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Data Management Plans: a Resource to Shape Institutional Data Management Services

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Abstract

At KU Leuven, a university in the Flemish region of Belgium, data management plans have become an important resource to drive and shape the development of data management support, services, and training. With 8,000 researchers and 7,000 PhD students in fundamental and applied research across a comprehensive range of disciplines, KU Leuven is the largest university in Belgium. Public research funding is provided by the federal and regional governments, mainly via the Research Foundation Flanders (FWO) and via research funding allocated to universities based on excellence criteria through the Special Research Fund (BOF) and the Industrial Research Fund (IOF).

Since 2018, FWO and BOF–IOF have incorporated data management into their policies, requiring researchers to submit Data Management Plans (DMPs) to their institutional research office. Since then, the number of DMPs that are developed each year has increased exponentially, from 150 in 2018 to nearly 700 per year now. The Research Coordination Office at KU Leuven decided to review and provide feedback on all DMPs to ensure high-quality plans. To manage the submission, monitoring, review, and preservation of this volume of DMPs efficiently, an online platform was developed that is integrated with the university's research information systems.

Initially, the focus of the DMP review was on supporting the development of DMPs, as this was a new concept for researchers. The review process has significantly improved the quality of DMPs. Later, support shifted to provide advice on best practices in data management. Reviews of over 2600 DMPs provide a rich source of information to develop services and training. Based on findings from DMP reviews, the IT department developed an interactive storage guide; methods to monitor ethical and legal compliance in research projects have been implemented; new data management training modules have been created; and a collection of example DMPs has been developed. In addition, the growing DMP collection is a rich source of information on researchers' data practices, providing the baseline information to develop further services. Future plans include implementing artificial intelligence in DMP reviews to automate problem detection and exploring machine-actionable DMPs for an institutional data register.

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Introduction

Since the mid-2000s, data management plans (DMPs) have evolved from their initial use as functional documents to plan the management of data in complex projects, into documents public research funders require to increase economic and scientific benefits from high-quality research data that are shared and reused (Smale et al., 2020). The implementation of DMPs by funders as part of their data policies started in the UK and USA. This practice spread across Europe, driven in part by the OECD Declaration on Access to Research Data from Public Funding (OECD, 2004) and the OECD principles and guidelines for access to research data from public funding (OECD, 2006). In the UK, the Natural Environment Research Council included data management planning in its Data Policy Handbook as early as 1996 (Jones, 2012); and most UK research councils required DMPs by 2011. In the USA, the National Institutes of Health have required DMPs since 2003, and the National Science Foundation have requested DMPs since 2011 (Williams et al., 2017). In 2012, the European Commission called member states into action to improve access to and preservation of scientific information. An open data pilot was launched in their Horizon 2020 framework programme in 2013, and the use of DMPs in this pilot was implemented in 2016 (Corti et al., 2020). Soon thereafter, public funders in EU member states also started adopting data policies with DMP requirements. In Belgium, the regional public funders Research Foundation Flanders (FWO) implemented the use of DMPs in 2018. The federal research funder Belgian Science Policy (BELSPO) published their Open Research Data Mandate in 2019 (Sveinsdottir et al., 2021).

Funders use DMPs as a way to increase return on investment in research. Research institutions and advocacy groups supporting DMP-writing point towards the value and professional benefits that DMPs have for researchers in terms of enhancing how research data are managed, and with that increasing the productivity, visibility, integrity, and transparency of research. For institutions, DMPs are valuable in terms of planning the provision of support services, resources, and infrastructure, monitoring compliance with ethical and legal frameworks, and providing evidence for research integrity (Mannheimer, 2018; Smale et al., 2020).

At KU Leuven,[1] a research-intensive university in Flanders, Belgium, the development of DMPs as a result of research funders requirements has grown exponentially from 2018 onwards. We reflect here on the strategies and developments in DMP support over the past six years and show the value that more than 2600 DMPs that have so far been developed by researchers at the university have brought to the institution, in shaping the provision of data services and providing direction for future advancements.

Policy Context

KU Leuven is a university located in the Flemish region of Belgium, with 8,000 researchers and 7,000 PhD students[2] engaged in fundamental and applied research across a comprehensive range of disciplines, including biomedical sciences; science, engineering and technology; and humanities and social sciences.

