



Development of Knowledge Base System Linked to Material Database

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Background

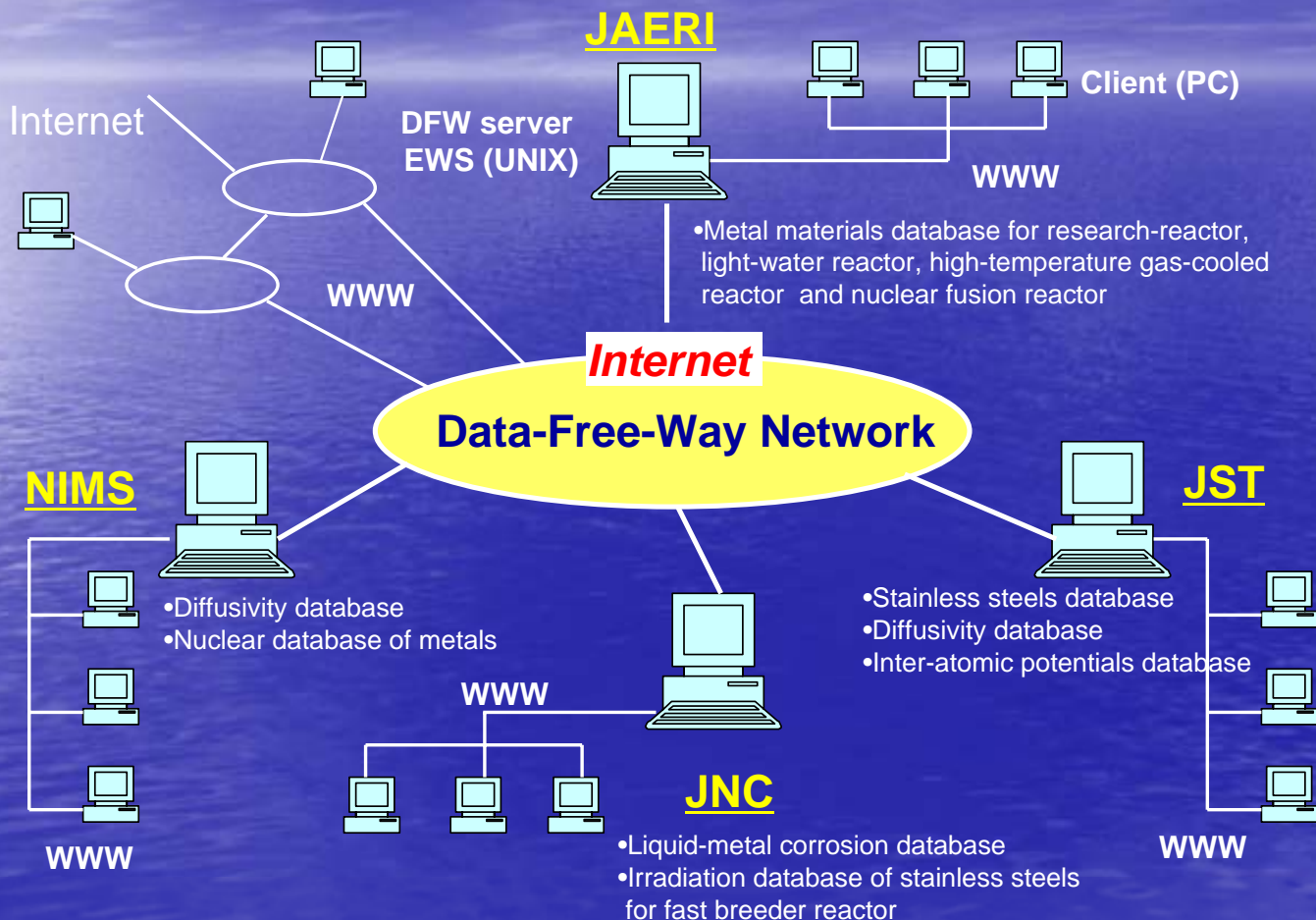
The distributed material database system named “**Data-Free-Way**” which can be shared from the Internet has been developed under the collaboration of NIMS, JAERI, JNC, and JST. In the system, the retrieved results are displayed as tables and graphs, and the users judge the meaning of the retrieved results.

If the meaning of the retrieved results and the analyzed results are stored as knowledge, the system becomes more beneficial for many users. Therefore, in order to create additional values of the system, **knowledge base system**, in which knowledge extracted from the material database is expressed, is planned to be developed for more effective utilization of Data-Free-Way.



Present Status of Data-Free-Way

- Networking Overview of Data-Free-Way System -





Present Status of Data-Free-Way

- Status of stored data in four organizations -

Organization	Status of data input	Data
National Institute for Materials Science (NIMS)	Creep, tensile and corrosion properties of superalloys at elevated temperatures in air, helium and hydrogen	1000
	Creep and tensile properties of stainless steels	500
	Mechanical properties of Ni-based superalloys	1000
Japan Atomic Energy Research Institute (JAERI)	Low-cycle fatigue and fatigue-crack-growth properties of low-alloy and stainless steels	1100
	Mechanical properties of Alloy 800H, Hastelloy XR and Cr-Mo steels for high temperature gas-cooled reactor	1500
	Mechanical properties of Al-based alloys for research reactor	500
	Mechanical properties of superalloys	200
	Mechanical properties of irradiated stainless steels	900
Japan Nuclear Cycle Development Institute (JNC)	Sodium-compatibility and irradiated properties of ceramics	1400
	Lithium- /Potassium-corrosion and mechanical properties of metals	600
	Mechanical properties of irradiated stainless steels	500
	Properties and Lithium- /Potassium-compatibility of irradiated Nb- /Mo-based alloys	100
Japan Science and Technology Corporation (JST)	Mechanical properties of irradiated stainless steels	5300



Present Status of Data-Free-Way

— Example of retrieval —

Tensile properties for type 316 stainless steels

Condition items
MATERIAL NAME [Type 316]

Display items
MATERIAL NAME [X] FEATURE OF THE TEST [X]
UPPER YIELD POINT [X] ULTIMATE TENSILE STRENGTH [X]
UNIFORM ELONGATION [X] FRACTURE ELONGATION [X]
REDUCTION OF AREA [X] TEMPERATURE [X]

