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A RESEARCH DATA MANAGEMENT PLAN

FOR

**THE DEPARTMENT OF MECHANICAL ENGINEERING,
UNIVERSITY OF BATH**

MANSUR DARLINGTON & ALEX BALL

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Catalogue Entry

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Description	The purpose of this Departmental Research Data Management Plan is to support principal investigators, project, data and research managers and researchers and others, such as service providers, in performing data management at the project level. It does this in three ways. First, it specifies how projects should use data management plans: where they should be stored, how open they should be, expectations for review and revision, and so on. Second, it provides a template for project data management plans. Third, it recommends tools that can be used for data management, and additional guidance that may be consulted.
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1. INTRODUCTION

The need for better management of research data is increasingly becoming understood not only by those who collect and generate data for research first use, but also by those who have a research funding or governance rôle.

The motivation for better management comes from the recognition that the best return on the investment made in data acquisition can only be realized through using it in the most effective way and by maximizing its sharing and re-use. Better data management aimed at promoting enhanced availability of and easier access to existing data can result in a number of benefits. These include reducing the need for redoing work, making research work more transparent, providing a basis for validation of work and making the repetition of collection or generation unnecessary.

As a result it is now becoming more usual for research funders to expect evidence of formal data management planning as early as in the initial bid for funds, with detailed plans being required early in the management of a funded project.

As a prime recipient of, amongst other, EPSRC funding the University of Bath is required to show evidence of research data management strategy and policies, and that it has in place the necessary infrastructure to allow those policies to be implemented.

In the following pages is presented a Research Data Management Plan for the Department of Mechanical Engineering at the University of Bath. This plan (and its future manifestations) is one of the elements which will be provided to support research data management at the University. The plan will be referred to henceforth in this document as the ME-RDMP.

The ME-RDMP is department-level plan which should be seen as a specification for each project-level plan which will require to be prepared for execution based on the specific requirements of the project and the nature of the data that are expected to be collected and generated during the project.

This document is a deliverable (Deliverable 2) for the REDm-MED Project funded by JISC as part of the second phase of the MRD Programme, a wider exploration into managing research data resulting in the provision of policies, methods, procedures and tools in support of such management.

The ME-RDMP is based on some of the precursor work and deliverables from the [ERIM Project](#) and a number of precursor documents (e.g. McMahon, et al. 2009; DCC, n.d.). In addition, the detail of the plan is a response to the requirements specifications contained in the *Research Data Management Plan Requirements Specification for the Department of Mechanical Engineering (RDMPRS)* at the University of Bath (Darlington & Ball, 2012), itself a deliverable (Deliverable 1) of the REDm-MED Project.

It should be noted, that some of the infrastructure and the supporting guidance and documentation necessary for implementation of this departmental research data management plan is the subject of deliberation at the institutional level as part of the Research 360 Project under the auspices of the University of Bath Research Data Steering Group.

Currently, the first point of contact for advice on research data management matters is the [Institutional Data scientist](#), and the first source of published information is the University of Bath [Data Management Web Site](#) (UoBDMWS), currently hosted by RDSO.

1.1 Research Data and the Department of Mechanical Engineering at the University of Bath

The Department of Mechanical Engineering is typical of many in that it undertakes a spectrum of research projects all of which, of course, generate research data, but for which the practice of formal management of data is in its infancy. Earlier work (identified above) shows that the character of the research projects undertaken in the department is one of great diversity; likewise, the data generated by these projects are very diverse in nature.

In order for data management in the Department to be carried out on a project-by-project basis it is necessary to have management procedures in place to support this process – together with a suitable infrastructure – including a department-level data management plan from which a specific management plan can be drafted as appropriate to the character of each individual project and its research data. The ME-RDMP is just such a department-level plan.

The Department can be considered representative of many groups of researchers in terms of its generation, development, use and archiving of research data, and the attendant problems of research data management. As a result, many of the details of its data management plan will be generalizable directly to other research centres the research data characteristics of which are similar. This will include not only other departments of mechanical engineering but, more broadly, the departments of engineering with other research specialities. Further, given the very broad nature of the research data encountered in engineering research it may be that parts of the DMP would be usefully adopted outside the sphere of engineering research. Necessarily, some of the implementational recommendations will be unique to the Department given its local research support infrastructure and research activity organization and culture.

1.2 The purpose and scope of the ME-RDMP

The purpose of the ME-RDMP is to provide data management planning support to those such as principal investigators, project, data and research managers and researchers and others, such as service providers, who have a need to develop, manage, execute, or to provide support for, the individual project-level data management plans which will be derived from this department-level plan and which in most cases will be a mandatory governance requirement for a funded project. In fulfilling this purpose, the ME-RDMP satisfies the broader requirements of the Department's main funder, the EPSRC, in providing a functional mechanism for the proper governance – with respect to research data management – of the research that it supports. Such a DMP will also serve to satisfy many of the data management requirements that might be mandated by other funders, including those from industry.

The ME-RDMP provides the support necessary to manage data throughout the research life-cycle, including data preparation and development activities; and creation, development and execution of *project* data management plans. In doing so it will be

necessary to identify not only the processes and procedures necessary for data management, but also the infrastructure to support such processes and procedures. Such infrastructure will include physical elements, services and tools.

The ME-RDMP is constructed in such a way as to make general reference to components of the infrastructure. Detailed and up-to-date information on all aspects of the infrastructure necessary to plan for the management of and manage research data is held on the [UoBDMWS](#), which can be readily updated in line with the development of research data management at the University of Bath, and the development of supporting services, guidance and tools.

1.2.1 Research life-cycle support

It is intended that the ME-RDMP and project-level DMPs specialized from it will fulfil the needs of:

- data management planning,
- data management execution,
- bid submission,
- project planning,
- doing the research,
- collaboration with colleagues, industry and others,
- supporting data re-use, re-purposing,
- preparation for long-term preservation,
- end-of-life,

in accordance with the policies, procedures and provisions laid down by the institution and the department's funders as motivated by the desire to maximize the value of research data both during its first use and thereafter.

The items identified above constitute the research project life-cycle tasks, some of these being continuous and overlapping during the life of a project.

