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A Landscape Survey of #ActiveDMPs

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Abstract

Machine-actionable or 'active' Data Management Plans have gathered a great deal of interest over recent years, with many groups worldwide discussing a vision of how DMPs can enable researchers to manage their data and connect them with service providers for support. Discussions are focused on converting DMPs from a stick to a carrot. Researchers and other stakeholders must come to regard them as a benefit: something useful for doing their research, a manifest of their methods and outputs that can be used for reporting, evaluation and implementation, rather than an annoying administrative burden.

This paper reviews the work underway by different groups to gather user requirements and trial solutions. It notes several international fora where discussions are taking place and lists DMP platforms in active development. We offer a summary of where things are going, who needs to be involved and how we can include them. We conclude with next steps for machine-actionable DMPs that focus on continuing efforts to connect interested parties, share ideas, experiment in multiple directions to test these concepts and turn machine-actionable DMPs into reality.

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Introduction

The proliferation of international working groups and individual projects focused on a vision of enhanced data management plans (DMPs) signals widespread interest in repositioning DMPs as living documents, useful for structuring the course of research activities and integrating with other systems and workflows. The movement has reached critical mass now that funders are engaging directly in the active DMP landscape. In the past year, the Interdisciplinary Earth Data Alliance (IEDA) and California Digital Library (CDL) each received National Science Foundation (NSF) EAGER grants[1] to improve existing DMP infrastructure. The Wellcome Trust also revised its policy and renamed the requirement to submit an Output Management Plan that captures all outputs (not just data) related to a research project[2]. These developments indicate that everyone is thinking about how to achieve the goals of data policies – to help researchers do their research and manage their data – while reducing administrative burdens.

The transformation of static documents into active, machine-actionable[3] DMPs will provide significant benefits to the complex ecosystem of stakeholders (researchers, institutions, funders, repositories, and others) that currently employ these plans, but it will also require a significant degree of coordination to achieve practical results. Specifically, active DMPs should enable:

1. Researchers to manage, share, and discover data more easily, without having to enter the same information into multiple systems;
2. Infrastructure providers, especially data repositories, to plan their resources;
3. Institutions to provide effective data services; and
4. Funders to monitor data-related activities associated with individual grants.

Here we summarise the results of an ongoing survey of the active DMP landscape, which includes working group activities and development (both active and planned) of technical platforms. International fora and events such as the International Digital Curation Conference (IDCC), Research Data Alliance (RDA), and FORCE11 provide an opportunity to draw these threads together, share experiences, align requirements where appropriate, and create solutions that will benefit the entire research community.

Our goal for this paper is to advance the conversation beyond the customary starting point of writing a static DMP document. After deep philosophical debates about the goals, concepts, and terminology at recent meetings, we think it is practical to preserve the familiar language of DMPs and, at least for the present, to limit the scope of active or machine-actionable DMPs to what can be expressed in a template (as opposed to adding extra questions and attempting to collect every little detail about a project). Most

1 NSF Award Numbers: 1745675, 1649703, 1649555, 1649545
2 Wellcome Trust: Developing an Outputs Management Plan: https://wellcome.ac.uk/funding/managing-grant/developing-outputs-management-plan
3 Machine actionable is defined as “information that is structured in a consistent way so that machines, or computers, can be programmed against the structure.” See: https://www.ddialliance.org/taxonomy/term/198

templates are driven by questions from funders or institutions about the data a researcher *plans* to collect during a research project.

Now we want to begin talking about years of research being captured in a single DMP hub that includes an element of time. The plan will eventually become a report, an inventory of key pieces of information about a project and all of the outputs (not just data). We want to reflect on the fact that certain pieces of information only become available at certain points in time. And we want to maintain a change history of this information, which may or may not be tied to a workflow or lifecycle stages. We also want to explore the question of privacy and determine what pieces of information are sensitive, and how much information needs to be shared in order to enable machine-actionability. The next steps for machine-actionable DMPs involve answering these and other questions as a community in the context of ongoing and future projects.