Retrieve

Standard type retrieval screen

Tensile properties of
type 316 stainless steels

Retrieve



MATERIAL NAME	FEATURE OF THE TEST	UPPER YIELD POINT kgf/mm ²	ULTIMATE TENSILE STRENGTH kgf/mm ²	UNIFORM ELONGATION %	FRACTURE ELONGATION %	REDUCTION OF AREA %	TEMPERATURE °C
1	SPHA	213	262	24	23		20
2	SPHA	221	274	24	23		200
3	SCA-SPHA	223	263	28	28		200
4	SCA-SPHA	26	207	214	24		20
5	SPHA	222	247	28.7	28.7		200
6	SCA-SPHA	214	219	21.9	21.9		200
7	SPHA	234	274	24.9	24.9		200
8	SPHA	207	249	24.7	24.7		20

Result: To [2000] [2000] [200] [200]

Graph: X Axis [UPPER YIELD POINT] Y Axis [ULTIMATE TENSILE STRENGTH]

MATERIAL NAME	FEATURE OF THE TEST	UPPER YIELD POINT kgf/mm ²	ULTIMATE TENSILE STRENGTH kgf/mm ²	UNIFORM ELONGATION %	FRACTURE ELONGATION %	REDUCTION OF AREA %	TEMPERATURE °C
1	SPHA	213	262	24	23		200
2	SCA-SPHA	221	274	24	23		200
3	SPHA	223	263	28	28		200
4	SCA-SPHA	26	207	214	24		200
5	SPHA	222	247	28.7	28.7		200
6	SCA-SPHA	214	219	21.9	21.9		200
7	SPHA	234	274	24.9	24.9		200
8	SPHA	207	249	24.7	24.7		200

Result: To [2000] [2000] [200] [200]

Graph: X Axis [UPPER YIELD POINT] Y Axis [ULTIMATE TENSILE STRENGTH]

Retrieved results



Present Status of Data-Free-Way

- Graphic function -

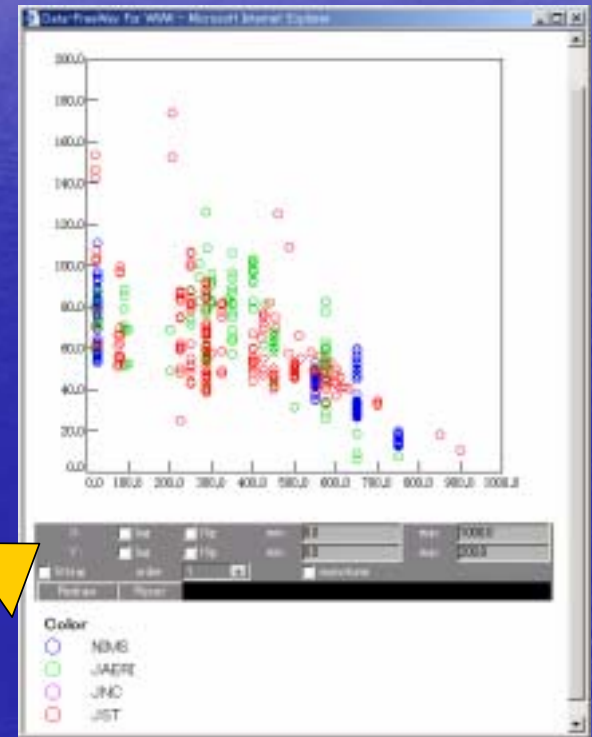
Retrieved results

The screenshot shows the Data-Free-Way interface with a table of retrieved results. The table has the following columns: MATERIAL NAME, FEATURE OF THE TEST, UPPER YIELD POINT, ULTIMATE TENSILE STRENGTH, UNIFORM ELONGATION, FRACTURE ELONGATION, REDUCTION OF AREA, and TEMPERATURE. The data rows are as follows:

MATERIAL NAME	FEATURE OF THE TEST	UPPER YIELD POINT	ULTIMATE TENSILE STRENGTH	UNIFORM ELONGATION	FRACTURE ELONGATION	REDUCTION OF AREA	TEMPERATURE
5	SPK32	313	391	30.3			23
2	SPK32	301	374	34			300
3	SPK32	303	383	28			300
4	SPK32	30	301	21.8			23
5	SPK32	303	341	28.7			300
6	SPK32	312	379	31.9			300
3	SPK32	312	374	28.9			300
8	SPK32	307	349	34.7			23

Below the table, there is a 'Graphic condition input screen' with fields for X and Y axes. The X-axis is labeled 'UPPER YIELD POINT' and the Y-axis is labeled 'ULTIMATE TENSILE STRENGTH'. A yellow box highlights this input screen, and a yellow arrow points from it to the graph on the right.

Graphic condition input screen



Graph

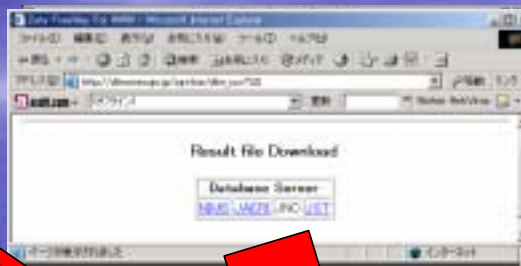


Present Status of Data-Free-Way

- File conversion function -

A stack of six overlapping screenshots of a web browser displaying data tables. Each table has a header row and multiple columns of numerical data. The tables are arranged vertically, with the top one being the most prominent.

Retrieved results



Download screen

A screenshot of Microsoft Excel software displaying a large spreadsheet. The spreadsheet contains multiple columns and rows of data, including numerical values and text labels. A red arrow points from the download screen to this spreadsheet.