1.2.2 Data preparation support

The plan will include provision for the management of both physical (paper documents and research artefacts) and digital **Records**.

The plan will support three types of data preparation activity, identified and defined by the authors during the ERIM Project:

1. making existing research data available and fit for a future known research activity (*data re-purposing*);
2. managing existing research data such that it will be available for a future unknown research activity (*supporting data re-use*);
3. using research data for a research purpose or activity other than that for which it was intended (*data re-use*).

To these activities will be added any that are required additionally expressly for making data ready for long-term preservation through archiving.

1.2.3 Project-level research data management planning

The ME-RDMP should be seen as a broad specification to be used for development of the individual data management plan required for each research project carried out in the Department.

In the first instance the development of such a DMP will be to the extent necessary that it conforms to the requirements of and supports the PI in bid planning and submission.

Then, each complete project level-DMP produced as a specialization of this department-level DMP will have two functions. In the first instance, it will act as a guide to researchers on re-using existing data, re-purposing their own data and supporting data re-use throughout the **Research Activity**. At the end of the Research Activity, its purpose is to act as a record of how the data have been re-used and re-purposed, where applicable, and how data re-use has been supported. Further, the DMP will provide information about the location, accessibility and ownership of the data associated with a project as a means of supporting the principal motivation of research data management which is to promote second use.

It can be seen that much of the data management necessary to fulfil the two functions referred to above must be made during the research activity, since it is during this activity that most is known, and can be recorded about, the data, and the most effective actions can be taken for supporting the three types of activity outlined above.

Many of the terms used in this document have been defined in Howard, et al (2010) in a terminology for research data management; the key definitions in their entirety can be accessed in the on-line [terminology](#) and those used within this DMP can be found in a glossary, in Appendix A to which they are hyperlinked at first use here.

1.3 Tools and Guidance for the execution of Project Data Management

While every effort has been made within the ME-RDMP to recommend guidance and tools to be used to support and execute data management at the project level, gaps remain in some areas. The primary reason for this is that mature, intuitive tools and practice-based guidance documents do not exist for all the tasks necessary for good data management, though much work is in progress to remedy this situation. The ME-RDMP will be updated periodically to reflect this ongoing development of tools and guidance.

Between such revisions, PIs, Data Managers and Researchers are encouraged to direct queries to research-data@bath.ac.uk, the email address provided by the University for supporting the management of research data across the institution. Requests sent to this email address are being handled by the Institutional Data Scientist and by members of the Research360 project team, including the Technical Data Co-ordinator and BUCS.

General information on up-to-date tools and guidance for different aspects of data management will be found on the University of Bath [Data Management web site](#) (UoBDMWS). Here PIs, Data Managers and Researchers will find information to help them make choices appropriate to the demands of their project. When such tools or guidance become adopted at an institutional or Departmental level they will become integral to the recommendations in this document. Further expertise may be found on the website of the [Digital Curation Centre](#) (DCC) where, amongst other things, a

helpdesk service for answering specific queries is provided. Another possible source of expertise is the [Research Data Management discussion list](#) which is provided by JISC.

2. A DATA MANAGEMENT PLAN FOR THE DEPARTMENT OF MECHANICAL ENGINEERING AT THE UNIVERSITY OF BATH (ME-RDMP)

The ME-RDMP should be used in its entirety – together with such tools as are available – to guide the process of developing a DMP for a specific Research Activity. Such a plan is referred to henceforth in this document as the **Project Data Management Plan** (Project DMP).

Provision of a draft Project DMP, which fulfils the requirements outlined, may be a requirement of the bid for project funding and then subsequently, in completed form, as part of the funder's requirement for project governance. Reference should be made to the documentation on funder requirements created by the DCC and linked from the [UoBDMWS](#). At the same time, the University itself mandates the development and documentation of a data management plan for each project (see Section 2.1.4.).

The ME-RDMP which follows is composed of two parts. The first part – Section 2.1 Infrastructure and Implementation Issues – concerns matters which must be in place in order for development and provision of data management plans and for researcher-based data management (carried out during the research activity and specified in the second part) to be supported and carried out satisfactorily. Details of the implementation of these form part of this DMP. The second part – Section 2.2 DMP Contents – provides details of the plan itself which will provide guidance and prescription for the implementation at the time for each Research Activity (project) and associated **Data Case**. Thus, it is assumed that for each research project in the Department, a data management plan will be produced using the guidance found in the ME-RDMP, taking into account the special needs which will spring from the particulars of the research activity and the data being managed. The DMP will take into account both management of research data and management of other information associated with the project.

Throughout the following, as appropriate, each management item below will be cross-referenced to the requirement specification(s) satisfied by it. To this end the requirement specification number(s) (as identified in Darlington and Ball, 2012) will be appended in brackets after the sub-heading text. A correlation between the requirement specification and the satisfying data management intervention documented below can be seen in Appendix B.

2.1 Infrastructure and implementation issues

Delivering and executing a Project DMP is dependent on certain supporting mechanisms either being in place as part of the Department's management infrastructure or being put in place as part of execution of the Project DMP. These items are enumerated below in terms of the functions they will support.

2.1.1 Relating the DMP to other documentation (RS1)

The Department data management plan, and any Project DMPs that are a specialization of it, is informed by a number of key documents, each of which is available for inspection:

[The University of Bath Code of Practice in Research](#)

Research Data Management Strategy and Draft Strategic Plan 2012-2015.

[RCUK Policy and Code of Conduct on the Governance of Good Research Conduct](#)

In addition, of particular importance – because of the EPSRC’s important position as funder of both the University and of the Department of Mechanical Engineering projects – is the on-line research data management [expectations guide](#) published by the EPSRC.

Items of documentation specific to a research project or research activity should be identified, along with their locations, within that research activity’s Project DMP. In order to conform to the requirements for perpetuated discovery of and access to project RDM documentation, the following key documentation (at least) should be identified:

- The project proposal document.
- The detailed project plan(s).
- The **Project Record Manifest**.
- Confidentiality agreements (where such agreements are themselves not confidential).
- IPR statements and other documents that affect how the research data may be used.

Uniquely important amongst these documents will be the project record manifest. This [template-based](#) document will list all key project documents and other records and their associations, locations, authors and access particulars.