The paper is structured as follows. In the first two sections we document relevant international working groups and their activities, and technical platforms with active or planned machine-actionable DMP implementations. Then we offer a brief discussion of where things are going, who needs to be involved in answering the questions outlined above, and how we can include them. We conclude with next steps for machine-actionable DMPs that focus on continuing efforts to collect interested parties from around the globe to share ideas, experiment in multiple directions to test these concepts, and turn machine-actionable DMPs into reality.

Working Groups

Research Data Alliance (RDA) Active DMPs

There are multiple international groups devoted to making DMPs active and supportive of the research process. The RDA Active DMPs Interest Group has hosted vibrant discussions at CERN and recent plenaries. In a related forum at IDCC17, California Digital Library (CDL) and Digital Curation Centre (DCC) convened a workshop with 47 participants from 16 countries to develop machine-actionable DMP use cases that resulted in a white paper (Simms et al., 2017). The community-generated ideas presented in the white paper crosscut various working group and infrastructure developments, and helped launch two RDA working groups – the DMP Common Standards Working Group and the Exposing DMPs Working Group[4] – that aim to deliver a framework for implementing machine-actionable DMP use cases across different projects and platforms. Anyone can join one or both of these groups and contribute to their deliverables over the coming months.

The case statement for the DMP Common Standards Working Group describes a community consensus about the need for common standards to integrate existing systems and enable machine-actionable DMPs. Specifically, they "will develop a common data model with a core set of elements … [and] provide reference implementations of the data model using popular formats such as JSON, XML, RDF, etc. This will enable tools and systems involved in processing research data to read and write information to/from DMPs."[5] The group is actively collecting use cases via

4 Exposing DMPs Working Group: https://www.rd-alliance.org/groups/exposing-data-management-plans-wg

5 DMP Common Standards Working Group: https://www.rd-alliance.org/groups/dmp-common-standards-wg

GitHub[6] and holding in-person meetings at plenaries and other events. Deliverables will consist of models, software, and documentation that can be adopted by DMP tools and related systems to evaluate how much information contained in a DMP can be automatically validated and which actions or alerts can be triggered, e.g., by sending notifications to repositories or funder systems.

The Exposing DMPs Working Group is working in parallel to investigate the perceived risks and benefits of exposing (or sharing) DMPs to various human and machine actors; this includes other researchers, funders, institutions, repositories, journals, publishers, and DMP tool providers. Many machine-actionable DMP use cases require access to complete DMPs and/or certain information contained in them, which are currently treated as closed grant materials. Therefore, this group will be instrumental in defining what information needs to be exposed to serve machine-actionable interests and shift DMP culture toward greater openness to advance data sharing practices. Deliverables include a use cases catalogue with implementation scenarios that articulate the benefits to researchers and other stakeholders, and a reference model that documents generic components and workflows for exposing plans (and metadata about plans).

Force11 FAIR DMPs

The FORCE11 FAIR DMPs group[7] is another community where stakeholders are discussing high-level principles for a shared understanding of what we hope to achieve with active, machine-actionable DMPs. The main objective of this group is to aggregate ideas across various communities and national contexts, and eventually distill them into a common set of principles. At FORCE17, we interrogated a draft manuscript entitled '10 Simple Rules for Machine-Actionable DMPs' that contains recommendations for institutions, funders, and other stakeholders who will ultimately drive the cultural and technical changes required to transform DMPs (Miksa, Mietchen et al., in prep).

Australian National Data Service (ANDS) DMP IG

ANDS facilitates a DMP Interest Group[8] focused on Australian and New Zealand DMP initiatives and connecting them with international efforts. In Australia, the two major research funders – the Australian Research Council (ARC) and the National Health and Medical Research Council – do not require researchers to complete a DMP when applying for a grant. However, the ARC requests that researchers applying for discovery or linkage grants include a short section that describes plans for the management of data produced as a result of the proposed research. A similar situation exists in New Zealand, where research funders do not require a DMP in the grant submission process. As a result, DMPs in both countries are driven by institutional needs rather than funder requirements.