Spread sheet software (Excel)



Present Status of Data-Free-Way

- Example of image data -

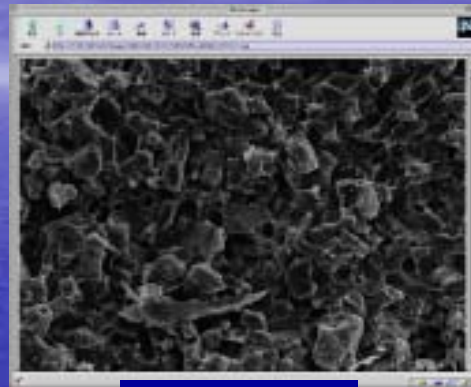
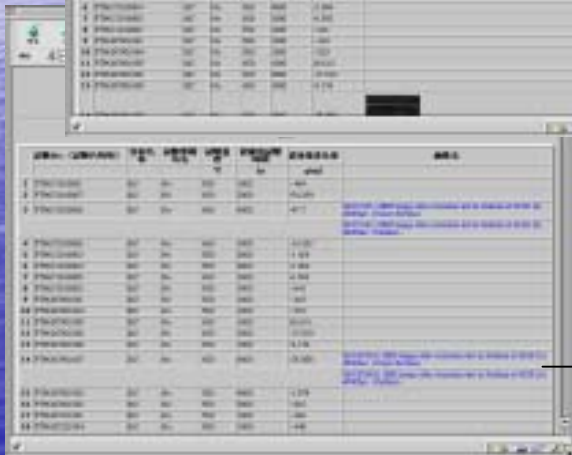
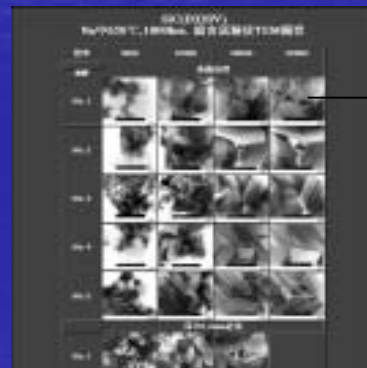


Image data



Retrieved results



Assembly of image data



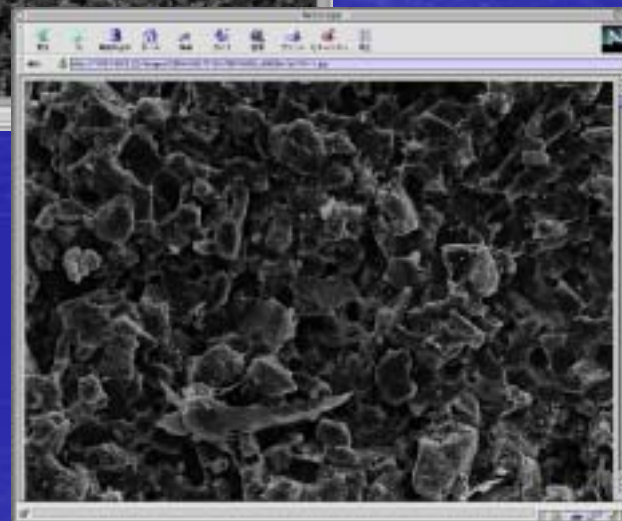
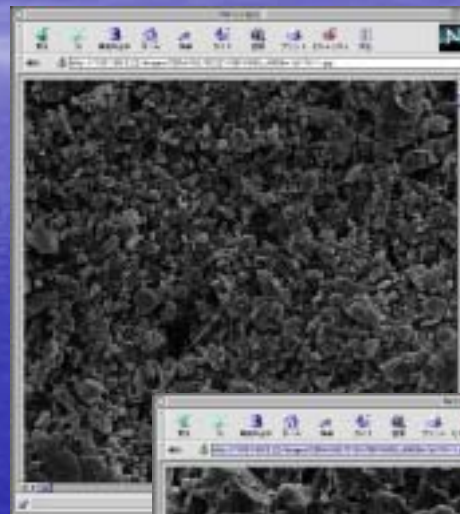
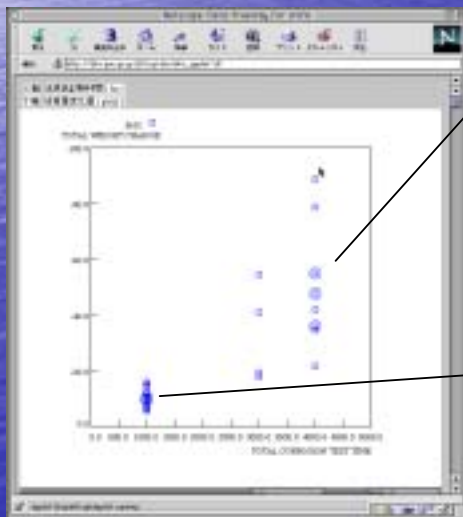
Image data



Present Status of Data-Free-Way

- Linkage function between numerical data and image ones -

Image data can be obtained by clicking the datum point interested on the graph.





Present Status of Data-Free-Way

- Homepage of Data-Free-Way at each organization -

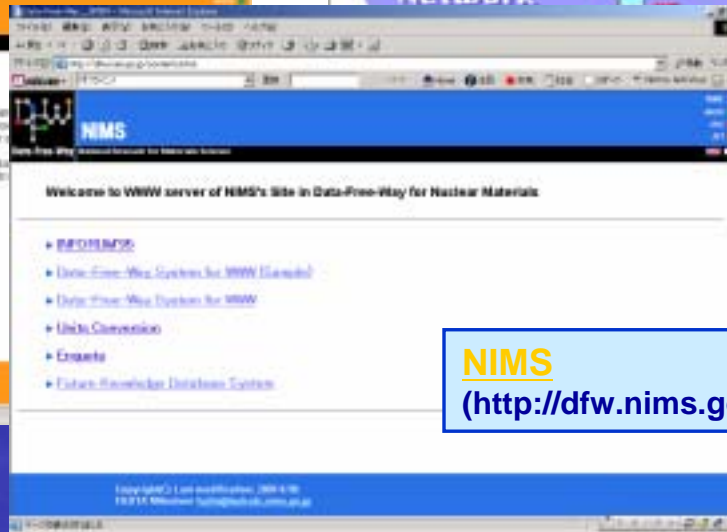
JAERI
(<http://jmpdpca.tokai.jaeri.go.jp/>)



JNC
(<http://dfw.jnc.go.jp>)



JST
(<http://dfw.jst.go.jp/>)



NIMS
(<http://dfw.nims.go.jp/>)



Description Method of Knowledge Extracted from Material Database

- Conceptual design of knowledge base -

- **Material database (Data-Free-Way)**

Standard type retrieval screen is prepared for users' convenience.