[1] KU Leuven : https://www.kuleuven.be
[2] KU Leuven Facts and Figures: https://www.kuleuven.be/english/about-kuleuven/facts-and-figures

Public funding for research is provided by the federal government and regional governments. At the federal level, Belgian Science Policy (BELSPO)[3] funds research that supports federal competencies and international commitments made by the federal government. At the regional level, in Flanders, Research Foundation Flanders (FWO)[4] funds fundamental, strategic, and applied research; and Flanders Innovation & Entrepreneurship (VLAIO)[5] funds research for innovation, including research in collaboration with companies. The Flemish government also allocates research funding to universities on excellence criteria via the Special Research Fund (BOF)[6] to finance fundamental research, and through the Industrial Research Fund (IOF). This is distributed at KU Leuven to projects and fellowships through a competitive process. KU Leuven research expenditure in 2023, which totalled € 739.89 million, was mostly obtained from FWO (25%), BOF–IOF (19%), EU framework programmes (9%), and VLAIO (4%) grants.[7]

FWO incorporated data management into their policy in 2018, requiring data management to be briefly described in the grant application and a DMP to be developed within six months after the start of the project. The FWO policy's focus is on data management and data preservation to ensure high-quality and reliable research. Compliance with the FAIR principles and data sharing is encouraged, but not mandated. Importantly, researchers submit the DMP to their institutional research office rather than to FWO. In the case of KU Leuven, this is the Research Coordination Office. The institution is responsible for preserving DMPs and for reporting compliance to FWO. VLAIO has followed the same procedure since 2022, with DMPs submitted to the institutional research office. For BOF–IOF projects and fellowships, KU Leuven sets the policy, and has expected since 2018 a DMP within three to six months of the start of the project to be submitted to the Research Coordination Office. For EU-funded projects, DMPs are submitted to the European Commission. The university is thus custodian of the majority of DMPs that are written for funded research projects and fellowships, these being the DMPs developed for FWO, VLAIO, and BOF–IOF grants and fellowships.

In 2020, the Flemish Open Science Board (FOSB) was founded with the mission to implement the Open Science policy of the Flemish government.[8] This brought significant funding to research institutions, earmarked to recruit data support staff and develop data infrastructure. A Flemish Research Data Network (FRDN) was set up to support institutions in implementing this Open Science policy.[9] One of the realisations of FRDN was the development of the Flemish Standard Data Management Plan[10] template that all Flemish research institutions now use, as well as funders FWO and VLAIO. This standard template is maintained by FRDN. If updates of the DMP template are needed, FRDN is responsible for the process, rather than the funders or institutions. All DMPs at KU Leuven (and in Flanders) are written in English.

[3] Belgian Science Policy: https://www.belspo.be/
[4] Fonds Wetenschappelijk Onderzoek: https://www.fwo.be
[5] Vlaams Agentschap Innoveren & Ondernemen: https://www.vlaio.be/en
[6] Bijzonder Onderzoeksfonds regulation: https://data-onderwijs.vlaanderen.be/edulex/document.aspx?docid=14104#269986
[7] KU Leuven Annual Report 2023: https://www.kuleuven.be/over-kuleuven/pdf/jaarverslag-ku-leuven-2023-met-uv.pdf
[8] Flemish Open Science Board: https://www.ewi-vlaanderen.be/nieuws/flemish-open-science-board-fosb-opgericht
[9] Flemish Research Data Network: https://www.frdn.be
[10] Flemish Standard Data Management Plan: https://www.frdn.be/media/slrbpbs4/flemish-dmp-template.pdf

Evolution of Research Data Management Support

A first university-wide policy guideline on research data management (RDM) was adopted at KU Leuven in 2014, and a working group was set up to support research data management best practices (Figure 1). In 2018, an RDM Steering Group was created, led by the Vice-Rector for Research Policy, with three working groups with a membership of representatives from the institution's professional services and academic groups. A Policy working group develops and maintains an institutional research data management policy with thematic guidelines according to needs. An Infrastructure working group determines technical infrastructure and tools to manage research data and provides technical solutions to meet researchers' needs. An Advice, Training & Communication working group streamlines the organisation of training and advice, and coordinates communication and the capturing of researchers' data needs.

In 2018, the university's RDM service capabilities and needs were analysed using the Research Infrastructure Self-Evaluation Framework (RISE) (Rans & Whyte, 2017). For most research data support service areas, the capability was then at Level 0 or 1 (of 3), except for active data management (Level 2). Based on this, an institutional roadmap for further RDM developments was drawn up.

