Requirements Analysis of System for Research Data Management to Prevent Scientific Misconduct (RDM-PSM)

Open Science, Research Data Management, and Research Transparency (DSIR-SS1)

7th International Congress on Advanced Applied Informatics

July 9, 2018

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Outline

1. The Rationale for RDM at Academic Institutions

2. Defining System Requirements for RDM-PSM
   a. Derivation of Basic Functionalities
   b. System Requirement Analysis

3. Conclusion & Discussion
1. The Rationale for RDM at Academic Institutions
From Access to **Research Publications** to Access to **Research Data**

- **Publicly-funded Research**
- **Research Data**
- **Research Publications**
Policy Developments in Research Data Sharing

- 2003, NIH, Data Sharing Policy
- 2004, OECD Declaration on Access to Research Data from Public Funding
- 2007, OECD Principles and Guidelines for Access to Research Data from Public Funding
- 2007, Biotechnology and Biological Sciences Research Council (BBSRC-UK), Data Sharing Policy
- 2011, Research Councils UK, Data Sharing Policy
- 2011, NSF, Data Sharing Policy
- 2013, OSTP-US, Increasing Access to the Results of Federally Funded Scientific Research
- 2014-20, Horizon 2020, Open Research Data Pilot
Rationale for making Research Data publicly available

- **Accountability**
  - Publicly funded research should be transparent

- **Economic Efficiency**
  - Reuse of data leads to new findings without additional investments

- **Global Challenges Solving and Innovations**
  - Combining data from multiple discipline leads to solving global challenges
  - Industries using data leads to innovations
Difficulties of making Research Data publicly available

- **Variation across discipline**
  - The size and profile of research data varies vastly across discipline

- **Difficult to describe (metadata)**
  - The description of research data is not standardized.
  - Difficult to add description to make research data findable and reusable in general terms.

- **Researcher’s hesitation**
  - Since research data is the core element of research publishing, researchers are reluctant to share research data with other researchers.
Funding agencies requiring Data Management Plans (DMP)

Data Archiving Policies

- No policy for (58%)
- Requires (28%)
- Encourages (13%)
- ["funder_fieldopt_data_req_other" not defined] (1%)

- Data Management Plans (DMP)
  - Required at the submission of research proposals on the handling and sharing of research data.

Retraction Watch

The Retraction Watch Leaderboard

with 21 comments

Who has the most retractions? Here's our unofficial list (see notes on methodology), which we'll update as more information comes to light:

1. Yoshitaka Fuji (total retractions: 183) Sources: Final report of investigating committee, our reporting
2. Joachim Boldt (96) Sources: Editors in chief statement, additional coverage
3. Diederik Stapel (58) Source: Our cataloging
4. Adrian Maxim (48) Source: IEEE database
5. Peter Chen (Chen–Yuan Chen) (43) Source: SAGE, our cataloging
6. Hua Zhong (41) Source: Journal
7. Shigeki Kato (39) Source: Our cataloging
8. James Hunton (37) Source: Our cataloging
10. Hyung-In Moon (35) Source: Our cataloging
11. Naoki Mori (32) Source: PubMed, our cataloging
12. Tao Liu (29) Source: Journal
13. Cheng-Wu Chen (28) Source: our cataloging
14. Gideon Goldstein (26)
15. Scott Reuben (25)
16. Gilson Khang (22) Sources: WebCitation.org, WebCitation.org, journal
17. Friedhelm Herrmann (21)
18. Noel Chia (21)

Source: The Retraction Watch Leaderboard
Academic journals requiring evidence-data

Journals implement data archiving policy
2011/01/14 by Peggy Schaeffer

It’s January 2011— do you know where your data are?

It would be a good idea to know and be ready to deposit your files in a data repository, because this month marks the implementation of the Joint Data Archiving Policy. The policy, endorsed by a consortium of prominent journals and societies, states that journals will require

"as a condition for publication, that data supporting the results in the paper should be archived in an appropriate public archive."

