The interface optimization of radioactive waste management life cycle processes using big (meta) data profiling and mining

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1. Introduction

As a part of a decommissioning, IAEA has developed the L&IL radioactive Waste Management Life Cycle Process (WMLCP)[1], involving pre-disposal, disposal and its supporting utilities. Recently ISO is developing the Part-1 fundamental requirements[2][a] that could be applied to the L&IL radioactive WMLCP as de-facto standard.

To optimize the interfaces among all the waste management processes described in paragraph above, this paper provides the philosophy of establishing the bigdata platform of *m-Trek*® [4] [b] based on the management aspects in Table 1, described ISO NP 24389 Part-1. (See Figure 1 and 2), which is eventually reasonable way to share this information for process interface optimization.

Table 1 the aspects of metadata[2]

Management topics	Detail topics	meta Id
Quality	Quality Assurance/Quality Control, Configuration Management (CM), Process Control Program (PCP), Data Quality Objective (DQO)[6]	QuaMet
Process	Predictability, reliability, traceability, justifiability	ProMet
Technology	technologies involved in radioactive WMLCP	TecMet
Resource	Equipment, container, facility, personnel, and any other objects	ResMet

2. Data and meta data profiling

The simple definition of metadata is "data about data". Although it may seem a superficial statement, it nonetheless captures an important point: that metadata provide some additional description, context or supplementary information about existing data[3].

ISO NP 24389 Part-1 considers the general management requirements such as the quality, the process, the technical and the resource management. Based on these management aspects, *m-Trek*® analyzes and collects the meta data for each process as indicated in Table 1. In this paper, *ResMet* and *TecMet* are primarily addressed.

2.1 ResMet (Typical)

To collect and accumulate the meta data for resources management (*ResMet*) in radioactive WMLCP, it demands that all the stakeholder's resource be declared, released, and collected for resource sharing that is one of the critical issues for optimizing the interface among the L&IL radioactive WMLCP. Thus, all the data for each meta data profiling Id needs to be analyzed thoroughly.

Most of these profiling has been established with DB schema design and typical instantiation in *m-Trek*®.

2.2 TecMet (Typical)

TecMet is the measurand data profile encapsulated with meta data for technologies that is to be involved in radioactive WMLCP, which is closely coupled with the compliance of waste certification to disposal.

Some of the data category examples of the technology management could be the topics as below typically;

(1) characterization
(2) scaling factor
(3) metal and concrete's irradiation distribution data
(4) characteristic testing of treated radioactive waste (ex. solidified, vitrified etc.), and any others

With the meta data, to enhance the reliability of measurand data during waste management processes, ISO NP 23580[6] is trying to establish the systematic process to collect the data through DQO process. Also, this data could be reformulated to a basis for (Standard Reference Data) SRD [c], and finally be the bigdata platform for waste management [7]. See Figure 3.

3. The optimization of waste management process

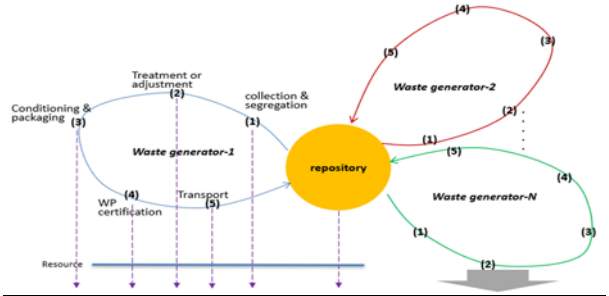
The degree of the optimization between radioactive waste management process is obviously dependent on the sharing of data and meta data overarching radioactive WMLCP. Data and meta data vary according to the position of stakeholder, for example the law, notice and discipline, regulation and the practice of waste generator and disposal.

3.1 Resource sharing strategy and implementation

Figure 1 shows overall strategy for sharing of resources information that is to be needed during the radioactive WMLCP. It assumes that each waste

[a] Under development by author leading in ISO TC85 SC5 WG5, which is composed of Part-1 through Part-4.
[b] R&D project under development with the support of KETEP by author.
[c] https://www.srd.re.kr:446/main/page.do

generator and disposal site owner (stakeholder) are willingly to declare, release the resource information, and access to the independent web server system to collaborate with each other to implement the integrated radioactive waste management policy in national level.



The schema and instantiation for meta data profiling,

Figure 1 Resource sharing strategy

Once this strategy is setup, system development and implementation proceed in transparent and straight forward way repeatedly. Resource sharing is a comprehensive approach for the interface optimization, and some type of meta data and its operation have been launched in *m-Trek*®[4] as one of the independent functional units.

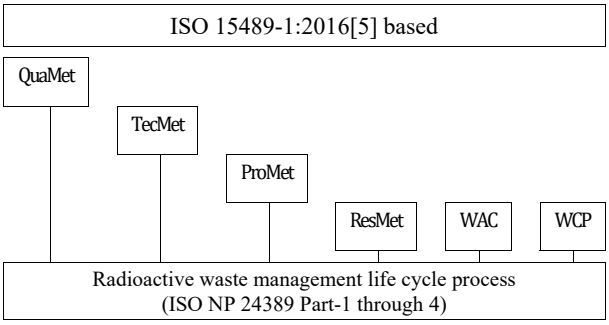


Figure 2 Big (meta) data topology with WTS

The meta data in Figure 2 has topology to interface with Waste Acceptance Criteria (WAC) and Waste Certification Program (WCP) to evaluate the compliance of waste to disposal, which is organized for patent application.

3.2 Process optimization based on Artificial Intelligence (AI) engine

To achieve the optimization of waste management process such as treatment, transport and/or disposal, there will be an attempt to utilize the technologies like mining and deep learning of the bigdata between processes, including the statistical analysis and TensorFlow for example (See Figure 1). The bigdata is composed of technical data and SRD, and its meta data to make bigdata more reliable.

Domain system analysis in detail level needs to be done to design the schema, which is core activities for organize the bigdata platform in Figure 3 for waste management processes.

It is more important to manage through bigdata platform including meta data, SRD and deep learning the data rather than to experiment for simply collecting data.

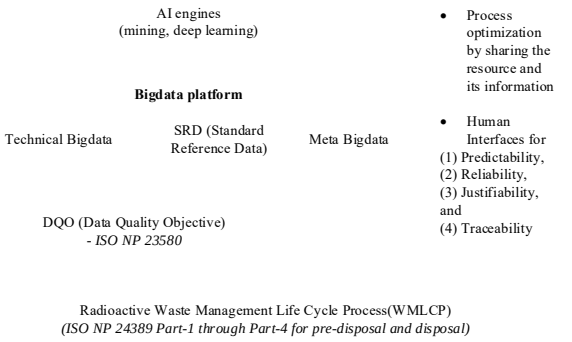


Figure 3 bigdata platform layout

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4. Conclusions

To provide the optimization such as predictability, reliability, justifiability and traceability among the radioactive waste management processes, a part of the bigdata platform and the analysis for information sharing is implemented, and in future it will be extended to use AI technologies to respond to specific customer's needs.

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