In 2019, a Research Data Management Policy[11] was adopted, focusing on high-quality research and scientific integrity. This policy further expanded in 2024 with guidelines on publishing research data to make them available for reuse. This new policy is currently going through approval by the institution's academic and governing bodies.

An RDM Competence Centre (RDM-CC) was set up in 2020 with five RDM experts across the main central services: Research Coordination Office, Information, Communication, Technology & Systems (ICTS), and Libraries. The central services each have their niche within the RDM activities. The Research Coordination Office is responsible for funder and ethical compliance. The libraries are responsible for domain-specific and data-sharing aspects. ICTS is responsible for data storage and preservation infrastructure. The RDM-CC has been coordinating the development and roll-out of RDM services, tools, and infrastructure, with a growing network of RDM support staff thanks to FOSB funding.

Initially, the focus of RDM support was mainly on supporting the development of DMPs for various funders, as this was a new concept for researchers. From 2014, the DMPonline tool[12] hosted a KU Leuven DMP template. In 2017, a locally hosted version of the DMPonline tool was created at KU Leuven in collaboration with the Digital Curation Centre. In 2022, the switch was made to using DMPonline.be[13] hosted by Belnet, the Belgian provider of digital services to universities, research centres, and educational organisations, as this offers more possibilities for integration and automation with other systems in future. Using this tool, researchers have access to the Flemish Standard DMP template, as well as templates for European projects, which provide both the funder's and KU Leuven-specific guidance.

Given the university's responsibility to ensure researchers comply with funder DMP requirements and to preserve all DMPs for Flemish-funded research, the Research Coordination Office decided in 2018 to review all DMPs and provide feedback to researchers so as to ensure the high quality of DMPs produced. Initially, this was done by existing research support staff. When the RDM-CC was set up, dedicated RDM staff took over this task. Reviews were conducted in a standardised manner, and the quality of DMPs was systematically monitored. Over 2600 DMPs have been reviewed since, providing rich information on RDM practices across the university. DMP reviews are done by a team from

[11] KU Leuven Research Data Management Policy: https://www.kuleuven.be/rdm/en/policy
[12] DMPonline: https://dmponline.dcc.ac.uk
[13] DMPonline.be: https://dmponline.be

across the Research Coordination Office, libraries, ICTS, and support staff within departments and faculties.

In 2022, the university developed a Research Data Repository (RDR)[14] to facilitate data publishing. RDR currently contains nearly 400 published datasets. In 2023, the ManGO platform for managing data during the active phase of research was launched.[15] This platform, based on open-source iRODS software, facilitates the description of data through metadata, the automation of data workflows, and the sharing of data for collaboration within and outside the university. Over 130 projects currently use ManGO. Overall, the university now has a portfolio of RDM training, guidance, services, and tools for its researchers, accessible via the English-language RDM website.[16]

When in 2022 the RISE evaluation was repeated, progress had been made in all service areas. Level 2 capability had been achieved for RDM policy and strategy, business plans and sustainability, advisory services, training, active data management, and access and publishing. For data management planning, Level 2 had not been achieved, as the institution does not mandate DMPs for all researchers. Based on the evaluation, further developments for the next four years were planned, which have been translated into annual RDM action plans. For the service area of data management planning, Level 3 is aimed for by working towards machine-readable DMPs, service provision for practical implementation of DMPs into good data management practices, and active monitoring of DMP implementation.