Source: Dryad. Journals implement data archiving policy
https://blog.datadryad.org/2011/01/14/journals-implement-data-archiving-policy/
How we classify our tools and services

Data Management Support

Data Management Planning

Active Data Infrastructure

Data Stewardship

Before research

During research

After research

DMP Online

500GB無償

機密データのための

Research Data Safe Heaven

データ資産登録

データ共有

データ保管庫
FACT:

MANY FUNDING AGENCIES REQUIRE DATA MANAGEMENT PLANS WITH GRANT PROPOSALS.

purr.purdue.edu

2,542 grant proposals

PURR IS YOUR SOLUTION FOR:

DATA MANAGEMENT PLANS
READY-MADE BOILERPLATE TEXT TO PUT IN YOUR PROPOSALS, TUTORIALS AND BEST PRACTICES, SUPPORT FOR DEVELOPING A GOOD DATA MANAGEMENT PLAN.

COLLABORATION
PURR PROVIDES A FREE HUBZERO™ PROJECT SPACE FOR PURDUE RESEARCHERS AND THEIR COLLABORATORS TO WORK TOGETHER ON RESEARCH AND SHARE DATA AND TOOLS ONLINE.

PUBLISHING YOUR DATA
PUBLISH YOUR RESEARCH DATA WITH DIGITAL OBJECT IDENTIFIERS THAT OTHER SCHOLARS CAN USE TO EASILY FIND AND CITE YOUR DATASETS.

ARCHIVING YOUR DATA
YOUR DATA WILL BE PRESERVED AND MADE ACCESSIBLE FOR LONG-TERM ACCESS IN A SECURE, TRUSTWORTHY DIGITAL REPOSITORY.

PURR IS A PURDUE RESEARCH CORE FACILITY DEVELOPED BY THE OFFICE OF THE VICE PRESIDENT FOR RESEARCH, PURDUE LIBRARIES, AND INFORMATION TECHNOLOGY AT PURDUE.

To learn more, visit PURR at purr.purdue.edu or contact Courtney Earl Matthews purr@purdue.edu 765-496-2770

2542の研究助成申請書のDMP作成支援

研究担当副学長室、図書館、ITセンターの協力により実現。
• **RDM services we provide**
  – DMPTool:  [https://dmptool.org](https://dmptool.org)
  – Dash (data publishing platform):  [https://dash.ucop.edu](https://dash.ucop.edu)
  – Merritt (preservation repository):  [https://merritt.cdlib.org](https://merritt.cdlib.org)
  – Along with expertise, coordination, advice, support
Issue on RDM service at universities

- NO established method for actual RDM
  - How to store and organize data
  - What metadata and descriptions to add,
  - How to decide on the range of data to provide,
  - How long to keep the data,
  - Methods to make data available...

Right now, RDM infrastructure is just storage!
Rationale of RDM at Japanese academic institutions

- Several serious scientific misconducts

  「研究活動における不正行為への対応等に関するガイドライン」
  - Strengthening the guideline in 2006.
  - Holds institutions to be responsible for research transparency and preventing scientific misconduct.

  日本学術会議「（回答）科学研究における健全性の向上について」
  - “Ten-Years Preservation Rule for Research Data”
    研究データ10年保存ルール
Japanese funding agencies’ requirements

- **JSPS: Open Access Policy (2017)**
  - JSPS will promote OA of research articles.

- **JST: Open Science Policy (2017)**
  - Recommends OA of research articles,
  - Recommends archiving, managing, and sharing of research data,
  - Mandates submission of DMP upon acceptance of research grant.

Japanese academic institutions having data preservation policies (FY2014 survey)

Does your institution have an data preservation policy?

- Public institutions tend to have a data policy rather than private institutions.
- Institutions larger in size tend to have a data policy rather than small institutions.

Source: Ministry of Education, Culture, Sports, Science and Technology,
http://www.mext.go.jp/a_menu/jinzai/fusei/1368869.htm
Implementation of RDM at Japanese universities

- Introducing university-wide “Research materials preservation policy.”

- Cascading of responsibilities:
  - University holds departments,
  - Departments holds Labs,
  - Labs holds researchers responsible for data preservation.

- No long-term storage, no infrastructural support
Reporting of evidence-data for research articles at Japanese universities

- Research office sends out Excel spreadsheet to researchers to have them report evidence-data.

- Only single row to report,
- No direct link to data
- Data difficult to find.