- **Knowledge base**

If typical retrieved results through the standard type retrieval screen are available, users do not need to retrieve the database under the same conditions.

If the meaning of the retrieved results and the analyzed results are stored as knowledge, the system becomes more beneficial for many users.



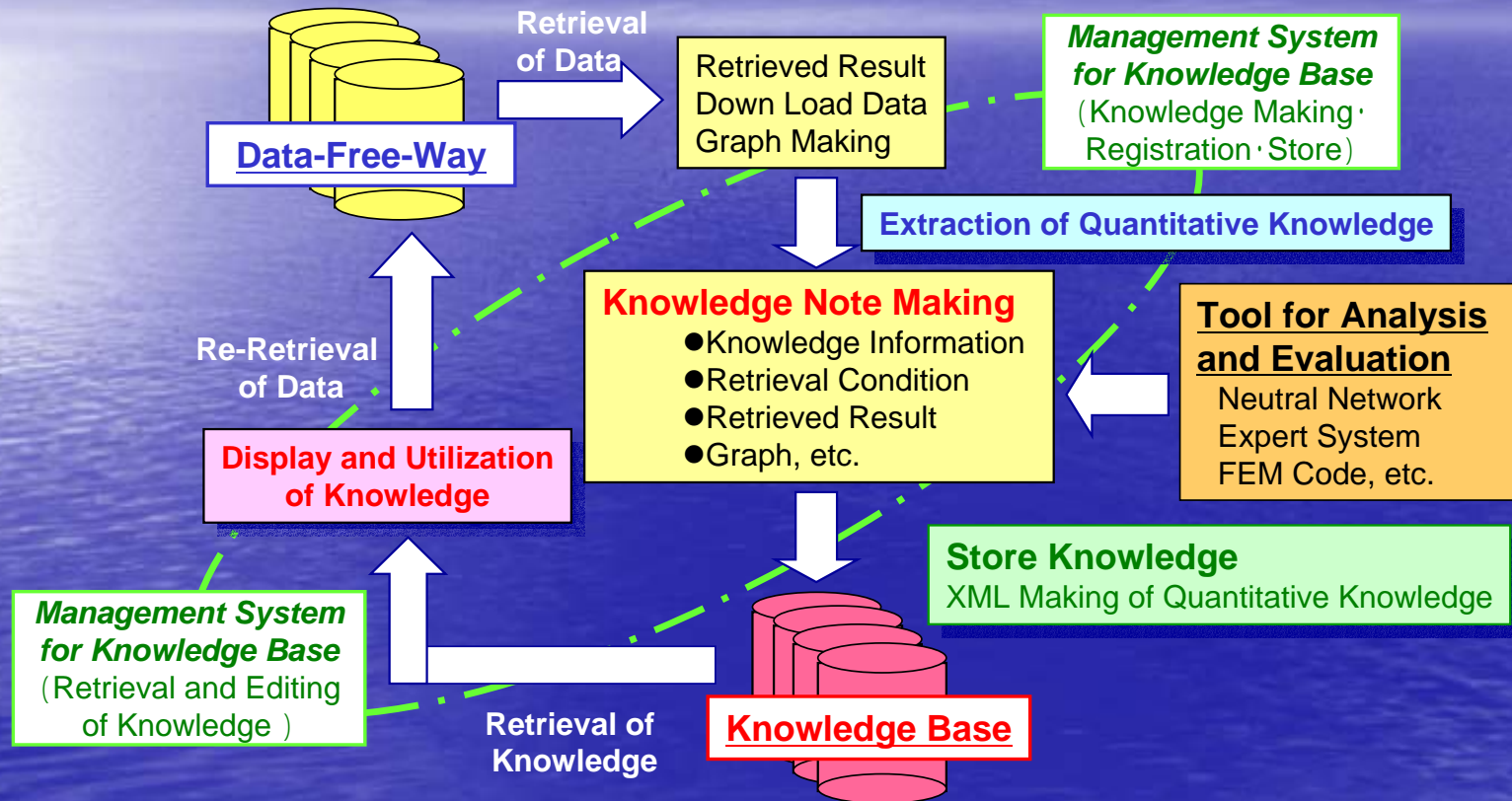
Knowledge Note

Typical retrieved results through the standard type retrieval screen
The meaning of the retrieved results