Institutions in Australia and New Zealand have established DMPs to support best practice for research, to track and report on data assets, and to mitigate risk such as loss of data. One example is Curtin University, where completion of a DMP is a condition for all projects requiring ethics approval for research involving humans and animals, Higher Degree by Research candidacy (i.e., doctoral candidates), or access to

6 RDA DMP Common Standards Work Group User Stories: https://github.com/RDA-DMP-Common/user-stories

7 FORCE11 FAIR DMPs group: https://www.force11.org/group/fairdmp

8 ANDS DMP Interest Group: http://www.ands.org.au/partners-and-communities/ands-communities/dmps-interest-group

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institutionally managed data storage (a requirement of the Curtin Research Data and Primary Materials Policy). The mandate has resulted in a dramatic rise in the number of DMP completions.

Other institutions, such as The University of Melbourne, also have a policy-led mandate for DMPs. However, staff there and elsewhere note that researchers are quite negative about DMPs, have trouble seeing the value in completing them, and often resort to simply filling in a (DMP) form rather than actively thinking through how they will manage their data. This situation has led to discussions in the research support community about whether DMPs are failing to create the culture change they aim to inspire; in parallel, fresh new approaches to DMPs are beginning to emerge, as described below.

Technical Platforms

As conversations about active DMPs multiply and evolve, an increasing number of projects are experimenting with implementation. Table 1 lists platforms that are currently under development or that have future plans in this space. We advocate for experimentation in multiple directions and discuss briefly the complementary objectives defined by these projects, as well as opportunities for direct collaboration or integration. The table is a first attempt to capture and connect active projects; we intend to update it as we continue to learn about new projects.

Table 1. Technical platforms with potential applications for machine-actionable DMPs.

Platform	Organisation(s)	Resource links(s)
DMPRoadmap	California Digital Library	https://github.com/DMPRoadmap/roadmap
	Digital Curation Centre	
	Portage Network	
	INIST CNRS	
University of Queensland Research Data Manager (UQRDM)	University of Queensland	https://research.uq.edu.au/project/research-data-manager-uqrdm
ReDBox DLC	Queensland Cyber Infrastructure Foundation	https://www.redboxresearchdata.com.au/rbdlc.html
(new DMP tool under development)	University of Auckland	https://doi.org/10.17608/k6.auckland.c.3912652.v1
RDMOrganiser (RDMO)	Leibniz Institute for Astrophysics Potsdam (AIP), Potsdam University of Applied Sciences (FHP), Karlsruhe Institute of Technology Library (KIT)	http://rdmorganiser.github.io/en/

Platform	Organisation(s)	Resource links(s)
Data Stewardship Wizard	ELIXIR Europe, Dutch Techcentre for Life Sciences (DTL)	https://github.com/DataStewardshipWizard
ezDMP	Interdisciplinary Earth Data Alliance (IEDA)	https://www.iedadata.org/ https://www.rd-alliance.org/system/files/documents/4-RDA10-Lehnert-ezDMP.pptx
easy.DMP	UNINETT Sigma2 / NorStor Research Data Archive	https://easydmp.sigma2.no/
DMP Service	OpenAIRE and EUDAT	Public beta due in February 2018

Table 1. (continued)

The DCC and UC3 team at the CDL have developed and delivered DMP tools since the advent of open data policies in 2011. DMPonline[9] (DCC-UK) and the DMPTool[10] (CDL-US) are now established in our national contexts as the resource for researchers seeking guidance in creating DMPs. With the spread of open data policies and explosion of interest in both of our tools across the globe, we joined forces in 2016 to co-develop and maintain a single open-source platform for DMPs called DMPRoadmap. The new platform will be separate from the services that each organisation runs on top of it, but will create a common foundation to consolidate value upstream for the growing list of local installations across the globe.[11] Development teams from the Portage Network in Canada and Inist-CNRS in France have already contributed to the project. Following the release of v 1.0 in the coming months, we will shift our focus to implementing and testing machine-actionable DMP use cases (Simms et al., 2017). We also plan to adopt the recommendations of the RDA working groups.