Research Data Preservation List (研究データ保管管理簿)

<table>
<thead>
<tr>
<th>No.</th>
<th>Title of Research Article</th>
<th>Conf.Name</th>
<th>Date</th>
<th>Prsv. Perio</th>
<th>Data delete planned</th>
<th>Storage place</th>
<th>Preserving data</th>
<th>Data deleted date</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>5</td>
<td>5</td>
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<td></td>
</tr>
</tbody>
</table>

https://db.jimu.kyutech.ac.jp/cgi-bin/cbcb/db.cgi?Page=DBRecord&did=206&rid=236
Research Aim

- To define the system requirements of RDM-PSM:
  - Minimum requirements
  - System Requirements
  - Functions

- RDM-PSM:
  - Research Data Management to Prevent Scientific Misconduct
2. Defining System Requirements for RDM-PSM

a. Derivation of Basic Functionalities
b. System Requirement Analysis
Approach to define requirements for RDM-PSM

Derivation of Basic Functionalities
1. Identify Reference Document
2. Element Analysis—Derivation of Minimum Requirement
3. Derive Basic Functionalities

System Requirements Analysis
4. Formulate System Requirements and Functions
5. Requirements Analysis of Functions using Workflow Model
1. Identify Reference Document

- MEXT guideline: sets out principle
- SCJ guideline: sets detailed procedure


2(2) The basic duties and care of an academic researcher, and the period and means to preserve research data

- 2(2) 研究者としてわきまえるべき基本的な注意義務、並びに実験データ等の保存の期間及び方法

  ➢ 2(2) ⑤ Guideline for the preservation of research materials
  
  2(2) ⑤ 研究資料等の保存に関するガイドライン

SCJ Guideline for the preservation of research materials

Six instructions on:

1. Preservation of lab notebooks in which the daily research activities are recorded
2. Preservation of research materials
3. Means and period of preservation of digital research materials
4. Means and period of preservation of physical research materials
5. Procedures for when a researcher or lab head is leaving to another institution or retiring
6. Research materials that require special treatment
## 2. Element Analysis of SCJ Guideline

### SCJ Guideline: instruction 2

<table>
<thead>
<tr>
<th></th>
<th>Preservation of Research Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Research materials (documents, numerical data, picture, etc.) used for research outputs such as research publications, oral presentations, and the like, shall be preserved in appropriate format for the future reuse and testing of research outputs.</td>
</tr>
<tr>
<td>2.2</td>
<td>Upon preservation of research materials, proper measures shall be taken so that future reuse and referencing are enabled; measures include adding metadata and enabling of discoverability and trackability of research materials.</td>
</tr>
</tbody>
</table>

### Extracted elements

<table>
<thead>
<tr>
<th></th>
<th>research materials (documents, numerical data, picture, etc.) used for research outputs such as research publications, oral presentations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1</td>
<td>appropriate format for the future reuse</td>
</tr>
<tr>
<td>2.1.2</td>
<td>appropriate format for the future testing of research outputs</td>
</tr>
<tr>
<td>2.1.3</td>
<td>future reuse are enabled</td>
</tr>
<tr>
<td>2.2.1</td>
<td>future referencing are enabled</td>
</tr>
<tr>
<td>2.2.2</td>
<td>adding metadata</td>
</tr>
<tr>
<td>2.2.3</td>
<td>enabling discoverability</td>
</tr>
<tr>
<td>2.2.4</td>
<td>enabling trackability of research materials</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>(研究資料の保存)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>論文や報告等、研究成果発表のもととなった研究資料（文書、数値データ、画像など）は、後日の利用・検証に堪えるよう適正な形で保存しなければならない。</td>
</tr>
<tr>
<td>2.2</td>
<td>保存に際しては、後日の利用／参照が可能となるようにメタデータの整備や検索可能性／追跡可能性の担保に留意すべきである。</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>論文や報告等、研究成果発表のもととなった研究資料（文書、数値データ、画像など）</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.1</td>
<td>後日の利用・検証に堪える保存</td>
</tr>
<tr>
<td>2.1.2</td>
<td>後日の利用に耐える保存</td>
</tr>
<tr>
<td>2.1.3</td>
<td>後日の検証に耐える保存</td>
</tr>
<tr>
<td>2.2.1</td>
<td>後日の利用が可能</td>
</tr>
<tr>
<td>2.2.2</td>
<td>後日の参照が可能</td>
</tr>
<tr>
<td>2.2.3</td>
<td>メタデータの整備</td>
</tr>
<tr>
<td>2.2.4</td>
<td>検索可能性の担保</td>
</tr>
<tr>
<td>2.2.5</td>
<td>追跡可能性の担保</td>
</tr>
</tbody>
</table>
2’. **Procedure** for deriving minimum requirements of RDM-PSM

1. Extracting elements from SCJ guideline,
2. Listing all elements,
3. Deleting overlapping elements,
4. Organizing elements by several categories.