In addition to this the locations should be given of any other management documents relating to the research activity or protocols, regulations or procedures for carrying out the research activity. These might include requirements and guidance from a receiving repository, if any, in relation to data management, ethics forms, etc.

Ideally, in the interests of making research data discoverable, accessible, interpretable and usable, the items identified above should be freely accessible. Care must be taken, however, to ensure that sensitive and confidential information is protected in an appropriate manner. Where this is an issue, the items in question should be kept in secure, password-protected locations accessible only to those with the necessary authority or clearance. The responsibility of ensuring appropriate sharing or protection of documentation rests with the PI who, if necessary, should take advice from the University of Bath Legal Department. For the reasons given above, though, PIs should consider making redacted versions of sensitive documents freely accessible and, where possible, making the full documentation available once the information contained therein is no longer sensitive or confidential.

The location of electronic records should in general be identified using, where possible, an embedded URL (i.e. a hyperlink). For physical records (including physical specimens or objects, which represent ‘data’) a description of the physical location should be given, together with the name and contact details of the owner of the records.

To ensure persistence of the information a description of the physical object, with information about its ownership and location should be placed on a secure, persistent wiki page (see the following sub-section below) dedicated to this function. All references to the location and ownership should be made on this page, a reference to which should be placed in the Project Record Manifest in the section related to project management documentation.

Providing Access-free and Access-restricted Collaboration Space

By its nature, some project management documentation and a large proportion of, specifically, data management documentation must be universally accessible. To this end, a Project Data Management wiki page should be created on the [Departmental Research Data Management wiki](#) in the appropriate place. Any such documentation that can be made freely accessible should be attached to, or included in a child page of, the Project Data Management wiki page. That page should also contain links to where further information can be found, both public areas (e.g. project web site, project blog) and private areas (e.g. X drive directory, project intranet).

For the storage of sensitive research project documentation, the use of University of Bath wiki pages is recommended. For each project a project wiki space should be created by the principal researcher or designated project manager. This space can be used for activities during the course of the project (e.g. project management and communications and deliverable and paper co-creation, etc.) and to provide access to and redirection to project management documentation and research data both during and after the project. An alternative to the use of the [University of Bath wiki](#) space is use of other institution-provided tools such as [iSusLab](#), which provides the support necessary for team-based research activity. The choice of collaborative tool is left to the PI or project manager.

To ensure persistent access to information about project documentation and data it is necessary to arrange for the space to be controlled in various ways. As a matter of policy, any page intended as a persistent location for a document should not have its name changed, as such changes may break incoming links. Usually it is necessary to have working space for the project the access to which is limited to those in the research group. By default when a new ‘space’ is created in a wiki the parent node is designated as ‘Home’ and all other pages are then children of the home page. As children they inherit any access characteristics of the home page, so if the home page is restricted to a user base – which is likely to be the case for research projects – then so too will all other pages. Child pages can also have additional restrictions placed on them, using the ‘Restrictions’ section at the bottom of the editing screen. With platforms such as iSusLab, access will always be limited to a user group.

2.1.2 Relating other documentation to the DMP (RS1, RS20)

A system must be in place to allow readers of high-level project documentation and users of the Data Case itself to find the corresponding DMP. To satisfy this requirement, the Project Data Management wiki page in the BUCS-supported [Departmental Research Data Management wiki](#), described in the preceding section, must provide a link to the Project DMP. Ideally the Project DMP should be attached to the Project Data Management wiki page, or be one of its child pages.

2.1.3 *Understanding the DMP (RS1)*

A system must be in place to allow readers of the Project DMP to find and read its precursor documents. To this end, the URL of this document, the ME-RDMP (redm1rep120207mjd12), and the higher-level specification ‘The Mech. Eng. Research Data Management Plan Requirement Specification’ (redm1rep120105mjd11) will be embedded in the Project DMP.

The URL for the ME-RDMP (i.e. this document) is: <http://opus.bath.ac.uk/30099>

The URL for the RDMP requirement specification is: <http://opus.bath.ac.uk/28040>

2.1.4 *Rôles and responsibilities (RS9)*

The responsibilities for writing, implementing and reviewing the Project DMP are shared between a number of rôles within the Department, as dictated ultimately by [The University of Bath Code of Good Practice in Research](#):

‘Research data management and archiving is the responsibility of the principal investigator (PI) for each project and must be considered from the outset of new projects. Research data management plans should be drawn up. ... Oversight of the management and archiving of research data generated by postgraduate research students is the responsibility of the lead supervisor, reporting to the project PI where applicable.’

It is implicit in this that the project data management requirements be considered, according to the perceived needs of the project research, at the time of development of the project submission document. As noted earlier is likely that delivery of a complete Project DMP, either as part of the submission document or as an early deliverable, will be required by the project funding body. The task of origination of the Project DMP will fall, accordingly, either to the author of the project proposal or another person, probably the project researcher or, in larger projects, to a project manager. The name of the plan’s authors and their contact details should be appended to the Project DMP and be kept up to date.

For specialist data management planning advice at the institutional level and current information on such things as funder requirements the [Institution Data Scientist](#) should be contacted.

2.1.5 *Creation and development of the Project Data Management Plan*

This document – the ME-RDMP – provides the foundational information for the creation and development of the Project Data Management Plan. Section 2.2 below identifies the key components of the plan itself.

For initial creation, and subsequent through-project development of the Project DMP, it is strongly recommended that use be made of the [DMP Online](#) tool, which is provided by DCC. This tool contains a template that reflects the local needs of the Department of Mechanical Engineering (visible under ‘Institutional templates’ when creating a new DMP) and provides DMP creation and versioning support. The outputs of the tool, that is, the initial DMP and any subsequent versions, are stored on the DMP Online site where they can be accessed and revised as necessary. Users of the service are strongly advised, however, to export copies of these outputs and store them locally. It is recommended that the file name and versioning for these exported DMPs conforms to the [guidelines for project documentation file naming and version control](#) specified for

research data management for the Department of Mechanical Engineering. The Project DMP will uniquely have the document type 'dmp' as part of the file name.