The University of Melbourne opted for an educative approach to DMPs, rather than capacity planning. The Digital Scholarship team (Library) mapped sections of their DMPMelbourne[12] tool (a customised version of DCC's DMPonline) to the relevant sections of 'Managing Data @ Melbourne,' an online training course based on The University of Edinburgh's MANTRA.[13] The University of Utrecht in the Netherlands has echoed this approach after hearing about Melbourne's lessons at IDCC17, structuring their new online data management training around the themes addressed in a DMP. Melbourne recently reworked its training program to align with specific University and Australian requirements, with a focus on local researchers' needs. They are evaluating the efficacy of this approach (DMP tool and jointly packaged training) through a research project and continue to engage actively in the international machine-actionable DMPs discussion. DMPMelbourne has migrated to the DMPRoadmap

9 DMPonline: https://dmponline.dcc.ac.uk
10 DMPTool: https://dmptool.org
11 DMPRoadmap Local Installation Inventory: https://github.com/DMPRoadmap/roadmap/wiki/Local-installations-inventory
12 DMPMelbourne: https://dmp.research.unimelb.edu.au
13 See https://www.slideshare.net/AustralianNationalDataService/dmpmelbourne-lyle-winton-and-peter-nash

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codebase to benefit from future enhancements, and at the same time they will contribute their experiences back to the core project.

The University of Queensland developed an innovative approach to DMPs through their Research Data Manager tool. In order to divert researcher efforts from completing lengthy and 'labyrinthine forms' often resulting in a 'throw-away DMP,' the team renamed to creating a 'Data Management Record' and refocused the exercise to encourage researchers to actively manage their data at the project level, not just the planning stage. DMRs leverage a new identifier service called RAiD (Research Activity Identifier)[14], which assigns a PID to research projects and activities. The UQRDM system was formally launched on 5th January 2018 and the group is currently working with the university legal team to get the code released under open licensing. The tool captures metadata about people and projects – dubbed the 'minimum viable metadata' – that can be entered manually or from other systems, and publishes a record with a RAiD. The DMR includes an optional DMP component and can allocate storage space for data deposits and provide a metadata harvest point for Research Data Australia, a national web portal for discovering data collections produced by, or relevant to, Australian researchers. Future enhancements include international federated login for collaborative projects via eduGAIN, harvesting additional PIDs (ORCID iDs, GRID, etc.), and exploring LinkedIn as a mechanism for linking to research outside of academia.

Another new DMP tool that employs the RAiD service is ReDBox DLC, developed by the Queensland Cyber Infrastructure Foundation to support the Australian Research Data Life Cycle Framework. ReDBox has a three-fold purpose of being a DMP-creation tool, enabling the registration of research projects and resulting data, and creating a mechanism to identify projects that may benefit from referral to eResearch tools and services, such as virtual laboratory platforms and cloud storage solutions. The goal is to assist researchers at the Australian universities that have adopted the platform with managing their data by integrating and automating various components of the ecosystem; v 2.0 is due for release in 2018.

In New Zealand, the University of Auckland has taken a design-thinking approach, engaging over 400 researchers in activities to inform the creation of a new DMP tool. This work includes workshops and interviews, and a doctoral candidate mapping journey. Their goal is to create a DMP tool that is researcher-centric, machine actionable, embedded and integrated across the research ecosystem and the research (data) lifecycle.

RDMOrganiser (RDMO) is a DFG-funded project that also aims to link DMPs with other activities and systems across the full research data lifecycle within the context of German institutional infrastructures. It aims to enable institutions and researchers "to plan and carry out their management of research data."[15] The main functionality of RDMO is comparable to the DMPRoadmap platform, providing users with the ability to answer questions based on a number of existing funder templates, share projects with collaborators, create snapshots and export plans. One significant difference is that the platform is designed to be deployed and managed at the local institutional level rather than hosting a centralised national instance, though a demo is provided. Future enhancements also include adding support for repositories and identifier systems, repository recommender and cost estimation services, and participation in the RDA DMP Common Standards efforts.

14 Research Activity Identifier: https://www.raid.org.au/
15 RDMO Demo: https://rdmo.aip.de/

The Data Stewardship Wizard is a tool that steps researchers through creating DMPs, with an underlying Knowledge Model optimised for the life sciences and FAIR data initiatives in Europe. The detailed knowledge model is stored in JSON and includes a validator. Members of the project team are also engaged in the broader machine-actionable DMP community and are keen to integrate their tool with other systems to offer discipline-specific guidance.

