# Study on Efficiency Improvement of Strategic Item Classification Through Intelligent System

Seung-hyo Yang, Sung-ho Yoon, and DongHoon Shin [*]

Korea Institute of Nuclear Nonproliferation and Control (KINAC), 1534 Yuseong-daero, Yuseong-gu, Daejeon, Korea

[*]nucleo@kinac.re.kr

## 1. Introduction

Korea has strictly adhered to procedures such as Classification and Export License according to the Foreign Trade Act [1] on strategic items. However, there are various problems such as delay in processing and inconsistency of results when a limited reviewer processes Classification to determine whether it is strategic item for thousands of goods and technologies included in a nuclear power plant.

Intelligent System for Strategic Item Classification (ISSIC) applying latest artificial intelligence technology such as expert system, text mining, and deep learning technique has developed in order to process more quickly, minimize deviation of the results and ensure consistency in similar cases.

## 2. System structure and development results

### 2.1 Overall system configuration

ISSIC consists of Classification Expert System to systemize the know-how of the Classification reviewer, Similar Case Searching System to search for similar cases using text and images included in the application documents, Open Data Search System to automatically collect open documents on the web and compares the similarity with the application documents to determine whether they are open or not and Export Control Semantic Search System to provide one-stop searching service of various export control related materials, as shown in Fig. 1.



Fig. 1. Main screen.

### 2.2 Classification Expert System (CES)

Expert system is a system that solves problems similar to experts by systematizing expert knowledge, experience and know-how of experts. In order to develop this system, know-how of Classification review was analyzed through interviews with reviewers who had many years of experience.

As a result of the analysis, the examination of Classification was derived in the following 4 steps. (1) Search for export control items related to application technology (2) Confirmation of exclusion of strategic technology according to relevant laws (3) Review of special examination requirements (4) Analysis of type and key factor of application technology [2]. By implementing the analyzed review procedure using web programming, CES can be easily accessed by a web browser. This system induces the implementation of the same Classification procedure for each reviewer and makes it possible for beginners to review at the level of experienced reviewers.

It is possible to trace the whole classification process by database and to automatically generate the draft of the review report, which can shorten the report writing time by at least 30% with this system.

### 2.3 Similar Case Searching System (SCSS)

Applicants frequently apply for a Strategic Item Classification of similar documents repeatedly in order to export thousands of documents contained in a nuclear power plant. Maintaining the consistency of the classification results of similar documents is very important for securing the reliability of the classification. Until now, the scope of the search for similar cases was very limited because the application documents can be found based on document file names.

SCSS has developed to search similar documents with texts and images included in application documents as well as document names. SCSS automatically extracts key words related to nuclear and export control from the

application documents and calculates frequency of key words. The similarity of the document is calculated by using the TF-IDF (Term Frequency - Inverse Document Frequency) method, which is often used in recent data mining techniques.

In addition, image similarity comparison function using Hog and Deep Learning has developed to compare similarity of images. Based on the HoG algorithm, black and white images such as design drawings are used to extract specific values of an image and calculate the similarity using the k-NN method [3]. The color-based image extracts a specific value of the image using the deep network-based residual network (ResNet) [4] and calculates the similarity by the k-NN method.

SCSS allows the search for similar documents based on the contents of 16,000 documents submitted during the period, and the search time is about 3 minutes.

### 2.4 Open Data Search System (ODSS)

The domestic law and the international export control system apply the principle to do not control the technology already open to the public. Therefore, the technology that has already been released is not Strategic Item and no export license is required. It is not easy to confirm whether or not the application document is released except for the documents prepared for the publication of the papers and patents.

ODSS has developed, which collects publicly available nuclear data and compares similarities and confirms whether they are open to the public. The public data collection was implemented based on Google Custom Search. The keywords and site information needed for the search were selected and applied through the interview method with the classification experts.

ODDS shows search results within about 5 minutes among a total of 24,191 document files and 18,883 web-based publications collected as of August 2017.

### 2.5 Export Control Semantic Search System

There are many types of data that should be examined for Classification such as export control codes, nuclear terminology information, Denial Lists, national nuclear nonproliferation status, and past review reports. Each data should be searched by keyword. Because there are many abbreviations and synonyms, the search time is delayed and the search range is limited due to iterative search.

First, export control database of export control related domestic and foreign data accumulated over 10 years has been created. In addition, a semantic search function is constructed that automatically analyzes the synonyms related to the input keywords by applying the nuclear export control ontology and searches all the export control related data at once. ODDS is expected to reduce the processing time of classification considerably because it can search all export control related data in real time at once.

### 3. Conclusion

With the development of ISSIC, processing time of classification has been drastically shortened through real-time similar case search function and the consistency of classification result has been improved through the expert system that systemizes the examination know - how. This will support the timely export of nuclear power plants and improve the credibility of Korea's nuclear nonproliferation through the implementation of thorough strategic export controls

### REFERENCES

[1] The National Assembly of the Republic of Korea, "Foreign Trade Act", Act No. 13838, Jan.27, 2016

[2] Seung-hyo Yang, Jae-woong Tae, Dong-hoon Shin, "A Study on the Systematization of Classification Process for NSG Trigger List Items", Transaction of Korean Nuclear Society Spring Meeting, May.30-31, 2013.

[3] Altman, N. S., "An introduction to kernel and nearest-neighbor nonparametric regression". The American Statistician, 46 (3): 175–185, 1992.

[4] K. He, X. Zhang, S. Ren, J. Sun, "Deep Residual Learning for Image Recognition", arXiv: 1512.03385v1, Dec.10, 2015.