There may well be a good reason for using other tools to create a Project DMP. If the choice is made not to use the DMP Online tool the rationale for the choice should be included in the project documentation.

The Project DMP may be created either as a wiki page within the project documentation or as a stand-alone document attached to it. In the latter case, the same recommendations apply for file naming and versioning as for DMPs exported from DMP Online. All such documents should be given the most liberal access permissions appropriate to the confidentiality or sensitivity of the documents.

Further advice on creating a DMP may be found on the [UoBDMWS](#) and the [Departmental Research Data Management wiki](#).

2.1.6 Review of the DMP (RS16)

The Project DMP acts as guidance and as a record of activity. Provision of the Project DMP will fulfil the governance requirements of the University and the funder and will provide the *potential* for good data management. Implementing and conforming to the Project DMP will promote good data management practice and result in better managed data, making its use and re-use more effective.

To ensure conformance with and accuracy of the Project DMP, and to ensure that the data management arrangements best support the research data as the research activity unfolds, reviews of the Project DMP will be required during the project. The timings of these reviews, perhaps being included in regular project meetings, will be recorded in the Project DMP itself, under this heading.

2.1.7 Revision of the DMP (RS16)

The DMP is not a static document, but should be updated throughout the project to reflect what actually happened. It is therefore important that the versioning and amendment history of the DMP be created and maintained.

For stand-alone documents, such as those created using the DMP Online tool (see Section 2.1.5), two practices will together satisfy the requirement. First, versioning should conform to the Department [guidelines for project documentation file naming and version control](#). The Project DMP will uniquely have the document type 'dmp' as part of the file name. Second, change dates and authorship should be recorded within the Project DMP, together with author contact details.

A Project DMP created as a wiki page will have its revision history tracked automatically by the system.

2.1.8 Budget (RS7)

It is recognized by funding bodies that costs for data management will be accrued as a result of expenditure of management time and for storage. A number of these bodies (e.g. ESRC, BBRC, NERC and Wellcome Trust) expect that these costs are identified in

the project submission budget and that they will be met by them as part of the full economic costing of the project. Currently the EPSRC does not invite the identification of data management costs in their bids for funds; data management costs are to be met within indirect costs by the institution. It is not clear how this arrangement will work at present since there is no way of indenting for during-project management time.

In respect of data storage costs, it is BUCS's [current policy](#) to provide 1 terabyte of storage per project free; further space being charged per terabyte. It is recommended that for projects where the storage requirements are likely to be greater than 1 terabyte, these are discussed with BUCS early in the process.

Where the funder expects to meet such costs, the cost of implementing the Project DMP and, if appropriate, future preservation activity, should be estimated and factored into the project budget. It follows that a data management plan of detail sufficient to identify the data management budgetary requirements will be a required part of any funding submission. Some general guidance on the topic of [costing research data management](#) activities is provided by the UK Data Archive and a costing tool is available. Likewise some guidance can be had from the [Keeping Research Data Safe](#) cost/benefit analysis. Currently, however, there is little practical experience of research data management costing and – with the exception of the assessment of storage costs – no ready information that may be relied on by which accurate predictions can be made about project-related RDM costs so that appropriate funds may be requested during grant submission. Until such time as personal expertise can be acquired or reliable advice is published, an educated guess necessarily must be made by the PI.

2.1.9 Data Security (RS2, RS11, RS13, RS14, RS15)

In making data management provision it is important that steps are taken to ensure that research data (in the form of **Data Records** both physical and electronic, and physical specimens which represent data) are not lost, and are made accessible only to those who are entitled to see them. Both loss prevention and the maintenance of confidentiality rely on appropriate storage and access provisions being made.

Planning to Prevent Loss

A digital [research data storage policy](#) is published by BUCS. All data placed on BUCS-provided space will be the subject of university-wide back-up policies, for the length of time published by BUCS. In general these will conform with the legal and governance requirements mandated by government and by funders. Where non-BUCS storage facilities must be used (for example, when using laptops, external hard-drives, etc.) appropriate back-up procedures must be recorded in the Project DMP and implemented during the project. The Department provides file and data storage [preferred-practice guidance](#) (conforming to BUCS requirements) which should be conformed with unless special provisions are necessary.

There is no equivalent institution-level data storage policy for physical data entities. Therefore for physical data records, it may be necessary to make special provision for secure storage to prevent gross loss (e.g. a fire safe, lockable cabinet, etc.) or to prevent damage (specimen mounts, cabinets, etc.) over an appropriate time frame.

The location and the identities of all storage spaces must be identified in general in the Project DMP. This information should be updated as necessary during the course of and on completion of the research project, when it is likely that distributed data associated with a project will be brought together and their locations recorded as a post-project activity in the final version of the Project Record Manifest.

Planning to Maintain Confidentiality

The need to keep data confidential stems from such things as a desire to protect intellectual property or because of commercial or state sensitivity. The Project DMP should identify any areas of sensitivity and make provision for data use where access is constrained or made available for sharing with appropriate limitations.

Where external collaboration will be carried out it is likely that a collaboration agreement will already be mandated to formalize such things as the agreement of duties, responsibilities and IP rights. Where appropriate, consideration should be given to a form of words clarifying the data access, sharing and security requirements agreed by research partners. Advice on this may be had from the University of Bath Legal Department.

The default access to BUCS file space is through the use of a BUCS user-name and password. This space includes BUCS-provided servers which provide file storage (e.g. the H: and X: drives) and communication services such as email, wiki, Moodle, iSusLab, Jabber and blogs. Access to all of these can be controlled in such a way as to allow additional users, individually or by group, either at the storage level or at the application level. In addition there is limited provision for extending access to named external users, depending on the service being used. Questions relating to access provisions and control related to the use of these services should be directed to research-data@bath.ac.uk.

Planning for long-term preservation

The governance requirements for the long-term preservation of and the maintenance of access to research data are mandated by the University, by government and by funders. Currently there is no University of Bath research data repository nor any formal curatorial support available to researchers. It is likely that this situation will be remedied in due course. Similarly, there is no national data archive expressly for engineering research data.

It is recommended that best use is made of the X: drive storage space at the University of Bath; of the facilities currently available this is the most appropriate for the long-term storage of research data.