The IEDA DMP Tool allows researchers to generate a DMP for inclusion in U.S. National Science Foundation (NSF) proposals, especially those related to solid earth data. The project team is currently enhancing the tool – renamed ezDMP – with funding from the NSF EAGER program to create more structured and machine-readable DMPs. The prototype will focus initially on the Geoscience, Biological Science, and Social Behavioral and Economic Science directorates of the NSF, with future extension to other directorates.

The Data Planning tool offered by UNINETT in Norway is focused on the NorStor High Performance Computing context. Based on SurveyMonkey-style webforms, a series of questions are asked to elicit information that assists in data management planning and service resourcing. This tool has been used as the basis for the DMP Service currently in development by OpenAIRE and EUDAT, for which a public beta is due to be released in February 2018. This forthcoming tool is structured around dataset profiles, which define the attributes of a dataset description and allow for their validation. Data Management Plan profiles will be supported in future work.

Many of the technical platforms are driven by funder mandates that require a DMP as part of a grant proposal, especially in the US, UK, and EU. The DMR project in Australia, where researchers are largely unencumbered by funder mandates, introduces some refreshing new approaches (e.g., defining the minimum viable metadata for a project) and is focused more on helping researchers do their research, as well as promoting the use of national infrastructure. The Data Stewardship Wizard offers tailored DMP guidance for a particular domain, which is a high priority for future development across all domains and was flagged as a key user need in the recent survey on Horizon 2020 DMPs (Grootveld et al., 2018). It is also encouraging to note how many are concerned with user-centered design. In order to be successful, any technical solution or enhancement for DMPs must convey obvious benefits (such as reducing the need to enter information in multiple places), be easy to use, and fit seamlessly into established research practices and workflows.

These technical projects are underway with complementary objectives and opportunities for direct collaboration or integration, and we are gratified to count them among the usual suspects in DMP working groups. All are candidates for adopting the recommendations of the RDA Working Group to test what information can realistically be exposed and passed between systems. The higher the level of adoption of common standards, the greater our chances for achieving the vision of machine-actionable DMPs. We suspect many others are planning or actively engaged in similar work and invite them to share their perspectives, requirements, and experiences via direct participation or simply adding their projects to the Active DMPs list online[16]. We also encourage all active DMP projects to engage in the international fora and share their code, preferably under an open licence, to enable the community to collaborate and advance solutions more quickly.

16 See: https://activedmps.org

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Discussion

We think the timing is ripe to elevate the discussion and increase the doing with regard to machine-actionable DMPs. As a community we have described the myriad challenges posed by traditional DMPs and expected benefits of machine-actionable DMPs. We are also beginning to cohere around shared principles and a broader vision, particularly through the activities of the RDA Common Standards Working Group and Force11 FAIR DMPs group. Reviewers for this paper asked us to address the most important question of all: how do we make the transition from research and development to building consensus around an infrastructure, and mitigate against the risk of this becoming an academic exercise?

First, we would push back on the notion of a universal machine-actionable DMP infrastructure. To be successful some level of coordination and scale is required, but we must acknowledge the reality that practices and workflows will always be highly variable across different countries, funders, institutions, systems, and disciplines. This is why it is important for the community to continue investing its time and energy in establishing a network of partners representing all stakeholders – e.g., under the auspices of the RDA – to agree on a set of requirements. We can and should experiment with different forms of implementation, in a transparent and collaborative manner to maximise the opportunities for success. Research data management is a complex, international ecosystem of human and machine actors and successful solutions for machine-actionable DMPs require a high degree of coordination among them. We also want to emphasise the critical role of human actors and remind ourselves that we cannot solve social problems with technology alone.