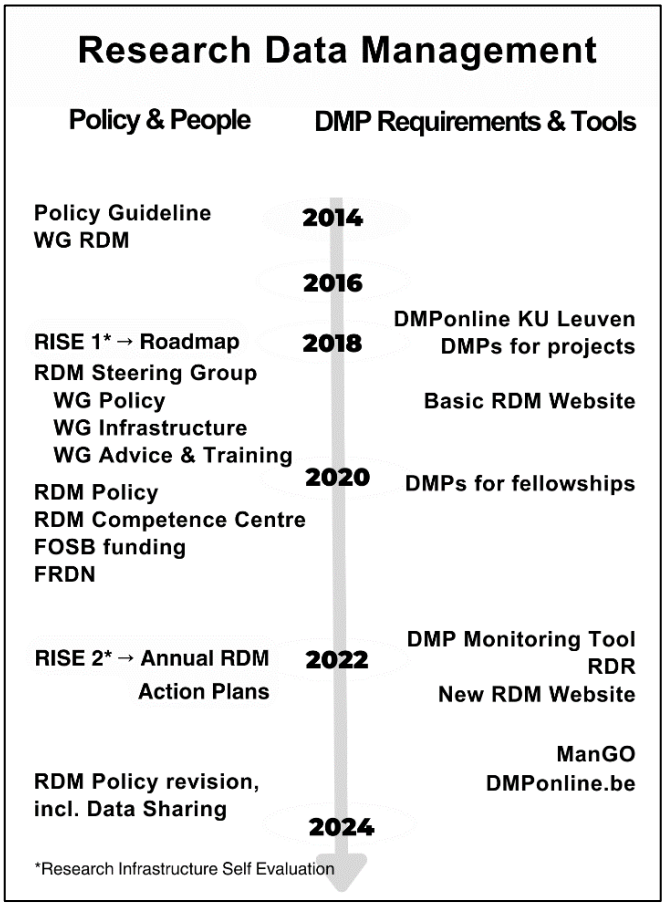

Figure 1. Timeline of key RDM developments at KU Leuven and in Flanders over ten years.

[14] KU Leuven Research Data Repository RDR: https://rdr.kuleuven.be
[15] ManGO: https://rdm-docs.icts.kuleuven.be/mango
[16] Research Data Management KU Leuven: https://www.kuleuven.be/rdm

Evolution of Data Management Plan Support

Since 2018, the number of DMPs developed at the university has increased exponentially, rising from 150 in 2018 to almost 700 per year currently, as funders have gradually rolled out DMP requirements (Figure 2). Initially, the requirement by FWO and BOF–IOF for DMPs to be developed applied only to (large) research projects; this was later extended to doctoral and postdoctoral fellowships.

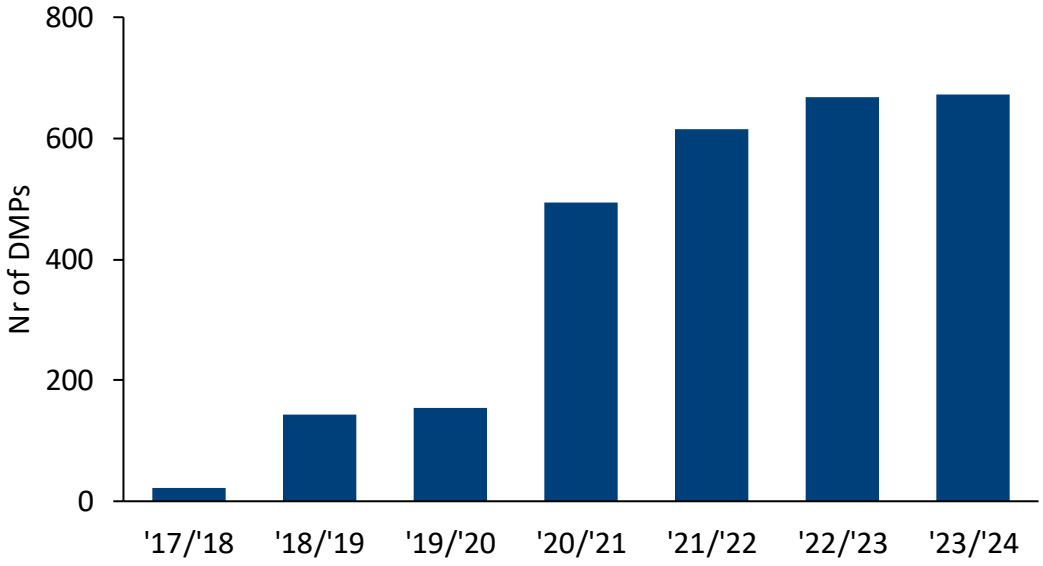

Figure 2. Number of DMPs developed over time at KU Leuven. The DMP Monitoring Tool (DMP-MT) has been used since Academic Year 2021/2022.

To develop their DMPs, researchers can use the DMPonline tool. Since 2023, DMPonline.be has been used. This tool has templates for various funders so researchers can meet specific funder requirements. It provides tailored guidance for each funder, and institutions can also include their own specific guidance for each question in the DMP.

With growing numbers of DMPs being developed, and review being done by a team spread across the university's central services, an online platform was developed to enable easy submission, collaborative review, monitoring of DMP submission, and exchange of information with the university's research information systems. This DMP monitoring tool (DMP-MT)[17], built on SharePoint and linked to the university's SAP environment, has been used since late 2021.