Description Method of Knowledge Extracted from Material Database

- Conceptual design of knowledge base -

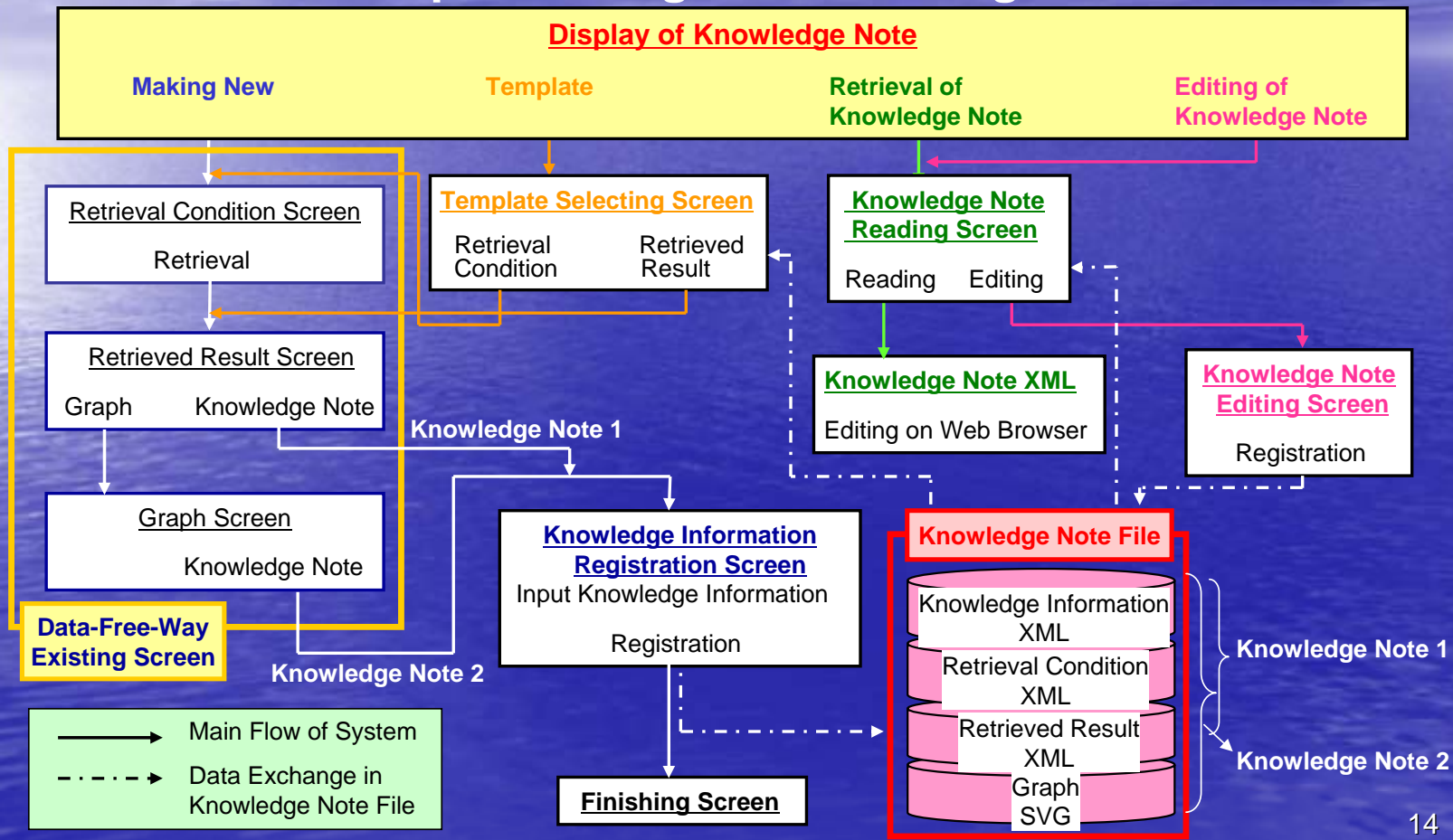


Relationship between Data-Free-Way and Knowledge Base



Description Method of Knowledge Extracted from Material Database

- Conceptual design of knowledge base -





Description Method of Knowledge Extracted from Material Database

- Knowledge note -

- Knowledge notes can be made at each stage of the data retrieval, the display of the retrieved results, or the graph making.
- A knowledge note consists of the table and the graph of the retrieved results, and description of the following items; the title, the register, the date of registration, the contents of retrieval, the knowledge document, and the references where the knowledge is described.
- By describing knowledge obtained from the material database with XML, the system possesses the function of not only displaying the table nor the mere graph as the retrieved results but also displaying knowledge.



Description Method of Knowledge Extracted from Material Database

- Knowledge note (Continue) -

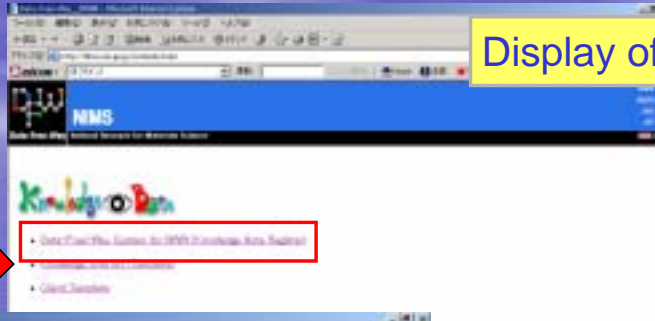
- The user can easily convert the display form of the table and the graph into the data format which the user usually uses. Moreover, additional information to the retrieved numerical values such as a unit can be easily conveyed.
- If such knowledge notes are made by many experts or researchers of materials and they are accumulated, effective knowledge base system can be constructed. As this knowledge base system is described with XML, the system can be shared in the world scale.



Knowledge Note

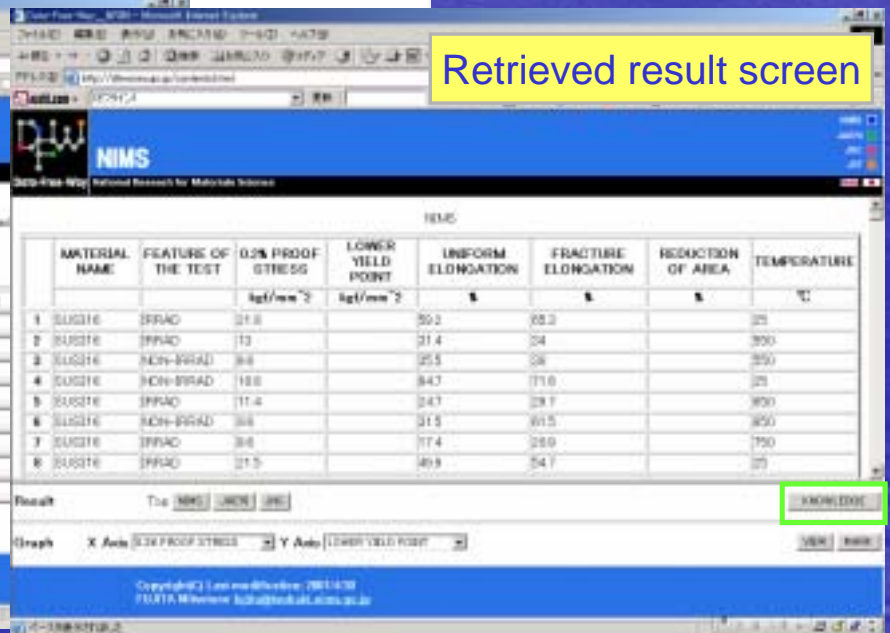
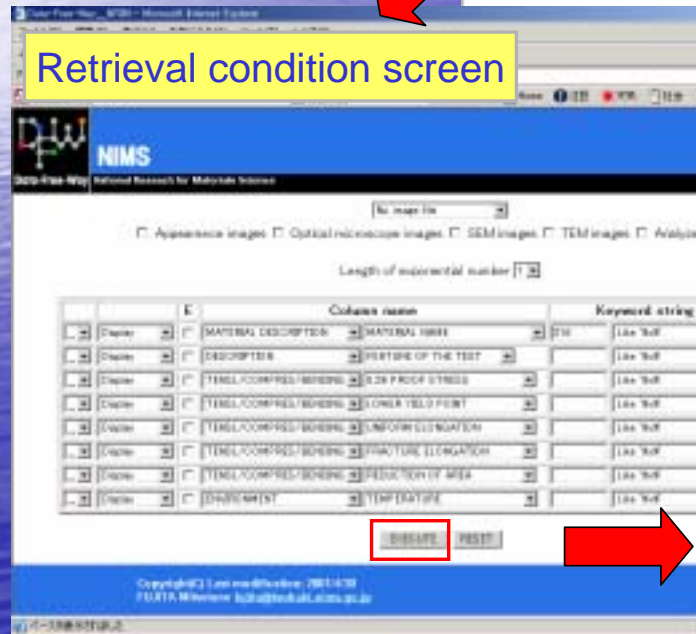
- Example of knowledge note (Knowledge note making) -