**Categories of Minimum Requirements of RDM-PSM**

<table>
<thead>
<tr>
<th>I. Materials to be preserved</th>
<th>IV. Preservation methods,</th>
</tr>
</thead>
<tbody>
<tr>
<td>II. Preservation period</td>
<td>V. Considerations for preservation,</td>
</tr>
<tr>
<td>III. Conditions for Preservation</td>
<td>VI. Institutional management methods.</td>
</tr>
</tbody>
</table>
## Minimum requirements and basic functionalities of RDM-PSM System

<table>
<thead>
<tr>
<th>Minimum Requirements for RDM-PSM</th>
<th>Basic Funct.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Materials to be Preserved</strong></td>
<td></td>
</tr>
<tr>
<td>Research activities (1.2.1)</td>
<td>(Prsvd Mat)</td>
</tr>
<tr>
<td>Condition of data acquisition (1.1.1, 1.1.2)</td>
<td>(Prsvd Mat)</td>
</tr>
<tr>
<td>Research materials used for research outputs such as research publications, oral presentations (2.1.1, 3.1.1)</td>
<td>(Prsvd Mat)</td>
</tr>
<tr>
<td>- Digital materials (3.2.1)</td>
<td>(Prsvd Mat)</td>
</tr>
<tr>
<td>- Paper-based materials (3.3.1)</td>
<td>N/A</td>
</tr>
<tr>
<td>- Physical materials such as specimen and devices (4.1.1)</td>
<td>N/A</td>
</tr>
<tr>
<td>Research outputs (6.2.1)</td>
<td>(Prsvd Mat)</td>
</tr>
<tr>
<td>Metadata (2.2.3)</td>
<td>(Prsvd Mat)</td>
</tr>
<tr>
<td><strong>II. Preservation Period</strong></td>
<td></td>
</tr>
<tr>
<td>Research materials need to be preserved for ten years after publishing of research outputs (3.1.2, 3.3.2)</td>
<td>N/A</td>
</tr>
<tr>
<td>Physical materials such as specimen and devices need to be preserved for five years after publishing of research outputs (4.1.2)</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>III. Conditions for Preservation</strong></td>
<td></td>
</tr>
<tr>
<td>Inalterable (1.1.3)</td>
<td>Cont Mgmt</td>
</tr>
<tr>
<td>Findable (2.2.4)</td>
<td>Cont Mgmt</td>
</tr>
<tr>
<td>Trackable (2.2.2, 2.2.5, 5.1.3)</td>
<td>Cont Mgmt</td>
</tr>
<tr>
<td>Verifiable (2.1.3)</td>
<td></td>
</tr>
<tr>
<td>Submittable (5.1.4)</td>
<td>Cont Mgmt</td>
</tr>
<tr>
<td>Reusable (2.1.2, 2.2.1, 3.2.4)</td>
<td>Cont Mgmt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV. Ways of Preservation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating back-ups (3.2.3, 5.1.2)</td>
<td>Cont Mgmt</td>
</tr>
<tr>
<td>Adding and managing metadata (3.2.2)</td>
<td>Inst Mgmt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>V. Considerations for Preservation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Preservation space constraints (3.3.3)</td>
<td>N/A</td>
</tr>
<tr>
<td>Fundamentally impossible to preserve (4.2.1)</td>
<td>N/A</td>
</tr>
<tr>
<td>Immense cost for preservation (4.2.2)</td>
<td>N/A</td>
</tr>
<tr>
<td>Existing legal regulations (6.1.1)</td>
<td>N/A</td>
</tr>
<tr>
<td>Ethical consideration needs (6.1.2)</td>
<td>N/A</td>
</tr>
<tr>
<td>Special agreement with funders (6.2.2)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VI. Ways of Preservation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic institutions can test the research materials created by its own researchers even upon moving out or retirement of researchers and lab heads (5.1.1, 5.2.1)</td>
<td>Inst Mgmt</td>
</tr>
<tr>
<td>Academic institutions can test the research materials created by its own researchers, especially those directly related to research outputs (5.1.2, 5.2.2)</td>
<td>Inst Mgmt</td>
</tr>
<tr>
<td>Academic institutions draft and put policy for research materials preservation into effect (5.3.1)</td>
<td>N/A</td>
</tr>
<tr>
<td>Researchers sign a memorandum for the transfer of research materials to institutions upon hiring (5.3.2)</td>
<td>N/A</td>
</tr>
</tbody>
</table>
3. Procedure for deriving basic functionalities of RDM-PSM

