

# XML Description for materials database sharing

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## 1. Introduction

We have examined sharing technique or data expression methodology of material property data of material database as common property, which is currently built. The material database exists widespread in the world. Though arrangements of those guideline for building database or standard for material data markup have already been established, data retrieval from the dispersed database, and a common procedure for practical use is still under a grope. So, developing a common or standard procedure for data exchange system is required.

## 2. Activities for Database

We have examined for a method and process of sharing a material database as a common property (Fig.1). It includes;

### 1) Activities for VAMAS

- The VAMAS activity which aim at international cooperation to standardize the examining method and evaluation of advanced material.
- And in each TWA, which is VAMAS technical working area, here we focus on “computerized material property data” (TWA10). Especially in TWA10, we examine the description of material database by XML.

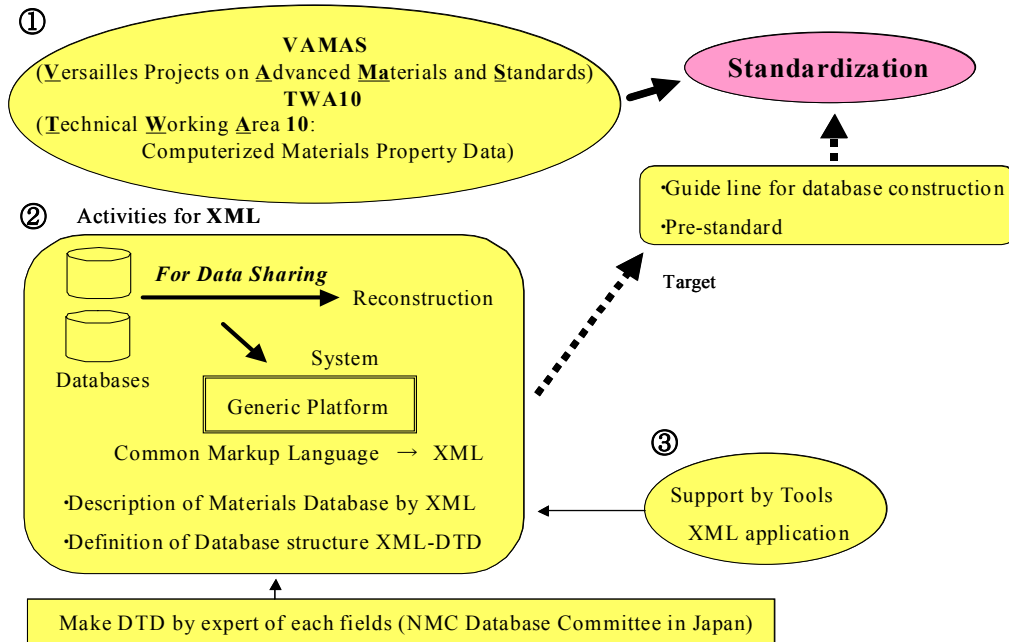


Fig.1 Activities for VAMAS and Database.

## 2) Activities for XML

Regarding this TWA10, in Japan

- We have reconstructed and redeveloped existing database for the purpose of sharing material database.  
As a process for sharing,
- A material database is shared on the generic platform (system).
- XML is used as a common markup language of material database, and XML – DTD is used to describe and define the structure of material database. Specialists in the NMC database committee are in charge of examining those subjects.

## 3) XML application

We also have produced a trial of XML application to support XML description of material database. It is to examine the application and use of XML - DTD.

As a result of this project about XML of TWA10, eventually we are going to develop a guideline, make a pre-standard, and standardize material database.

These are what we Japanese researchers have done in this area.

### 2.1 Activities for VAMAS

We would like to tell you about our VAMAS projects in material database.

So far, we have conducted activities such as,

- in 1997, restarted the database related activities,
- in 1998, participated in the workshop, ASTM-NIST,
- in 1999, commenced an XML related activity,
- in 2001, two VAMAS workshops, entitled as “the generic platform for the material database” were held in February and December, and in addition, participated in NIST-MatML workshop, which is related to the description of the material database, and CODATA conference as well. Recently, we held a meeting with a useful discussion about the future of the database in Japan.

We have actively participated and held those events of the material database in Japan and abroad.

### 2.2 Activities for XML

On the other side of the VAMAS TWA10 project, in Japan we have examined to reconstruct the material database and to develop with XML. As for sharing of the database, we

- set up a steering committee to discuss about the database,
- improved and reconstructed the database,
- examined the technique to utilize the database as a common property,
- as a result of review, developed an XML-based database and database description,
- defined its data structure by XML - DTD,  
by way of XML description, developed the data structure and defined its definition,
- framed basic structure of the database and structure of specialized field
- and developed a module with the basic structure, as a descriptive method for database sharing, and also a module with a structure which is peculiar to a specialized field.

□EBy the way, examining MatML<sup>1)</sup> of NIST as the basic module, so called kernel, of the material database is included here.