For each project and fellowship for which a DMP is required, a folder is created in the DMP-MT, and the tool imports basic information about this project from the SAP research information system. The folder contains areas for upload of an initial, intermediate, and final DMP. Researchers then receive automated messages and timely reminders, inviting them to upload an initial DMP by their deadline. These messages also point researchers to the RDM website for guidance, helpdesk, and training events.

This DMP-MT now facilitates submission, review, assessment, follow-up and storage of DMPs, and reporting compliance to funders, with researchers and support staff maintaining access to DMPs. It also facilitates DMP review on request, for example, for EU-funded projects, whereby the researcher updates and submits the DMP to the funder after we give feedback via the DMP-MT.

[17] KU Leuven DMP Monitoring Tool: https://www.kuleuven.be/rdm/en/tools/DMP-monitoring-tool

When a DMP is submitted to the DMP-MT, this is automatically reported to the Flanders Research Information Space, the research portal of the Flemish government, where the existence of the DMP is recorded as internal information.

In the DMP-MT, each DMP is assigned to a responsible reviewer at the Research Coordination Office, who can delegate review to reviewers from libraries, faculties, and departments. Via an internal communication text box, reviewers can discuss the DMP during review. Suggestions to the researcher are written in a feedback text box and sent to them via the tool. All feedback is preserved in the tool alongside the DMP for future reference.

DMP Reviews

DMP reviews follow a DMP Evaluation Rubric[18] adapted from the Science Europe DMP Evaluation Rubric (Science Europe, 2021), to align with the questions in the Flemish Standard DMP template. During review, we check whether all questions in the DMP are sufficiently addressed, and give feedback and tips to improve data management practices.

When DMPs were introduced by FWO in 2018, most researchers were unfamiliar with the concept and purpose of DMPs. The DMP was seen as an extra administrative task, written with minimal effort, so the information researchers wrote in the DMP was usually brief and generic. Plans that researchers developed generally contained very little detail about the research data to be created or reused and how these would be managed. The review then focused on ensuring that the DMP detailed all data comprehensively and provided useful information on data management practices. We invested in providing detailed guidance, including numerous examples, within the DMPonline tool and during training sessions.

Nowadays, researchers are familiar with DMPs and associated terminology, so review can focus more on giving advice and tips for implementation of the RDM practices described, rather than on improving just the information in the DMP. For example, suggestions nowadays may point to the existence of more optimal storage solutions or suggest a suitable data repository that can be used for data sharing.

Through review we decide:

- The DMP is good, and no further suggestions need to be given;
- The DMP is good, and suggestions are given for improvement of planned data management, that the researcher can implement during research and include in a final DMP; or
- The DMP is lacking critical information and needs revision, and a revised DMP should be submitted.

Evidence that the quality of DMPs has improved significantly over time comes from around 2300 DMP reviews over the last four years, from Academic Years 2020/2021 through 2023/2024 (Figure 3). The percentage of DMPs in the first category (Good) has increased from less than 10% in 2020/2021 to 50% in 2023/2024. For less than 10% of DMPs, we need to ask for a revised DMP to be submitted. Revisions need to be asked for when the submitted document is not a DMP detailing answers to the funder's questions. This might be the case when a generic data management description is used, a template is used that does not fit the funder's purpose, or a simple repetition is made of the brief data management text written in the grant proposal. Revisions are also asked for when critical

[18] Data Management Plan Evaluation Rubric: https://www.kuleuven.be/rdm/en/guidance/dmp/dmp-evaluation

information is missing, such as an incomplete data list or when legal or ethical issues have not been addressed in the plan. These researchers are offered a meeting with an RDM advisor to revise the DMP together. Interestingly, the percentage of doctoral researchers we needed to ask to revise their DMP was lower than that of postdoctoral and senior researchers, at 5%, 10%, and 8%, respectively).

