

Conceptual Design on the System Architecture of Intellectual Export Control System (IXCS)

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1. Introduction

Korean export control system on nuclear items has been established by 'Notice on Trade of Strategic Item' [1] of Foreign Trade Act [2] reflecting NSG (Nuclear Suppliers Group) Guidelines, after joining NSG in 1995 (NSG is an international regime to prevent proliferation of nuclear weapons).

Export control system in Korea consists of two parts. One is the commodity (goods and technologies) classification and the other is the export licensing. The commodity classification is for identifying strategic commodity, and the export license is for verifying that exports have met the requirement by the national legislation following international obligations (i.e. NSG guidelines)

Since 2008, the 'Nuclear Export Promotion Service (NEPS)' System has been used as a total IT system providing various functions for exporters and reviewers.

However, reviewers who make the decisions for commodity classification and export license, may have difficulties caused by ambiguity of criteria. For example, it is not sure whether a CVCS (Chemical Volume Control System) of a certain nuclear reactor plant belongs to strategic commodity or not. The NEPS is a useful system helping users save their time, but it cannot provide solutions reducing ambiguity of each classification or license case.

To solve these problems and provide more efficient ways to their decisions, various intelligent IT solutions are searched and studied.

2. Analysis Results

2.1 Requirement Analysis

The advanced system to help reviewers is named as IXCS (Intelligent eXport Control System) and was planned to be developed separately with the current NEPS system.

To build this system, the requirement analysis was performed as a first step.

The results showed six requirements for examiners. First, the efficiency and accuracy of the retrieval from existing decision case must be increased. Second, the decision 'know-how' of experienced reviewers need to be transformed to tangible assets. Third, enormous amount of related documents and explanation materials submitted by exporters should be analyzed preliminary by system, so that the reviewers can make a better

decision. Forth, a terminology dictionary and thesaurus dictionary on nuclear industry are needed to find the proper words in national legislation guidelines corresponding to field terminology used by exporters. Fifth, an image comparison and search engine must be included in documents analysis system, because generally the images may have much more information than text. Sixth, integrated information must be provided about export denial of NSG member states including USA. The denial information and database are scattered in separated websites, hence, it is inconvenient to use that information.

Fig.1 shows the conceptual diagram of IXCS to meet these requirements.

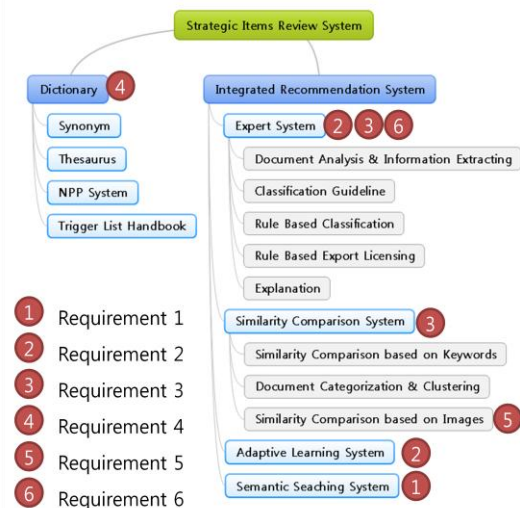


Fig. 1. Functional Tree Diagram of IXCS

2.2 Architecture of IXCS

After the requirement analysis, decision criteria were improved by specialization and systemization. Then, the newest IT technologies are reviewed to find the best technological combination, such as text mining, expert system, ontology technique, and neural network, and etc.

Fig. 2 shows the functional architecture of IXCS as the result of conceptual design.

IXCS has totally 15 databases, and 9 subsystems. The DB systems are the export denial lists, positional information such as Google map, application document, nuclear plant system explanation, the notice on trade of strategic item, technological specification, synonyms

and thesaurus dictionary, NSG Trigger List explanation [3], export control information of each countries, terminology dictionary, open materials and documents, review examples, EDP(especially designed or prepared) criteria, design and construction flow-chart, and image database. The 9 subsystems are image comparison system, image preprocessing system, text mining system, open material preprocessing system, text preprocessing system, expert system, adaptive learning system, semantic searching system and result generation system as shown in Fig. 2.