1. Eliminate elements that do not need to be considered to develop an e-infrastructure,
   a. Elements concerning only physical materials,
      - N/A at “I. Materials to be preserved”
   b. Elements referring only to modification of parameters or how people use the system,
      - N/A at “II. Preservation Period,” “V. Considerations for Preservation,” and parts of “&. Inst. Mgmt Methods”
   c. Denote elements to handle as digital contents as “(Prsvd mat)”

2. Scrutinize the remaining elements and derive the basic functionalities of RDM-PSM.
   - Content Management
   - Institutional Management
2. Defining System Requirements for RDM-PSM

a. Derivation of Basic Functionalities
b. System Requirement Analysis
## System requirements and associated functions of RDM-PSM

### Contents Management (1)

<table>
<thead>
<tr>
<th>Minimum Requirements</th>
<th>System Requirements</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Findable</strong> (Contents Search)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Able to find digital contents concerning scientific misconduct</td>
<td>1</td>
<td>Metadata retrieval function (including keyword search, navigation, filtering, sorting function)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Trackable</strong> (Contents Tracking)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Able to add metadata of digital contents needed for research data management, such as creator of contents, associated research publications, grant number, citations, etc.</td>
<td>2</td>
<td>Metadata management function</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Verifyable</strong> (Contents Verification)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Able to track digital contents and related researchers and institutions, upon incident of scientific misconduct</td>
<td>1</td>
<td>Persistent identifier assignment and management function for digital contents</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Provenance management function for digital contents</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Function to link digital contents with related researchers and institutions</td>
</tr>
<tr>
<td>- Able to verify digital contents upon incident of scientific misconduct</td>
<td>1</td>
<td>Research trail recording function (including version control, editing and update history, and file relationship management)</td>
</tr>
<tr>
<td>- Able to preserve the relations of files generated at different research stages such as the processing of raw data to primary and secondary data, and the final research output</td>
<td>2</td>
<td>Function to preserve research workflows</td>
</tr>
<tr>
<td>- Able to preserve and associate the research workflows and softwares needed for data validation</td>
<td>3</td>
<td>Function to preserve electronic experiment-notes</td>
</tr>
</tbody>
</table>
# System requirements and associated functions of RDM-PSM

## Contents Management (2)

<table>
<thead>
<tr>
<th>Minimum Requirements</th>
<th>System Requirements</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Submittable</strong> <em>(Contents Submission)</em></td>
<td>- Principal investigator is able to submit verifiable digital contents anytime within certain time period in response to an institutional investigation upon incident of scientific misconduct</td>
<td>1 Digital contents acquisition and archiving function</td>
</tr>
<tr>
<td><strong>Reusable</strong> <em>(Contents Reuse)</em></td>
<td>- Able to edit and process digital content using standard format (or open format anyone can edit and modify)</td>
<td>1 Conversion and migration function to standard format</td>
</tr>
<tr>
<td></td>
<td>- Able to declare the user license of digital contents</td>
<td>2 User license declaring function</td>
</tr>
<tr>
<td></td>
<td>- Able to provide or reproduce processing environment of digital data to ensure research reproducibility</td>
<td>3 Functions for virtual machine, container virtualization technology</td>
</tr>
<tr>
<td><strong>Inalterable</strong> <em>(Contents Inalterable)</em></td>
<td>- Able to prevent tampering with digital contents during research and upon incident of scientific misconduct</td>
<td>1 Function to prevent tampering with digital contents (time stamp, electronic signature, digital watermark, etc.)</td>
</tr>
<tr>
<td></td>
<td>- Able to preserve and confirm research trail of digital contents</td>
<td>2 Function to record and view research trail</td>
</tr>
<tr>
<td><strong>Creating backups</strong> <em>(Contents BK)</em></td>
<td>- Able to preserve and backup digital data for long term in a sustainable manner to ensure verifiability</td>
<td>1 Data backup function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Disaster Recovery Function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Automatic switching function of hot and cold storage</td>
</tr>
</tbody>
</table>
### System requirements and associated functions of RDM-PSM