Data should be organized and contextualized in an appropriate way by ensuring that the information described in Section 2.2 is provided as comprehensively as possible. In particular advantage should be taken of appropriate metadata standards for describing research data and its organization and location.

Consideration should be given to the file formats used in connection with data. Standard formats and formats with widespread software support are likely to remain understandable for longer than closed, software-specific formats. In cases where the

latter formats are unavoidable, ‘preservation copies’ in standard formats should be made and kept alongside them.

For important or valuable Data Records, it may be worth generating and recording checksums for them using an algorithm such as MD5 or SHA1; information on checksum-generation tools may be found readily using an internet search engine. The algorithm used should be recorded. This information can be used at a later stage to check the integrity of the Data Record, and may help support staff to locate uncorrupted backup copies.

Where specialist software is required to understand or re-use a Data Record, it is recommended that a copy of the software be kept on the X: drive alongside a copy of the licence terms and a record of known system requirements. Alternatively, the software could be installed on a virtual machine, and the virtual machine stored on the X: drive alongside the licence information. Instructions on locating and running the virtual machine should then be provided in the Project DMP (see Section 2.2.9). The practicability and advisability of retaining software will be dependent on the software licence conditions and the sort of resources required, judgements being made on a case-by-case by the PI. Advice may be sought from the [Institutional Data scientist](#).

2.1.10 Identifying Contractual and legal obligations (RS5, RS6)

There will be legal and, in most cases, contractual obligations with respect to data management which will have to be met as a result of funded or collaborative research. Obligations to funders might include the requirement to develop and submit data management plans, to keep research data for a specified length of time, to submit a research data set to national or discipline-related repositories, and so on. Obligations to collaborators might include ensuring the security and confidentiality of the data that they are providing, constraints on re-use and publication, and end-of-project disposal.

Up-to-date and detailed general funder requirements for data management planning, created by DCC, are available via the [UoBDMWS](#). In some cases, more detailed requirements may be part of the contractual documentation associated with the project.

2.1.11 End-of-Life

Efficient use of resources dictates that research data management includes making choices about what data to retain and what might be safely deleted.

Support for making decisions about what data to delete is limited at present. Fundamentally, there are no accepted principles to guide evaluation of the worth of data, and little practical guidance. At the same time predicting whether data, which may seem valueless at present, might be valuable in the future is fraught with difficulty.

Nevertheless, there will be occasions on which it is sensible to delete data; for example, data which are known to have become corrupted, have been found to be collected or created incorrectly, duplicate data, or where security considerations mandate deletion.

Where confidentiality is a concern, data should be deleted using secure methods. Some guidance on [reliable deletion](#) – including that for paper documents – is given by the UK Data archive.

Advice on which research data sets to select for long-term preservation can be found in the DCC's advice on the [appraisal and selection of data sets](#). It should be understood however, that for the usefulness of research data to be maximized, it is not only the data themselves that must be preserved but, together, the contextualizing information which makes the research data findable, accessible, readable and interpretable.

2.2 DMP Contents

The items in this section are those which, together with those noted in the preceding section complete the elements that will be found in a properly completed data management plan for a specific research project.

2.2.1 Summary of Research Activity

A brief summary should be provided of high-level project documentation relating to the Research Activity, and any confidentiality agreements, IPR statements and other documents that affect how the research data may be used.

This summary should include a link to the Project Record Manifest, where full details of documentation are recorded. This summary, therefore, need contain only the most notable facts, such as the project name, project dates, funder(s) and organizations involved.

Access restrictions and ownership of information should be stated here in the simplest, most concise form; where important complexities are glossed, prompts to consult the full documentation should be given.

2.2.2 Existing Data re-use (RS17)

In the interests of economy, consideration should be given, if possible during formulation of the project proposal, to whether the research activity's data requirements could be met in whole or in part by existing data.

A Research Activity can either mine existing data for new results, add to an existing body of data (to fine tune, generalize or place limits on previous results), or create an entirely new body of data. When planning a new Research Activity, researchers should be able to justify taking one of these three approaches.

If existing data can be used, then such data should be identified together with any potential access problems. If no data are available, briefly indicate how this is known.

Typical reasons for not re-using data include conducting a search and finding that there has been no similar previous research; conducting research on an object that has not previously been studied; operating in an area where all research is covered by strict confidentiality agreements. Typical access issues might include access that is contingent on successful application; unclear data licensing. Typical reasons for generating new data might include performing a comparison over time; extending existing research to cover new areas.

The rationale should be given here for the generation of any new data.

2.2.3 *Relating new data to existing data (RS19)*

Firstly, describe how the newly generated data relates to the wider landscape of existing data. This is not concerned so much with existing data that may be used in the Research Activity, but rather with the disciplinary context. A typical answer might identify a body of data with which it would be helpful to harmonize newly generated data, or from which methodologies might be drawn, e.g. ISO standard materials testing data, time/motion studies data.

Second, state the measures that will be/have been taken to ensure integrability between newly generated data and existing data. The following are possible issues to consider. Only brief answers are required here: full details should be given in corresponding sections later in the DMP:

- Method of assuring data quality (Section 2.2.8).
- Method of recording provenance (Section 2.2.5).
- Mechanisms for ensuring trustworthiness of data (Sections 2.2.6, 2.2.8).
- Choice of standard formats, ontologies, conventions, etc. for the data (Section 2.2.9).
- Choice of standard formats, ontologies, conventions, etc. for the metadata (Sections 2.2.9, 2.2.10).

A typical way in which data are re-used is in combination with similar data. This is considerably easier if compatibility issues are addressed in the planning stages of a Research Activity (see Principle of Reusability in [The Development of a Set of Principles for the Through-Life Management of Engineering Information](#)).

2.2.4 *Future use of the data (RS24, RS25)*

If the future uses for research data are known or can be predicted at the outset, special provisions can be made during the research that increase the compatibility of the data with that future use (Principle of Reusability cited above). Explicitly stating where this has been done can help **Data Librarians/Managers** continue this work in the preservation stage.

To assist future use, firstly list any bodies/groups which might be interested in the data, and the foreseeable contemporary or future uses to which they might put the data.