Display of knowledge note



Retrieval condition screen

Retrieved result screen





Knowledge Note

- Example of knowledge note (Knowledge note making) -

Graph condition setting screen

Fill setting

No.	Fill	Column name	Keyword	Comment
1	<input type="radio"/>		NON	Non-irradiated
2	<input type="radio"/>			
3	<input type="radio"/>	FEATURE OF THE TEST		
4	<input type="radio"/>			
5	<input type="radio"/>	Other		Irradiated

Color setting

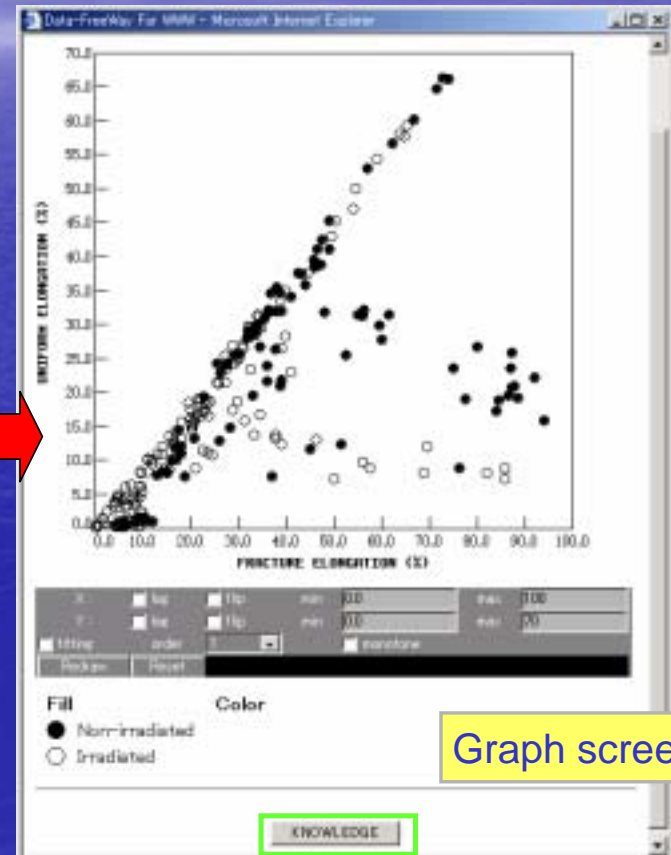
No.	Color	Column name	Keyword	Comment
1	<input type="radio"/>		MEMS	MEMS
2	<input type="radio"/>		JAREL	JAREL
3	<input type="radio"/>		JNO	JNO
4	<input type="radio"/>			
5	<input type="radio"/>	Other		

fitting:

Select: Show setting

No.	1	2	3
line type	dotted line (thin)	broken line (thin)	dotted line (thick)/broken

Title: uniform and fracture elongation in 316 stainless steels





Knowledge Note

- Example of knowledge note (Knowledge note making) -

Knowledge information registration screen

**Register knowledge
(Graph)**

Knowledge title: Relation between fracture elongation

Author: Mitsutane FUJITA

Writer: Yoshiyuki KAJI

Date: September 14, 2002

Purpose: Tensile properties of type 316 stainless steels under various test conditions

Knowledge: the data in the group B are unirradiated ones and those in the group C are irradiated ones.

Documents: M. Fujita et al., Fusion Engineering and Design 51-52 (2000) 769-774

Description of graph: Relation between uniform and fracture elongation in 316 stainless steels

REGISTRATION PREVIEW

Name	Description
dfw_12543.html	Relation between fracture elongation and uniform elongation for type 316 stainless steels
dfw_12543.svg	Relation between uniform and fracture elongation in 316 stainless steels

