance with the norms of the host country. Such system may also help in resolving disputes arising during inspections. Finally, the intelligent system can be used in crew training.

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Информационно-советующая система для безопасной эксплуатации судов

Караева Д.А.

Безопасная эксплуатация судов требует выполнения многих правил, регламентированных утвержденными документами. При подготовке судна к рейсу или его эксплуатации необходима актуальная информация о действующих регламентах по безопасной эксплуатации, объем которой может быть весьма значительным. Существенную помощь пользователям может оказать автоматизация процедур поиска и выдачи необходимых данных и документов.

В статье описан подход к созданию информационно-советующей системы по безопасной эксплуатации судов, основанной на семантических технологиях. Описаны пользователи системы и их основные информационные потребности. Определены задачи, решаемые системой. Приведена концептуальная схема системы. Наличие подобной системы позволит ускорить и упростить получение релевантной информации.

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