It is acceptable to define groups based on discipline, research interest or specific research topic. It is acceptable to list bodies or groups without reference to uses, and foreseeable uses without reference to specific groups, if appropriate.

Second, state the measures that will be/have been taken to prepare the data for these bodies/groups/uses.

The following are possible issues to consider. Only brief answers are required here: full details should be given in corresponding sections later in the DMP.

- Forms of data organization (Section 2.2.7).
- Choice of standard formats, ontologies, conventions, etc. for the data (Section 2.2.9).

- Choice of standard formats, ontologies, conventions, etc. for the metadata (Sections 2.2.9, 2.2.10).

2.2.5 *The Project Record Manifest (RS20, RS21, RS23)*

Providing details of what Data Records are included in a Data Case, how they came about and what relationships exist between them helps future researchers to understand the data, assess their suitability and re-use them for new research; it also satisfies Principle 8 from the Principles for Engineering Research Data Management (Darlington, et al, 2010). In particular, recording the relationships between Data Records (and between data) satisfies some users' requirements for provenance information.

The vehicle for making these records is the Project Record Manifest (PRM). The PRM contains information on two classes of data, this being on the one hand the project management and associated documentation, and on the other, the research Data Case, which consists of the set of data records gathered and generated in the course of the Research Activity.

The PRM for the Department is [template based](#). A new PRM should be created for each research project and should be reciprocally associated with the Project DMP.

For recording the development and association of items in the Data Case, ideally one, or if necessary a number of, **Research Activity Information Development (RAID)** diagrams should be presented for the Data Case, alongside instructions on accessing any computer-interpretable versions; the PRM should cite the RAID modelling method and specifications, alongside notes on how these will be/have been implemented in this case.

An acceptable alternative – where it has not be possible to use a RAID association method, would be to present an annotated list of Data Records showing associative information. The procedure for maintaining this list must be given in the Project DMP and the record(s) recorded in the PRM.

The PRM may be either an embedded wiki page or a stand-alone document. If it is the last, it is recommended that the file name and versioning conforms to the [guidelines for project documentation file naming and version control](#) specified for research data management. The PRM will uniquely have the document type 'man' as part of the file name.

2.2.6 *Data generation and manipulation (RS18)*

Give a detailed account of how the data will be/have been generated and manipulated, including the methods, technology, conventions, coding schemes, etc. that were used.

It is expected that the level of detail provided here will be low initially, but will increase as the plans are implemented.

At all stages, Principle 4 of the Principles for Engineering Information Management should be borne in mind which states that the notions of re-usability and re-purposing should be supported by the use, where possible, of generic or standard data generation and manipulation tools. This approach is reinforced further in The principle of robustness set out in the Principles for Engineering Information Management which

exhorts all information workers to use robust methods to capture, create and manipulate information entities as a means of supporting future use.

When writing a DMP in retrospect, it is acceptable to cite a journal/conference paper containing the information, provided it is detailed enough and that a pre- or post-print is available in case of access difficulties. In the normal course of events, the information should be provided here first and then adapted for use in a journal/conference paper. It may be helpful to provide this information in the form of a commentary on a RAID diagram.

2.2.7 Data organization (RS20, RS23)

Describe how the data will be/have been organized. This refers equally to how data are organized within Data Records, how Data Records are organized within the Data Case, and how project management records are organized. Providing this information makes it easier for others involved in the later management of research data (for example, by a project or **Data Manager**) or re-use of the data to navigate the Data Records and find specific parts. In addition, such information will aid in the efficient response to FOI requests. It can also help you to check that all the Data Records have been included.

The basic method recommended for organization of project documents (both within the Data Case and project management information) is by using a file naming convention of the sort referred to above.

In addition to allowing unique (human-readable) record names to be created, the file naming convention also provides the means for version control. A useful reference document both for version control (in general) and for record organization is the [Versions Toolkit](#) developed by LSE; its use is recommended.

It is strongly encouraged for management of Departmental research data and associated records, that full use is made of the metadata recording facilities provided by the electronic records-handling methods that are used. An example of this is the ‘properties box’ provided for individual files in all Microsoft Office applications in which can be recorded such things as document title, author(s), and so on.

Where possible, additional metadata description of the research data or **Research Data Records** should be provided. It is recommended at present that the Data Cite metadata schema is adopted for this (Starr et al., 2011).

All research data and other data and document records associated with a research activity should be assembled into a Data Case at completion of the research activity for ease of long-term curation and management. The Data Case should be packaged in a format that will promote its long-term potential for re-use. In particular, where special arrangements for archiving are mandated (e.g. by the funder) the packaging should follow the guidance provided which will ensure it is acceptable to the Data Librarian(s) taking custody of it. In the absence of such mandates, the [BagIt packaging format](#) is recommended: at their simplest such packages consist of a directory containing a file identifying the BagIt version, another listing the files in the package along with checksums, and a data directory containing the files and folders themselves. It is the responsibility of the PI that this is done and that all data is collected from independent file storage (independent and removable media) and from the personal (H-drive) storage

space of any researcher involved in the project. At this juncture the data case records should be associated by bringing the Project Record Manifest up to date.

2.2.8 Data quality (RS22)

Using high quality data in research is important to its outcome; equally, for their confident re-use by others data not only must be of high quality but must also be demonstrated to be so.

The quality assurance procedures and standards should be recorded here that will be/have been used for collection, generation and manipulation of the research data. If any data quality issues were encountered, list them and describe what was done to resolve them.

2.2.9 Data structures and formats (RS18, RS23)

At the project planning stage, the hardware and software environment in which the Research Activity will be conducted should be specified to the extent that it can be known. Where possible use off-the-shelf software and software that is supported by BUCS or a more local IT support service.

Indicate the formats to be used, and explain why these have been selected for use. If the choice of formats has been justified elsewhere in the DMP (e.g. Sections 2.2.2 and 2.2.3) readers may be directed to those sections in place of a recapitulation here.

Also indicate at this stage how this section will be completed during the course of the Research Activity.

Once Data Records have been made, start by specifying the hardware and software environment in which the data were generated or manipulated, and then consider alternative environments, tools and libraries that might support the data. If specialist tools were used, consider installing them on a virtual machine; in which case, provide details here of how to run the virtual machine.