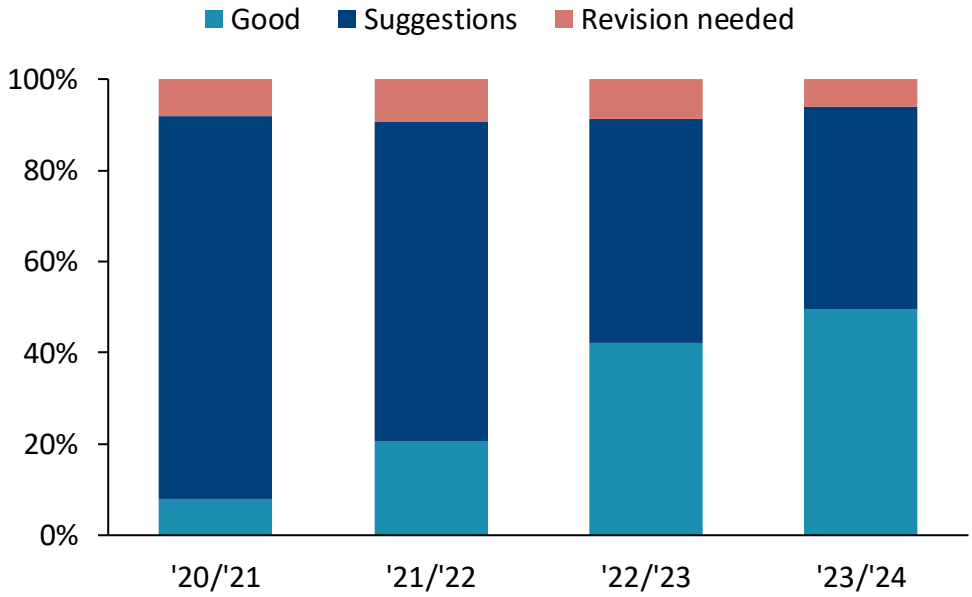

Figure 3. Results of DMP review, distinguishing good DMPs without further suggestions (light blue), good DMPs with suggestions (dark blue), and DMPs needing revision (red).

DMPs as Resource for Service Development

The fact that all DMPs for Flemish funded research projects and fellowships are submitted to the university via the DMP-MT, reviewed by RDM staff, and preserved, has given enormous advantages for the development and improvement of RDM support services at the university. The DMP-MT currently contains over 2000 reviewed DMPs. The assessment and feedback from review, as well as the textual content of individual DMPs, can be mined. These DMPs contain valuable information on research and data management practices across the university that has been actively used to shape the development and optimisation of the university's RDM support services.

For DMP support itself, we already described how the quality of DMPs at the university increased significantly over six years. On noticing the poor quality initially, which perpetuates the frequently reported idea that DMPs are considered ineffective or seen as an administrative burden to researchers (Hudson–Vitale & Moulaison–Sandy, 2019), we not only zoomed in on this aspect during reviews, but also addressed this in training and guidance. From real DMPs, detailed examples were developed on how to list data and describe their management, for use during training. We show why each topic is important to consider before data collection and how it connects with other aspects of data management. Training is thus hands-on and practical.

Development of an Interactive Storage Guide

During the first years of DMP review it was noted that many DMPs described the use of suboptimal data storage solutions for short- and long-term storage, for example using

personal storage devices, non-institutional cloud storage, or external hard drives instead of centrally managed solutions. Additionally, in the selection of institutional servers, researchers seemed confused between those for personal access, departmental access, or archival storage. The storage information described in 90 DMPs of doctoral researchers written in 2021 was shared with Information, Communication, Technology & Systems (ICTS) to highlight the problem. As a result, ICTS developed an interactive online storage guide[19] that points researchers to optimal data storage facilities, by selecting criteria that reflect the needs of their research data, such as security classification of the data, the need for collaboration and sharing of data within or outside the institution, the volume of research data worked with, the ease of reproducing the data, the need for versioning, etc. (Table 1.). Therefore, we now have a user-friendly guide to refer to if DMPs lack information on storage or when suboptimal solutions are listed.

Table 1. Criteria used as filters in the KU Leuven Storage Guide to select optimal central research data storage solutions.

What is the classification of your data with regard to confidentiality?	Not confidential Confidential Strictly confidential
Do you want to share data with colleagues?	No Yes, but only within the university Yes, with persons outside the university
What type of data do you want to store?	Research data Other
The ability to add metadata is important to me.	Yes Less important
How much storage space do you think you will need?	Less than 1TB Between 1TB and 5 TB More than 5TB
To what extent are your data reproducible?	Easy Difficult Not
Do you have special performance needs?	No, normal performance is sufficient My data interactions demand high transaction or transfer rates.
To what extent does your research depend on the continuous availability of your data?	To a minor extent Continuous availability is important Continuous availability is essential
Do you want to be able to access previous versions of the data yourself?	Yes No
How do you want to access your data?	From a browser, anywhere (https) Windows network drive (SMB)

