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A Conceptual Design of a Organizational Hazard Analyzer based on Business Process Modeling and Data Mining Filters

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1. Background : Operational Efficiency and Safety Culture in Nuclear Power Plants

O&M potion of generation cost is drastically increased to more than 60% over the remainder of the capital and fuel. The operational efficiency of nuclear power plants (NPPs) becomes a main technical challenge against to the many requirements from various perspectives as well as from safety concerns. Operational efficiency should be dependent on the sensing and data processing, and finally upon the decision makings conducted by the organizational staffs informed by the processed data. Many emerging technologies from data processing and business process modeling (BPM) and people analytics could support the operational efficiency and the profitability of NPPs.

This research is focused to the development of a new technique and a solution for detecting operational hazards and analyzing plausible countermeasures in organizational level. It will incorporate the business process modeling and data processing filters.

2. A Conceptual Design of Organizational Hazards in Nuclear Power Plants

2.1 Engineering Approach to the Safety Culture with Organizational Hazards Analyzer

Nowadays the NPP operation is frequently interrupted by the various new concerns, and the efficiency of NPP operation sometimes hindered by the minor disturbances. After Fukushima accident the safety culture becomes highlighted as one of the crucial tasks in nuclear systems. There still remain quarrelsome to monitor and intervene the human behavior for preventing inappropriate organizational behaviors after many non-compliance issues raised, especially Kori #1 event in Korea.

Those concerns frequently come from internal and routine processes that staffs in NPPs select during their works. They can be managed proactively if a support gives us a flag/cues for the possible happening of potential hazards.

The module proposed in a conceptual scheme of Figure 1 could be utilized for monitor the organizational effectiveness as well as operational efficiency.

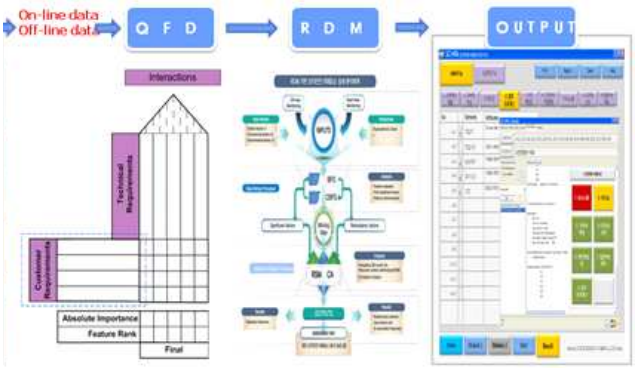

Figure 1. A Conceptual scheme of Organizational Hazard Analyser

2.2 QFD for Organizational Hazards Analyzer

To detect any operational hazards, the operational uncertainty and reliability can be defined based on the discrepancies of tasks from the prescribed requirements. QA requirements and the stake holder expectations described in the many concerning information could give a reference/criteria to the hazard. The deviations from the requirements are structured in form of QFD (quality factors deploy) into the entry step of monitor for the hazard analyzer.(see Figure 2)

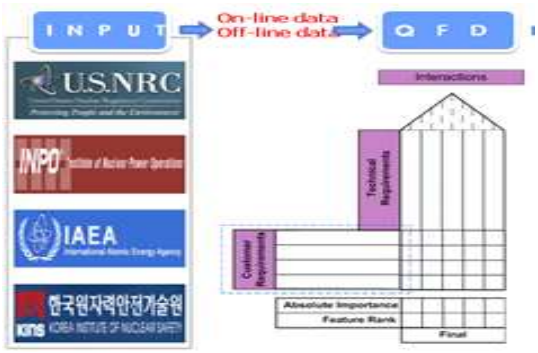

Figure 2. Requirements and QFD

2.3 Data Mining for Hazards Analyzer

Many unstructured operational data will be utilized such as amount of work applied in practice. Those are the temporal and qualitative punctuality of tasks from the plan, and other organizational information. The detections through the data filters are utilized as interrupts and/or additional observation points to the on-going tasks and decision makings.

Figure 3 shows RDM (robust data mining method) using RSDM (Response Surface Data Mining) and CBFS (correlation based feature selection). Figure 4 shows a conceptual scheme incorporating the analysis steps for causality, criticality, and others for hazard identification.

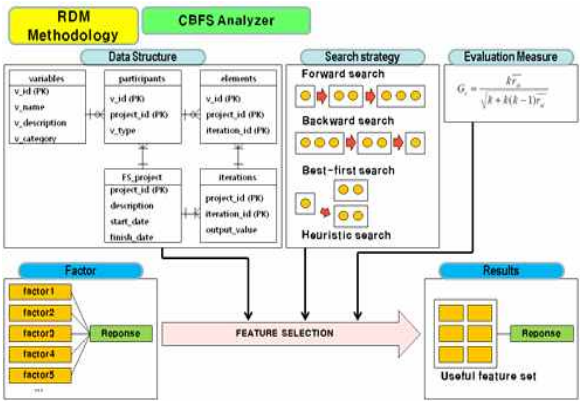

Figure 3. Application of RDM/CBFS Logics

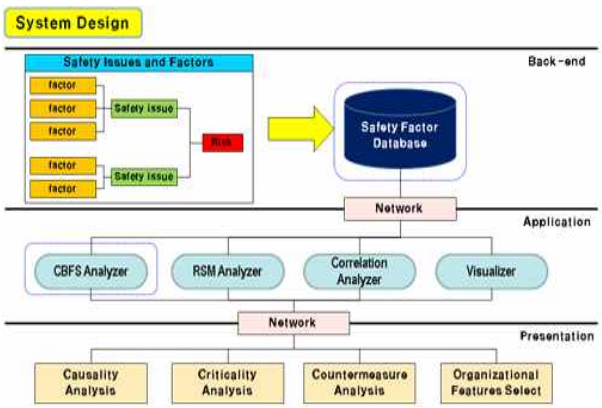

Figure 4. A Conceptual Scheme of Filters/Analysis

2.4 Use of Surrogate to the Hazard identified

With the support of the hazards identified from the retrospective cases, possible countermeasure for can be specified proactively. Most countermeasure could focus to the hazard itself based on the information and data for the previous identification. Surrogates rather than the hazards and their causal defects can be obtained alternatively through data analysis in practice (2010, Lee and Shin).

3. Applications and Further Works

This paper proposed a conceptual configuration for the development of a new technique and a solution for detecting operational hazards and analyzing plausible countermeasures in organizational level for the enhancement of NPP operational efficiency. It will incorporate the business process modeling including QFD of safety QA and data processing filters such as RDM/CBFS.

A support system are required for facilitating cooperations. However any additive work gives no merit to operational crews and managers but a burden to prepare and manage. The proposed system will effectively and proactive supports any collaborative point required. It should provide a foundation enough to make wider enhancement of operational management for ultimate efficiency of NPPs. We can determine if the hazard analyzer proposed here works for the operational efficiency since methods such as business process modeling, data mining and robust response surface method, etc. have been proven to industrial engineers. I think more cooperative development between operational and managerial sides of NPPs could work for safety culture as well as operational efficiency.

4. References

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