Up to now, the member of XML-DTD working group of the NMC database committee have developed XML - DTD files of each fields such as ceramics, powder sintering materials, heat resistant materials and those properties like creep and fatigue. Also, we have been comparing Japanese-made basic module and the kernel MatML of the material database. Up to this point, resulting the examination about XML description of database, NMC database committee has<sup>2)</sup>;

- choose to use tag as the property name of materials,
- and fixed the property name by tag.
- Tag has a long name
- and many of them, which exceed more than a thousand.

- A user can do a data retrieval by tags.

On the other hand, MatML is used

- to describe the property name of the material as an element data,

- and it can easily describe data on the XML file.

- Tag name is simple, and

- has no fixed property name,

- and not so many of them, which is 39.

Apparently they differ in that a property name is used as tag for NMC, and it is an element data for MatML. Also, a large difference is seen in number of tags to express a database. To date, we have obtained results as such. Therefore, we need a careful discussion to deal with MatML as a kernel of the material database in future. Up till now, We mentioned the results of examining the description method of the database with XML.

### **2.3 Database sharing on generic platform**

The concept of the database sharing using XML is shown in Fig.3. Here we are going to talk about a concept of using database on the generic platform.

- It is about to develop a module of the basic structure which is the kernel of the material database.

Members of NMC committee use ASTM Database Standard.

In future, MatML, shown in the figure, is to be examined.

- Developing a module of the data structure which is particular to each field of material.

It consists of the member of specialists in NMC committee.

- To customize both the basic module and the one particular to specialized field.

There is an expansion in XML description.

- If necessary, add the module which is common to the fields of study.

Add common parts such as test method and unit.

- Use customized XML-DTD as a database template.

The module of the specialized field is added on to the basic module for expansion and customization.

- A database is used on the generic platform with a template.

For the system of reflecting this XML-DTD, we have been in development. Also in this system, XML-DTD is reflected. So much for the report of activities which is going on in Japan at other side of VAMAS TWA10 project.

## 2.4 XML application

Next, we explain a practical example with XML.

Here, pay attention to material property data (creep data),

- Material information gained as a result of creep test,
- Structure of the material information,
- Unique description about creep data, Parallel, Conciseness, Complex

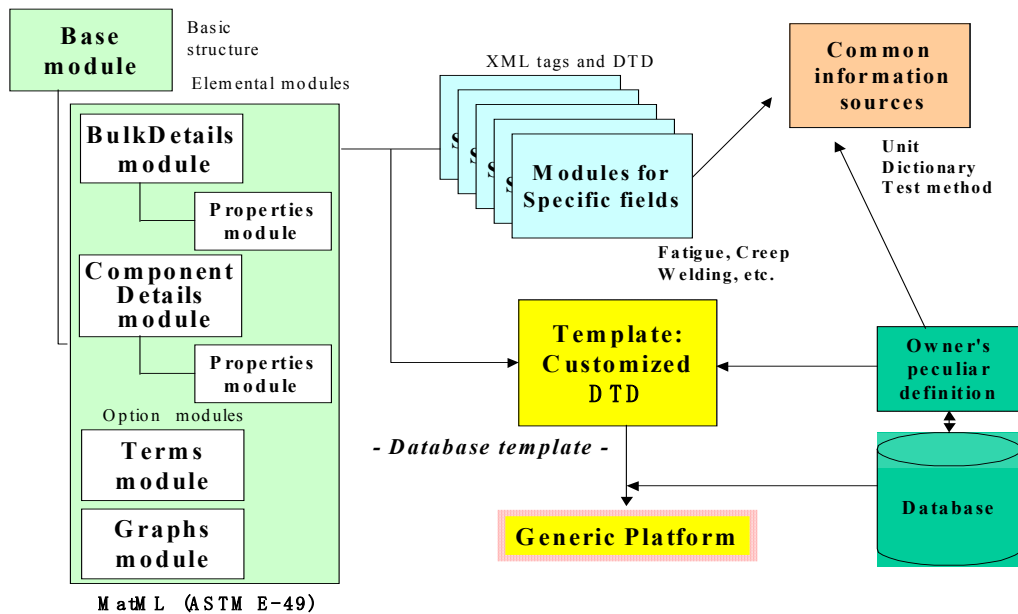


Fig.2 Database use on generic platform by XML,DTD

- Indication by the template of creep data,

These examples are explained by XML. These are hierarchy of information in regard to creep property. The rough information about creep property is shown in Fig. 3.

- Not only fact data, a test result like rupture time, is included in the creep data.
- There are data in which the test results were analyzed.