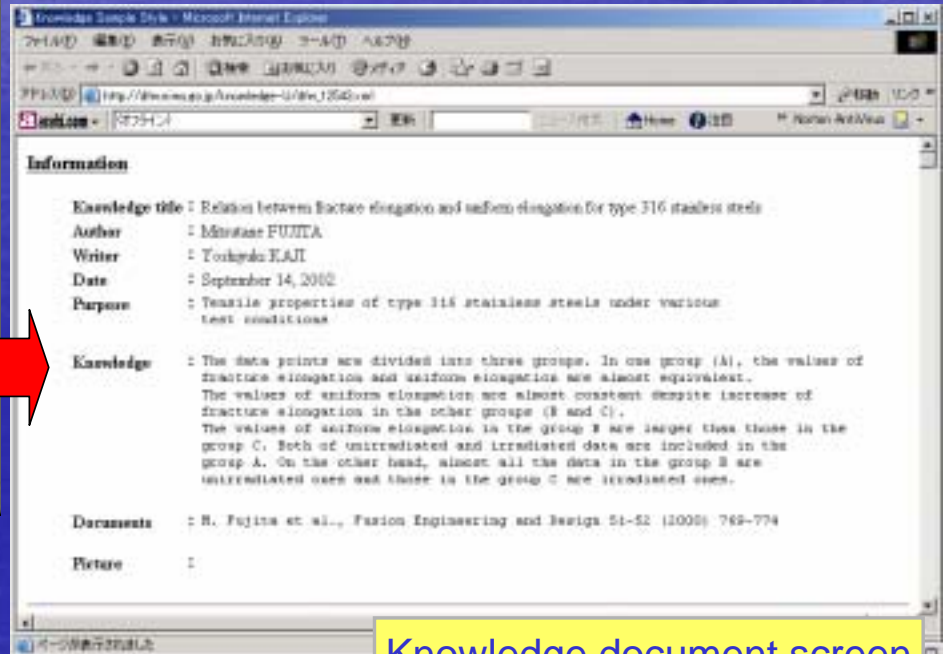
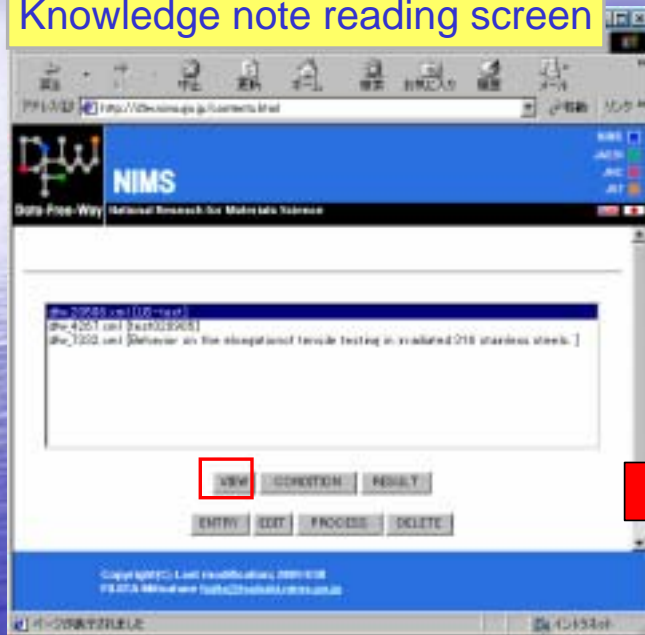
Description of knowledge obtained from Data-Free-Way



Knowledge Note

- Example of knowledge note (Viewing knowledge note) -

Knowledge note reading screen



Knowledge document screen



Knowledge Note

- Example of knowledge note (Viewing knowledge note) -

Retrieval condition screen

Search requirements

Database Servers

- NIMS
- JAERI
- JNC

検索形式(式)の小数桁数は1桁
Use ↑Tersile Properties↓ table set

	Column name	Requirements
Display	MATERIAL DESCRIPTION	MATERIAL NAME
Display	DESCRIPTION	FEATURE OF THE TEST
Display	TENSL/COMPRESBENDING	0.2% PROOF STRESS
Display	TENSL/COMPRESBENDING	LOWER YIELD POINT
Display	TENSL/COMPRESBENDING	UNIFORM ELONGATION
Display	TENSL/COMPRESBENDING	FRACTURE ELONGATION
Display	TENSL/COMPRESBENDING	REDUCTION OF AREA
Display	ENVIRONMENT	TEMPERATURE

Retrieved result screen

Result

NIMS:

	MATERIAL NAME	FEATURE OF THE TEST	0.2% PROOF STRESS	LOWER YIELD POINT	UNIFORM ELONGATION	FRACTURE ELONGATION	REDUCTION OF AREA	TEMPERATURE
			kgf/mm ²	kgf/mm ²	%	%	%	℃
1	SUS316	BEAD	21.8		59.2	65.3		25
2	SUS316	BEAD	13		31.4	34		550
3	SUS316	NON-BEAD	9.6		35.5	38		550
4	SUS316	NON-BEAD	18.8		64.7	71.6		25
5	SUS316	BEAD	11.4		24.7	29.7		650
6	SUS316	NON-BEAD	8.8		31.5	61.5		650
7	SUS316	BEAD	9.6		17.4	28.9		750
8	SUS316	BEAD	21.5		49.9	54.7		25
9	SUS316	BEAD	12.6		26.8	28.9		550
10	SUS316	NON-BEAD	9.2		32.1	56.3		650
11	SUS316	NON-BEAD	9.7		19.1	88.5		750
12	SUS316	BEAD	8.7		16.7	34.7		750
13	SUS316	BEAD	10.8		26.6	39.1		650



Knowledge Note

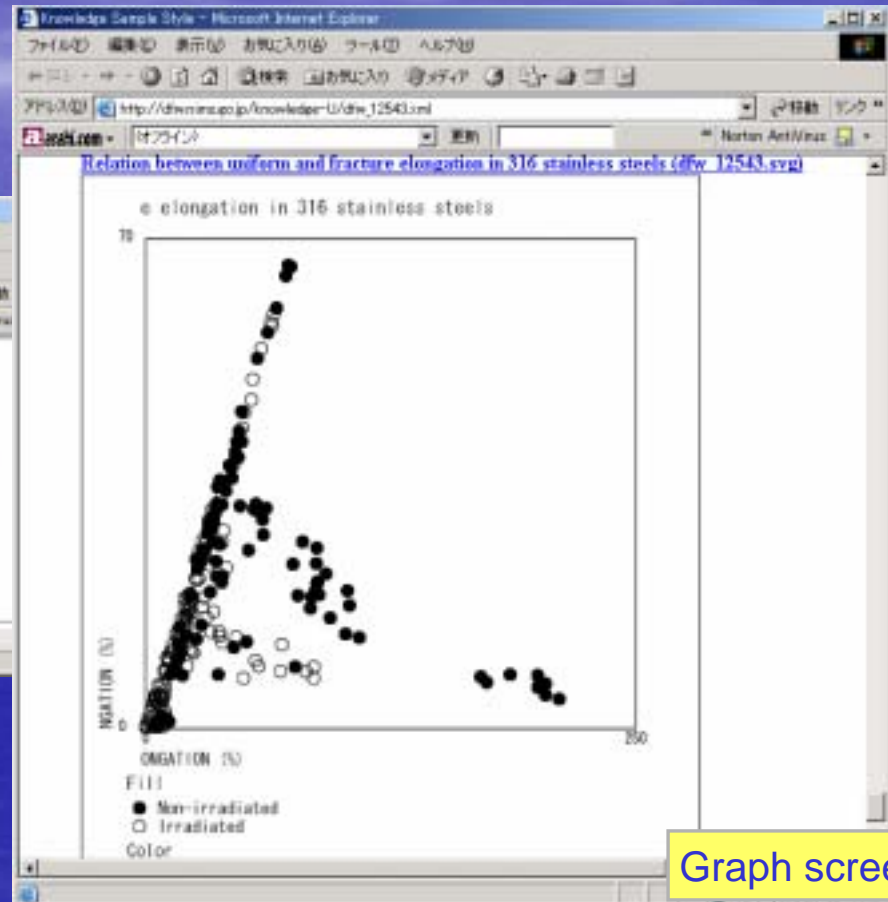
- Example of knowledge note (Viewing knowledge note) -