Specify the information, tools or resources that would be needed to manipulate or make your Data Records human readable. If available/known, cite here format specification documents for all data formats used.

2.2.10 Data semantics (RS23)

Data cannot be re-used if their meaning is not properly understood.

At the project planning stage, provide if possible a general statement about the conventions that will be used to allow interpretation of data (such as schemas, ontologies, and so on), and provide justification for the conventions used.

Indicate how this section will be completed during the course of the Research Activity.

Once Data Records have been made, provide any additional information that would be needed by an interested reader to understand the Data Records.

As an example, tabular data can have terse column headings; fuller explanations of what a column represents can be given here. Other examples of information to provide here include data dictionaries, coding schemes and ontologies. The information can be given directly in the DMP, or instructions can be given on how to look up the information for each Data Record.

3. REFERENCES

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APPENDIX A: DATA MANAGEMENT TERMINOLOGY

This document uses the ERIM Data Management Terminology (presented in draft form Howard, et al. 2010) from which the following terms are extracted for ease of reference. The full released [terminology](#) can be accessed on-line.

Research Activity The process through which research Data and context Data are accumulated and developed.

Data Case The set of Data Records associated with some discrete Research Activity (project, task, experiment, etc.).

Record Information in any medium, created, received and maintained as evidence of an activity.

Data Record The Data Object which contains the Data.

Research Data Record A Record containing research Data, i.e. Data that are descriptive of the research object.

Research Object Data Record A Data Object which is itself the object of research interest or which together with Research Object Data Records constitutes the object of research interest.

Data Librarian People originating from the library community, trained and specialising in the curation, preservation and archiving of data. (Swan & Brown, 2008)

Data Manager Computer scientists, information technologists or information scientists and who take responsibility for computing facilities, storage, continuing access and preservation of data

Project Data Management Plan The data management plan which contains details of management of the management documentation and the Data Records (the Data Case) of a discreet IdMRC Project or activity.

Project Record Manifest The inventory which lists both the set of project management documents and the set of Data Records which constitute the Data Case(s), and which provides associational, locational, ownership and other metadata about these physical and digital data objects.

Research Activity Information Development (RAID) Diagram A diagram using the RAID modelling formalism which records and visualizes the research and associated data record development in a Data Case resulting from the Research Activity.

APPENDIX B. REQUIREMENT SPECIFICATION SATISFACTION AND SUPPORT

RS No. = Requirement Specification number (from the DMPRS)

Principal rôles supported: PI = Principal Investigator, DM = Data Manager, R = Researcher

ME-RDMP Cross-reference = the section number in this document in which the identified requirement specification is satisfied

Yellow Highlight = support items requiring creation

Magenta Highlight = Items requiring creation and ownership by the institution



DEPARTMENT RESEARCH DATA MANAGEMENT PLAN

Requirement Motivation			ME-RDMP Cross-reference	RDMP Focus		Support Required	
RS No.	Requirement	Rationale	Section No	Principal Rôle(s) Supported	Organizational Level	Implied information /resource requirement	Identity of cited/linked guidance, tools, etc.
1.	Identify location of support available for each project for data management planning development and execution	To provide a project plan at the project level which conforms to the DMP requirements and can be executed as specified in the plan	2.1.1 2.1.2 2.1.3	PI	Institution, Dept.	ME-RDMP provides links to such docs. Also DCC DMP Online Tool; and either Departmental RDM web page or wiki – requires creation Also Project Record Manifest Template – to be derived from IdMRC PRM template.	The University of Bath Data Management web site The Mech. Eng. Research Data Management Plan Requirement Specification The ME-RDMP document University of Bath Code of Good Practice in Research RCUK Policy and Code of Conduct on the Governance of Good Research Conduct EPSRC Guide to Expectations of Funded Organizations Project Record Manifest template DMP Online Tool Guidance document on File-Naming Best Practice University of Bath Research Data Storage Policy
2.	Identify location of guidance policies wrt to availability of data storage	Project DMP will rely on prescribed criteria	2.1.9	PI, DM, R	Institution, Dept.	Policy document on institutional data storage	University of Bath Document Identifying availability and nature of BUCS-supported storage space

DEPARTMENT RESEARCH DATA MANAGEMENT PLAN

Requirement Motivation			ME- RDMP Cross- reference	RDMP Focus		Support Required	
RS No.	Requirement	Rationale	Section No	Principal Rôle(s) Supported	Organizational Level	Implied information /resource requirement	Identity of cited/linked guidance, tools, etc.
3.	Identify location of guidance procedures wrt access to data storage facilities	Project DMP execution will rely on prescribed facilities	2.1.9	PI, DM, R	Institution, Dept.	Storage access procedure document; requires creation	University of Bath Document Identifying access procedures and security provisions of BUCS-supported storage space
4.	Identify location of guidance on budgeting and resources for data management	Between-project variation will mean support will be required case-by-case	2.1.8	PI	Institution, Dept.	Guidance document or tool for assessing budget/resources; requires creation (RDSO?) UKDA guidance and costing tool	UK Data Archive Costing Tool University of Bath Budgeting for Research Data Management Document
5.	Provide guidance on funding body (and other regulated governance) requirement wrt to DM planning and which elements of the DMP these relate to.	To ensure contractual conformance	2.1.10	PI	Dept.	Requires creation of document directing PIs in bare minimum requirements to meet their obligations (RDSO?)	University of Bath Guidance to PIs on Fulfilling Data Management Requirement of Funders
6.	Identify DM requirements arising from statutory and contractual legal obligations	To ensure legal compliance	2.1.10	PI	Dept.	Contracts (including that with funder, licences, summary of known legal issues	University of Bath Guidance to PIs on Fulfilling Data Management Requirement of Funders DCC Guidance on Funders Requirements