Fig. 3~6 shows the conceptual design of main modules of subsystems and necessary DB systems. These system modules should also operate independently with the whole IXCS. The image comparison module needs image preprocessing subsystem to eliminate the unnecessary noises such as captions, centerlines, dimension lines, and etc. Text mining module needs preprocessing of text and open materials. Text information from various forms (MS-word, pdf, hwp, etc.) is extracted and processed to database. The open material preprocessing is also necessary for text mining because published contents are not regarded as strategic item. Data from websites (Google, Naver, Daum, etc.) are migrated to this system and processed to database. The expert system module is a key system to convert the intangible ‘know-how’ of skilled reviewers to rule-based knowledge, and will help reviewers follow systematic and objective processes. Adaptive learning system will optimize the decision processes and make the decision efficiency be maximized by machine learning algorithm. Similarly, semantic searching module will be used to increase the searching efficiency of the whole IXCS.

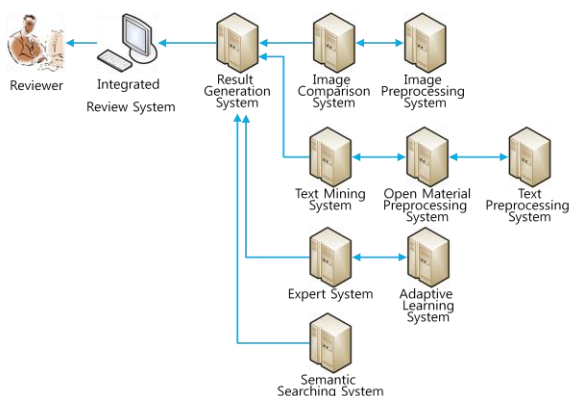


Fig. 2. Functional Architecture of IXCS

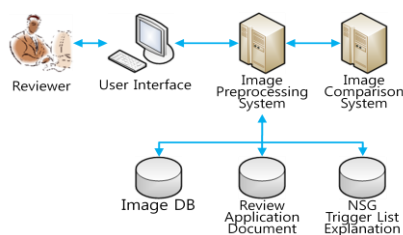


Fig. 3. Image Comparison Module of IXCS

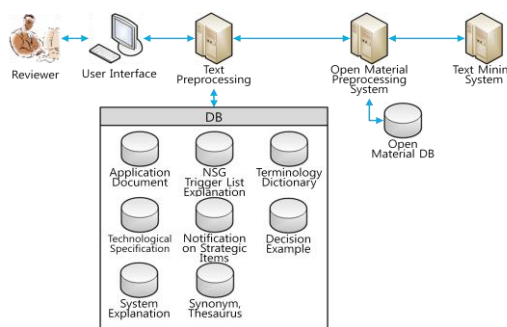


Fig. 4. Text Mining Module of IXCS

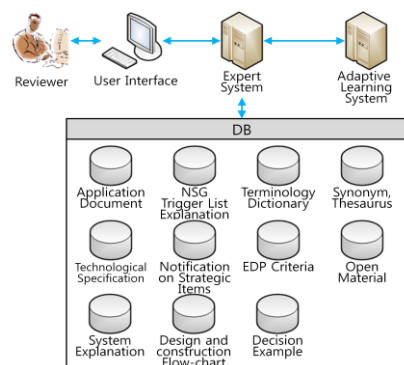


Fig. 5. Expert System Module of IXCS

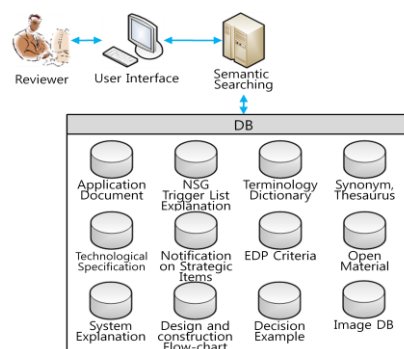


Fig. 6. Semantic Searching Module of IXCS

3. Conclusions

A functional architecture of IXCS is defined and designed conceptually. This conceptual design will be utilized to make database specification and to find the optimized artificial algorithm for review processes.

REFERENCES

[1] Ministry of Knowledge and Economy, “Notice on Trade of Strategic Items”, Notice No.2011-47, Mar.16, 2011.
 [2] The National Assembly of the Republic of Korea, “Foreign Trade Act”, Act No.10231, Apr.5, 2010.
 [3] U.S. Department of Energy/National Nuclear Security Administration, NSG Trigger List Handbook.