[19] KU Leuven Storage Guide: https://icts.kuleuven.be/storagewijzer/en

From a Virtual Server (Linux/Windows)

In order to check whether this means researchers now better describe their data storage in their DMPs, we compared the storage solutions mentioned in DMPs of 99 doctoral researchers written in 2024, with those of the 90 DMPs we had analysed in 2021 (Figure 4). A higher percentage of researchers use internal servers and institutional cloud storage for their active research data in 2024 (83% vs. 75%). In addition, the use of data repositories, including GitHub and GitLab for code, has increased (7% vs. 3%). The storage of data on external or laptop hard drives has decreased (from 15% to 10%). The most notable reduction observed is in the use of external cloud services, which dropped from 7% to 0.7%. For long-term storage and preservation, the most significant change is the substantial increase in the use of data repositories, from 7% to 30%. This could be largely attributed to the introduction of the institutional data repository, RDR.

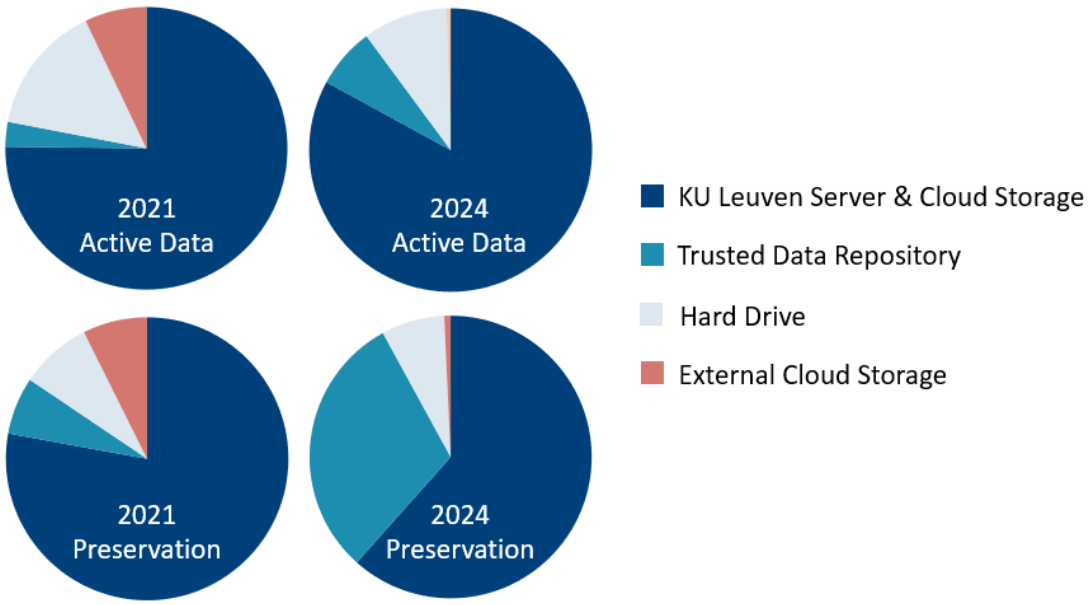

Figure 4. Storage solutions for research data indicated in DMPs by doctoral researchers.

Monitoring Ethical and Legal Compliance

An important aspect of data management is compliance with the General Data Protection Regulation (GDPR) law and national laws for experiments with human participants, human bodily material, and laboratory animals. During DMP review, we found that especially researchers in disciplines that are not traditionally trained in the handling of personal data, such as science and technology researchers doing surveys or interviews as part of their research, may overlook the need for ethical and privacy review. Although these cases are fortunately low (2% of all DMPs), compliance with privacy and ethical regulations remains crucial. These cases are therefore referred to the research integrity and ethics team so privacy and ethics reviews can be done. DMP review thus provides a backup to ensure that research complies with legal and ethical requirements, and to support researchers that may be unaware of the requirements. We also include training on the handling of personal data in research in all DMP training and have regular knowledge exchange sessions for DMP reviewers with the legal department to discuss difficult cases in DMPs.

DMPs as Source of Information for Services and Training

Reviewing all DMPs provides us with valuable insights into researchers' RDM practices. Each year, a report of these reviews is developed, which is used to decide the focus of training in the following year.