DEPARTMENT RESEARCH DATA MANAGEMENT PLAN

Requirement Motivation			ME-RDMP Cross-reference	RDMP Focus		Support Required	
RS No.	Requirement	Rationale	Section No	Principal Rôle(s) Supported	Organizational Level	Implied information /resource requirement	Identity of cited/linked guidance, tools, etc.
7.	Consider budgeting and resources for Data Management	Project data management will require appropriate resources	2.1.7	PI	Project	Guidance document, requires creation	UK Data Archive Costing Tool University of Bath Budgeting for Research Data Management Document
8.	Identify guidance on the identification and selection of appropriate data archive/repository/centre locations	Non-local archiving is not well supported and It is unlikely that researchers, and perhaps PIs, will have special knowledge of data repositories	2.1.9	PI, DM, R	Project	Selection procedures, criteria, esp. in relation to data character, security, sensitivity considerations.	None available at present
9.	Consider identification of roles and responsibilities associated with management at departmental and project level	Management of the data management requirements of a project at project and departmental/institutional level	2.1.4	PI	Project	These will include 'functional' as well as contractual responsibilities and roles, e.g. who is responsible for security of data; preparation for supporting re-use and for preservation/archiving	n/a
10.	Consider identification of long-term preservation strategy	Required to meet potential funder requirements and to support longer-term data sharing	2.1.9	PI	Project	n/a	n/a

DEPARTMENT RESEARCH DATA MANAGEMENT PLAN

Requirement Motivation			ME- RDMP Cross- reference	RDMP Focus		Support Required	
RS No.	Requirement	Rationale	Section No	Principal Rôle(s) Supported	Organizational Level	Implied information /resource requirement	Identity of cited/linked guidance, tools, etc.
11.	Consider identification of during-project storage needs	These needs will be project-specific, mediated by institutional and departmental support policies and practice.	2.1.8	PI, R	Project	Assumption of provision of appropriate storage	Departmental File and Data Storage Preferred Practice Guidance Document
12.	Consider identification of post-project storage needs	Required to ensure that suitable in-house storage support – is specified prior to project end.	Not done	PI, DM	Project	n/a	Departmental File and Data Storage Preferred Practice Guidance Document
13.	Consider identification of data security issues	Data must be secured as appropriate, wrt back-up and sensitivity, IP issues and collaborator requirements.	2.1.8	PI, DM	Project	The assumption will be that the Dept.. will provide the infrastructure to support the needs.	University of Bath Document Identifying access procedures and security provisions of BUCS-supported storage space
14.	Consider the identification of access and sharing constraints	As above	2.1.8	PI	Project	n/a	University of Bath Document Identifying access procedures and security provisions of BUCS-supported storage space
15.	Consider collaborator agreement appropriate to the project wrt data sensitivity and collaborator requirements	As above	2.1.8	PI	Project	This should be considered in relation to external sharing mandates. These will influence considerations of access	[Project Specific]

DEPARTMENT RESEARCH DATA MANAGEMENT PLAN

Requirement Motivation			ME- RDMP Cross- reference	RDMP Focus		Support Required	
RS No.	Requirement	Rationale	Section No	Principal Rôle(s) Supported	Organizational Level	Implied information /resource requirement	Identity of cited/linked guidance, tools, etc.
16.	Consider identification of guidance to execute and review data management plans	Planning alone will not provide the basis for maximizing data value: execution is necessary	2.1.5 2.1.6	PI, DM	Project	n/a	n/a
17.	Consider the identification and acquisition of existing data sets to support the planned research	Re-use of existing data sets is the motivation for data management	2.2.2	PI, R	Project	The existence of suitable data sets, and the information necessary for its location and identification	DataCite Metadata Search UKDA Search ICPSR Find Data Research Data Australia
18.	Consider the provision of detailed description of data acquisition and generation methods	Provides the basis for regeneration of source data, rather than its long-term curation and concomitant overheads.	2.2.6 2.2.9	DM, R	Project	n/a	n/a
19.	Consider actual or potential relationships between prior and new data	Part of the provision of context necessary for future comprehension and interpretation.	2.2.3	DM, R	Project	n/a	n/a
20.	Provision of record of data organization during research and of final data case	Part of the provision of context necessary for future data access, comprehension and interpretation.	2.1.2 2.2.5 2.2.7	DM, R	Project	n/a	n/a

DEPARTMENT RESEARCH DATA MANAGEMENT PLAN

Requirement Motivation			ME- RDMP Cross- reference	RDMP Focus		Support Required	
RS No.	Requirement	Rationale	Section No	Principal Rôle(s) Supported	Organizational Level	Implied information /resource requirement	Identity of cited/linked guidance, tools, etc.
21.	Provision of contextual data records	Part of the provision of context necessary for future data access, comprehension and interpretation.	2.2.5	DM, R	Project	Might imply the need for appropriate record-making software.	n/a
22.	Provision of assurance procedures and standards	Promotes and provides evidence of data quality and validity	2.2.8	DM, R	Project	Might imply pre-existing assurance procedures and standards applicable to the intended research	[Project specific]
23.	Documentation of project data sets	Supports sharing, access and interpretation	2.2.5 2.2.7 2.2.9 2.2.10	DM, R	Project	Project Record Manifest template – to be derived from IdMRC template RAIDmap or equivalent?	Project Record Manifest template RAIDmap application (or similar); Library of Congress Bagger tool Tools for working with METS
24.	Consideration of what other bodies/groups/individuals are likely to be interested in the data	Supports sharing and future discovery	2.2.4	PI, R	Project	Implies current knowledge or existence of and access to supporting information	[Project specific]

DEPARTMENT RESEARCH DATA MANAGEMENT PLAN

Requirement Motivation			ME- RDMP Cross- reference	RDMP Focus		Support Required	
RS No.	Requirement	Rationale	Section No	Principal Rôle(s) Supported	Organizational Level	Implied information /resource requirement	Identity of cited/linked guidance, tools, etc.
25.	Consideration of contemporary or future uses for the data	Provides motivation for data management for re-use and may provide indicator of best management approach.	2.2.4	PI, R	Project	n/a	[project specific]
26.	Provision of guidance on the disposal (that is the deletion) of research data	The management and physical storage provision overheads are sufficiently high as to warrant consideration of what data may discarded	2.1.11	PI	Institutional, Project	DCC and UKDA guidance cited.	UK Data Archive Guidance on Data Disposal DCC Guidance of the Appraisal and Selection of Data Sets