...**Institutional Management**

<table>
<thead>
<tr>
<th>Minimum Requirements</th>
<th>System Requirements</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional management</td>
<td>Academic institutions can test the research materials, especially those directly related to research outputs, created by its own researchers <strong>(Institutional Verification)</strong></td>
<td>• Able to have an overview of research outputs of the institution with associated digital contents at metadata-level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Able to devolve the digital data to another researcher in the same institution upon retirement of the principal investigator</td>
</tr>
<tr>
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<td>• Able to devolve the digital data to another researcher in another institution upon retirement of the principal investigator</td>
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<td>• Able to store provenance information of digital contents to be able to track the contents</td>
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<tr>
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<td>• Able to delegate access rights to digital contents to others upon principal investigator's demise</td>
</tr>
</tbody>
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4. Procedure for deriving system requirements of RDM-PSM

- Detailing system requirements under what conditions the minimum requirements need to be met:
  a. List all possible system requirements that fulfill the minimum requirements without referring to the SCJ guideline,
  b. Select system requirements needed for RDM-PSM,
  c. Cross-check whether the chosen system requirements do not deviate from SCJ guideline.

By first considering system requirements without SCJ guideline, several added requirements are detected!
4’. Procedure for deriving functions of RDM-PSM

- Listing functions which meets system requirements.
  - Some system requirements require multiple functions,
  - Functions are mostly described in technical terms without using academic terms,
    - However, some system requirements need to include RDM terms, such as “Research-trail recording,” to describe functions.
  - Derived functions are not unique allowing some variations especially with advancements in technology.
RDM-PSM Workflow and the Mapped Functions of the RDM-PSM System

...Normal State

1) Creation and Editing of Contents
- Contents Search 2
- Contents Tracking 2
- Contents Tracking 3
- Contents Verification 1
- Contents Verification 2
- Contents Verification 3
- Contents Reuse 3
- Contents Inalterable 1
- Contents BK 1

3) Long-term Contents Preservation
- Contents Reuse 1
- Contents BK 2
- Contents BK 3

2) Presentation of Research Outputs
- Contents Tracking 1
- Institutional Verification 1
- Contents Reuse 2

4) Management of Research Outputs
- Institutional Verification 2

5) Researcher Transfer · Retirement · Decease
- Mobility Management 1
- Mobility Management 2
- Mobility Management 3
- Mobility Management 4

Researcher

Academic Institution
RDM-PSM Workflow and the Mapped Functions of the RDM-PSM System

...In case of Incident

Researcher

(7) Contents Submission

Contents Search 1

(8) Verification of Research Outputs

Contents Inalterable 2

Academic Institution

(6) Incident of a Scientific Misconduct

Contents Search 1

Institutional Verification 2
5. Requirements Analysis of Functions using Workflow Model (1)

- Functions are mapped on the workflow model and scrutinized.
  - The workflow model on a time line allows to take into account when the functions are called,
  - All functions could be mapped, meaning that all the minimum requirements are covered,
  - No overlapping use of functions at different workflow stages, meaning only need to assume single settings,
  - One workflow-stage involves functions from different minimum requirements, meaning appropriate user interface needs to be developed considering this fact,
5. Requirements Analysis of Functions using Workflow Model (2)

Functions from “Inst Mgmt” are mapped only to workflow-box for academic institutions whereas functions for “Cont Mgmt” are mapped to both researchers and academic institutions.

- The functions for “Cont Mgmt” mapped for academic institutions are functions which could not be derived from SCJ guideline only.

- The analysis enabled to clarify whether the function is needed for researcher of the academic institutions.
3. Conclusion & Discussion
Conclusion

- The basic functionalities, system requirements, and associated functions of an RDM-PSM system were derived and scrutinized using the SCJ guideline.

- Since the SCJ guideline only prescribes the requirements for research materials preservation and not the procedures for RDM-PSM, our requirement analysis was a necessary step towards specifying the details of an RDM-PSM system.

- However, to implement an RDM-PSM system, further usability issues need to be worked out in cooperation with universities.

- It will also be worthwhile to work out metrics to measure the usability and effectiveness of such a system in advance.
Discussion

- Comparing towards RDM in Open Science:
  - FAIR (Findable, Accessible, Interoperable, Reusable)
- The procedure for formulating the system requirements and associated functions can also be used for RDM in FAIR.
  - FAIR RDM as a derivation of an RDM-PSM
- Even though RDM-PSM may be a unique concept in Japan, considering increasing number of scientific misconducts and retractions, an RDM-PSM system could be used other countries.