Initially, when funders introduced DMP requirements, training focused on how to develop a DMP, understanding the terminology, and other foundational aspects. In the early DMPs, we often found that the data descriptions were incomplete or some researchers claimed not to use any data in their research. The Flemish Research Data Network defines data as "any information collected or generated for the purpose of analysis to generate or validate scientific claims". We therefore ask researchers to include all data types in their DMP, including code, software, physical data such as samples, materials, or books, and literature used for text mining.

A next challenge we addressed was storage, which we tackled with the interactive storage guide described earlier. Metadata has been another topic for which researchers frequently provide incomplete information, or list standards that seem unsuitable for their discipline, without mentioning how to implement them. To address this, we now include multiple examples of how metadata can be used to document research data in a structured way during DMP training sessions. We also developed dedicated training sessions on data documentation and metadata for different disciplines that we have run annually since 2024.

Currently, data sharing has become a focal point. Our long-term storage analysis indicates a significant increase in data sharing via trusted repositories. We emphasise not only the importance of data sharing, but also best practices for making data available, for example, when research involves human participants. This includes guidance on anonymisation and pseudonymisation, and publishing metadata openly when the data remain with restricted access, available on request and after signing data sharing agreements.

The structured metadata that document all DMPs in the DMP-MT, and that can be used as filters, makes it possible to consult DMPs for RDM practices of specific research groups or disciplines when providing bespoke RDM support or training to these groups.

The search feature in the DMP-MT allows systematic textual searches for information through all DMPs. This allows searching for particular data types, metadata standards, use of electronic lab books, or data repositories used by researchers. This gives insights into topics we can address in future data management training sessions or when developing further services and support.

Some example searches are:

- A search for EGA finds 87 DMPs where the researcher plans to deposit human genome data into the European Genome-phenome Archive (EGA). That is important to know, as such deposit requires approval by the institutional Data Access Committee. We can contact the researchers to address this timely.

- In 2025, we want to focus on research software and promote the use of tools such as the KU Leuven GitLab instance. A search for GitLab finds 187 DMPs indicating the use of GitLab to manage code. And a search for GitHub finds 416 DMPs indicating the use of GitHub to manage code.

- Some researchers would like to see the development of an institutional Electronic Lab Notebook (ELN) system. A search for ELN identifies 99 DMPs. Searching for specific solutions gives 32 projects using Benchling, 32 elabJournal, ten elabFTW, nine LabCollector, and seven Mbook.

DMP Example Collection

Another need identified during DMP reviews and when liaising with researchers was for good examples of DMPs for different disciplines and funders. For this, we implemented a feature in the DMP-MT where a researcher submitting a DMP to the tool is now asked for permission to share the DMP as an example DMP within the institution. The reviewer confirms during review that the DMP is a good example, and the DMP is then automatically moved to an internal database of examples. Since DMPs may contain sensitive research information, we only share them internally within the institution. A growing collection of examples is thus available in the DMP-MT, that can be searched and filtered by funder, grant type, discipline, faculty or department, and research group. From 700 DMPs reviewed in 2024, over 160 DMPs are now included in the DMP example collection.

Conclusions and Future Direction

Over six years, data management plans at KU Leuven have evolved from low-value administrative plans containing little useful information for actual management of research data, and with researchers unsure what to write in a plan, into a rich source of information on researchers' data management practices. This not only helps researchers to manage their data well and to make more use of the available RDM services, but has also shaped the development of the university RDM support services. Thanks to the main public funder FWO expecting DMPs to be submitted to and kept by the institution, and the decision at KU Leuven to review each individual DMP developed, DMPs can be used as a resource to drive the development of data management support services to the benefit of not only researchers but also the institution. To date, over 2600 DMPs have been reviewed, and there is a collection of over 2000 DMPs in the DMP-MT, which grows by 700 extra DMPs each year. The DMP-MT itself as an infrastructure facilitates structuring and mining of DMP information. The content of DMPs has driven the improvement of their quality, but has also driven the development of services and tools that facilitate implementation of the plan into good management of data. Already now, this resource has been used to develop an interactive storage guide and to shape data management training.

This rich source of information will continue to shape support services as it tells the detailed story of researchers' data practices. Recently, we have started focusing on implementation of DMPs into well-managed research data, by visiting researchers a year into their research to discuss the implementation of their DMP and to point them to available training, support, and services where needed. Plans have started to explore the use of artificial intelligence in DMP reviews so review and detection of problem cases can be automated, and the content of DMPs can be mined to identify trends and problem areas. Discussions with DMPonline.be are ongoing towards machine-actionable DMPs that can be the foundation for an institutional data register.

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