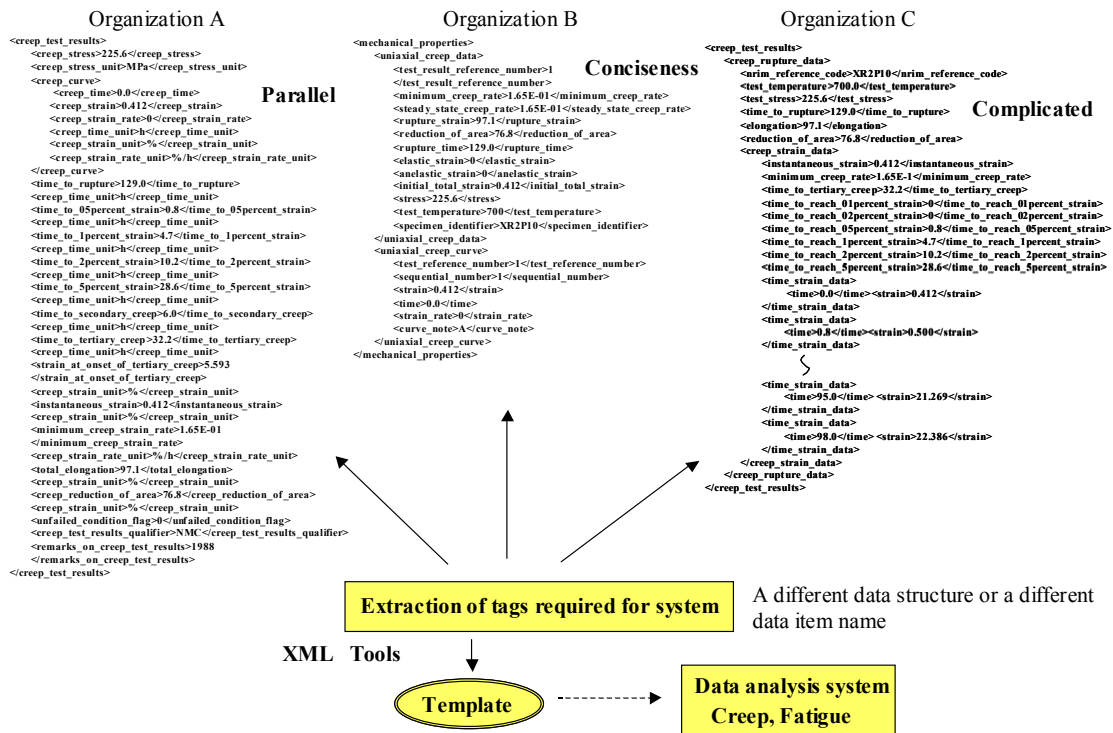


Fig.3 Flow for the data share which used XML

- The analyzed data contain various information from different fields of study such as design, creep deformation or microstructures.
- Each field has deep and complicated tiers of data. In design field, for example, it contains the information on technical analysis (TTP method) and log-term strength.
- These structures are described by XML (Fig.3).

These are information obtained from various fields, and each has many tiers and they are very complicated. To cover all these information, you need a considerable amount of work. Also, in case of describing XML, an introduction of the knowledge by the specialist of the field is necessary. This shows a flow about the data sharing in which XML was used on the basis of the data on the result of creep rupture test. This example shows that even the same property has different data structure and description according to the application technique employed at each institute. The example of the data structure built in some organizations is shown in Fig. 3. These structures vary in style of description such as parallel, conciseness or complex, respectively. This is one of the reasons a common format needs to be developed.

We show you an example of indicating data with different structure with XML - DTD (templates).

Based on the template, which can be a base of creep rupture data, data structure is transformed by XML and XSL to the styles used at each institutes (Fig.4).

- A basic creep data is described in XML (data extraction).
- A template (DTD) for data utilization is developed.
- An XSL for using DTD of the data structure is developed.

Likewise, the method in which XML-DTD are used can be transformed to the style of which is required at each institute.

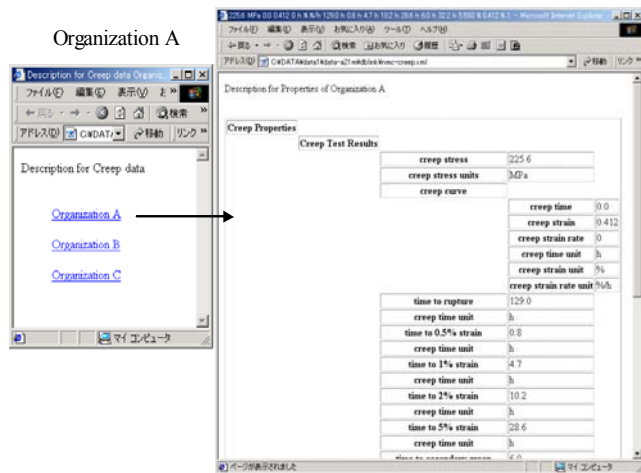


Fig.4 Display of property data by XML,XSL

### 3. Conclusion

To use XML in actual situation,

- It is possible to define the result of creep data in DTD and use it as a template.
- Having the template of the database makes it possible to convert it into the style which is adequate to each institute.
- At data analysis, having a template in which a necessary data item is extracted can expect data supply to individual systems.

As an overall summary, only an creep data, an example of XML utilization in a limited field was employed here. In material database, information regarding material is situated above property information. For database sharing, a through examination of the method is necessary.

- The examination of the basic kernel of the material database.
- If you think of a database system, the way of data retrieval is to
  - search by tag name,
  - by data in the element, and so on.

There remain some issues to solve like such.

- In future, a through examination is necessary to propose DTD, which is developed at each field, and template as the guideline or a pre-standard of building a database.

### Reference

- 1) <http://www.nist.gov/matml.html/>
- 2) NMC DTD-WG, Workshop Report, The second VAMAS Workshop, Dec. 2001