Graph condition setting screen

Marks

FEATURE OF THE TEST

	Requirement	Comments
●	NONを含む (LIKE %No%)	Non-irradiated
○		
○		
○	etc	Irradiated



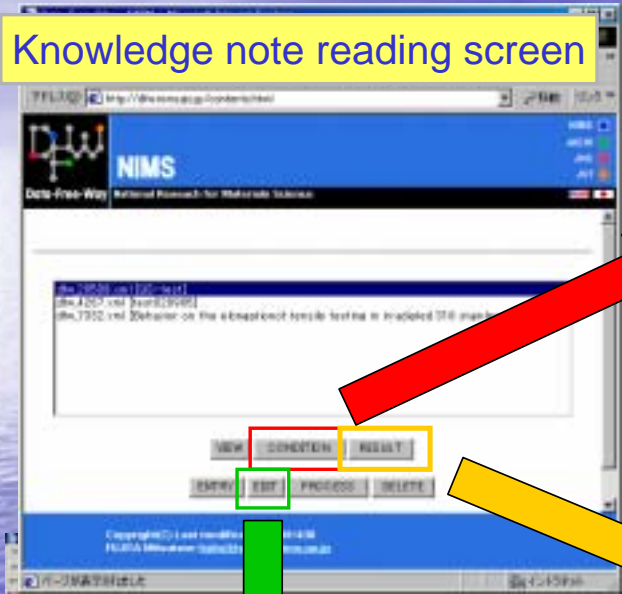
Graph screen



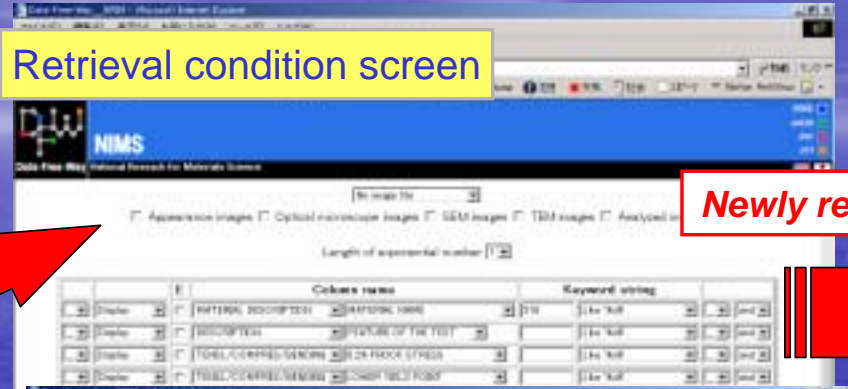
Knowledge Note

- Example of knowledge note (Retrieval knowledge note) -

Knowledge note reading screen

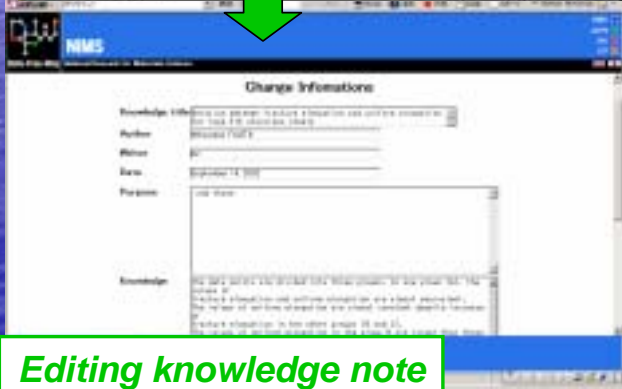


Retrieval condition screen

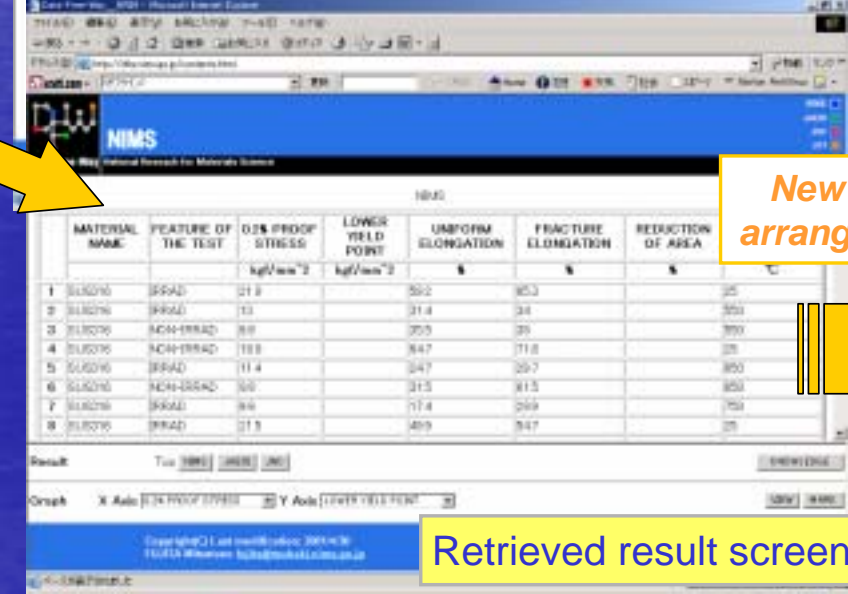


Newly retrieval

Editing knowledge note



Retrieved result screen



New data arrangement



Summary

- The distributed material database system named “Data-Free-Way” which can be shared from the Internet has been developed under the collaboration of NIMS, JAERI, JNC, and JST.
- In order to create additional values of the system, knowledge base system, in which knowledge extracted from the material database is expressed, is planned to be developed for more effective utilization of Data-Free-Way.
- As the first step of the knowledge base development program, knowledge notes have been made where typical retrieved results through the standard type retrieval screen and the meaning of the retrieved results are described with XML.