We agree that one way to make DMPs more useful is to transform them into living documents, but how do we operationalise this? For example, in the planning stages of a project researchers can only estimate the amount of data they will produce and select a data repository for eventual deposit. The basic project metadata and estimated data volume should be passed to that data repository, which can then allocate space. By the end of the project, the repository operators will need precise details about the amount and type of data in order to ingest the data. Funders, in turn, need to know that the data have been deposited successfully. We want machine-actionable DMPs and the supporting platforms to automate these tasks by sending notifications, or integrate with other tools that provide automation. But first we must understand the needs of each stakeholder and how they change over time. Some of the questions that need specific answers include:

- Who are the stakeholders at each lifecycle stage?
- How does available information change over the lifetime of a project/DMP?
- How does the need for information change over the lifetime of a project/DMP?
- What information contained in a DMP can be open and how do we manage access for those pieces of information that cannot be shared openly?

All stakeholders need to be involved in answering these questions, which requires building more relationships, within and across domains. We need to encourage dialogue between researchers and funders, across groups at the institutional level (e.g., connecting libraries, IT departments, Offices of Research, academic departments) and at the cross-national level through fora such as RDA and Force11. Recent meetings in the

USA and Europe have sought to bring together stakeholders to define concrete next steps in this very way. An AGU Enabling FAIR Data[17] meeting drew a wide range of stakeholders including program officers from NSF Geoscience directorate, USGS programs, NOAA and NASA to discuss data policies across the earth and space science journals. In Europe the EOSC Summit[18] brought together representatives from different member states, funders, e-infrastructure providers and disciplinary groups to build consensus on the implementation plan and next steps. The resultant EOSC Declaration remarks that:

> 'A key element of good data management is a Data Management Plan (DMP); the use of DMPs should become obligatory in all research projects generating or collecting publicly funded research data, based on online tools conforming to common methodologies. Funder and institutional requirements must be aligned and minimum conditions for DMPs must be defined. Researchers' host institutions have a responsibility to oversee and complete the DMPs and hand them over to data repositories' (European Commission, 2017).

Work is already underway by groups such as Science Europe to harmonise data policy and define Domain Data Protocols to assist in the development of DMPs suited to each disciplinary context. OpenAIRE and the FAIR Data Expert Group[19] have also been engaging with the European research community to understand their needs and experiences of developing DMPs to identify priorities for tools and support (Grootveld et al., 2018).

It is not possible or practical for everyone to attend everything, which is why we propose the #ActiveDMPs channels listed in the following section as a forum for collecting all the threads. Working together we can build and test things, iterate and prove out concepts in practice. This will also provide a forum to describe ongoing projects and plans, enabling collaboration with other related initiatives in the space such as Scholix, Make Data Count, FAIRsharing, Re3data and journal data policies.

Next Steps

To facilitate conversations and coordination of effort across this dynamic space, we plan to share the contents of this paper in a neutral forum that is not connected to any particular group or organisation: ActiveDMPs.org[20]. To amplify the signal we also registered a new Twitter handle @ActiveDMPs[21] and encourage the use of the #ActiveDMPs hashtag. We hope to reach a broader audience and draw new voices into the mix as open data policies proliferate across the globe. Recently, individual universities, funders, and government organisations from across Europe, South America, Asia, and Africa have contacted us for reciprocal information exchange about DMPs and to get involved in machine-actionable initiatives. We see the need for a

17 AGU Enabling FAIR Data: http://www.copdess.org/home/enabling-fair-data-project/
18 EOSC Summit: http://ec.europa.eu/research/index.cfm?eventcode=44D86060-FBA1-1BD1-9355822B162BB0EE&pg=events
19 FAIR Data Expert Group: http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3464
20 Active DMPs.org: https://activedmps.org
21 ActiveDMPs Twitter account: http://twitter.com/ActiveDMPs

central hub of information to continue sharing use cases, pilot projects, and galvanise the community around a future world of active, machine-actionable DMPs.

DMPs are a key component of a much larger conversation about open science (or open scholarship). Cultural change is a slow process, much slower than our aspirational timeline for implementing machine-actionable DMPs, but the mission alignment is clear. In order to advance both causes, we should be focused on converting DMPs from a stick to a carrot. Researchers and other stakeholders must come to regard them as a benefit, something useful for doing their research, a manifest of their methods and outputs that can be used for reporting, evaluation and implementation rather than an annoying administrative burden. How do we leverage machine-actionable DMPs to help researchers do their research? By addressing this question we can reduce barriers and potentially change attitudes toward open science.

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