Project Information			
Project Identifier	*To be completed by JISC*		
Project Title	Research Data Management for Mechanical Engineering Departments (REDm-MED)		
Project Hashtag			
Start Date	November 2011	**End Date**	31 May 2012
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Partner Institutions	n/a		
Project Web URL	http://www.ukoln.ac.uk/projects/redm-med/		
Programme Name	MRD Phase 2 (2011-13)		
Programme Manager	Simon Hodson		

Document Information			
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Project Role(s)	Project Manager		
Date	May 2012	**Filename**	redm-med_final_report_v1
URL	http://www.ukoln.ac.uk/projects/redm-med/reports/redm-med_final_report_v1.pdf		
Access	This report is for general dissemination		

Document History		
Version	**Date**	**Comments**
1.0	July 2012	
1.1	November 2012	Corrected location of Deliverable 7

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Acknowledgements
The Research Data Management for Mechanical Engineering Departments (REDm-MED) Project is one of the Strand B projects in Managing Research Data Programme 2011-13, this being the second phase of the MRD Programme funded by JISC. The REDm-MED Team would like to thank the funders and also the panel of researchers from the Department of Mechanical Engineering who assisted by providing input into the project.

1 Project Summary

The management of research data so that it can be re-used by others in future work – thus maximizing its usefulness and value – is becoming progressively more important to funders and researchers alike. On the one hand funders are keen to see the value maximized of the research data generated by the projects they have supported. On the other, researchers are now beginning to understand the benefits to their own current and future work that might result from better data management.

The REDm-MED Project set about scoping, specifying and designing a research data management plan suited especially to the needs of the Department of Mechanical Engineering at the University of Bath. This work has built upon the team's work investigating the research data management needs of the Innovative Design and Manufacturing Research Centre (I*d*MRC) at the University of Bath during the JISC-funded ERIM Project and other recent work by the Managing Research Data Community. Work completed in the ERIM Project in specifying a Research Activity Information Development Associational Tool (RAID) – an example of just one of many tools that are needed for effective research data management – has been continued by the implementation of the prototype RAIDmap Associative Tool.

The aim of the work has been to specify effective and practical research data management practice where there is little or none and that can be adopted easily elsewhere. The output of the project has included not only the research data management plan and the RAIDmap tool, but a number of other tools and documentation which support the plan. In addition, the pan-institution infrastructure necessary to support the RDM plan has been identified.

The work been carried out in conjunction with the UKOLN and the DCC at Bath, and with the support of the Department of Mechanical Engineering and the Bath University Computer Service (BUCS). The REDm-MED Project is complementary to the University of Bath's Research360 Project which is being funded similarly by JISC under the Managing Research Data Programme 2011-13 which is tasked specifically with developing policies for managing data across the institutional research life cycle.

NOTE: many of the technical terms used throughout this report are defined in the Terminology of RDM terms.

2 The REDm-MED Project

2.1 Project Outputs and Outcomes

The following two tables identify the outputs and outcomes respectively of the REDm-MED Project. In the first table the first column identifies, as appropriate, the deliverable number given to the output.

Deliverable No.	Output	Doc Title/description	Source/location
1	Planning document	Research Data Management Plan Requirements Specification	http://opus.bath.ac.uk/28040/
2	Planning document	A Research Data Management Plan for the Department of Mechanical Engineering, University Of Bath	superseded by http://opus.bath.ac.uk/30099/
3	Planning document	A Model Research Data Management Plan for Engineering Research	http://opus.bath.ac.uk/30104

Deliverable No.	Output	Doc Title/description	Source/location
4	A report	Infrastructure Supporting a Research Data Management Plan for the Department of Mechanical Engineering, University of Bath	http://opus.bath.ac.uk/29583/
5, i	Technical infrastructure tool	DMP Online Template for the Department of Mechanical Engineering at the University of Bath	http://opus.bath.ac.uk/30094/
5, ii	Technical infrastructure tool	Naming Documents for Better Organization	http://opus.bath.ac.uk/30095/
5, iii	Technical infrastructure tool	Project Data Record Manifest Template for Research Projects	http://opus.bath.ac.uk/30096/
5, v	Guidance document	RAIDmap Application User Guide	http://opus.bath.ac.uk/30097/
5, vi	Guidance document	RAIDmap Application Installation and Developer Guide	http://opus.bath.ac.uk/30098/
6, i	Prototype application	RAIDmap Application, installation files	http://sourceforge.net/p/raidmap/
6, ii	Software code	RAIDmap Application code	http://sourceforge.net/p/raidmap/
7	Summarizing Report	A summary of interactions with the DCC and the feedback given by the project about DCC tools and guidance	http://opus.bath.ac.uk/30232/
n/a	Project Blog	A blog recording some insights gained during the project	http://blogs.bath.ac.uk/redm-med/about/
	Project Web Site	A web site with links to key documents	http://www.ukoln.ac.uk/projects/redm-med/
n/a	Information provision and storage	A department-level wiki for RDM	http://go.bath.ac.uk/um4w
n/a	Report	Review of Data Management Lifecycle Models	http://opus.bath.ac.uk/28587/
n/a	Report	Tools for research data management	http://opus.bath.ac.uk/29189/
n/a	Report	Minimum Mandatory Metadata Set for RAIDmap	http://opus.bath.ac.uk/30372/

Outcome	Brief Description
Transferable Knowledge	Understanding gained during this project will result in shareable knowledge on DM planning that will be readily generalizable to other mechanical engineering departments. It might be expected that such knowledge would be generalizable to other engineering disciplines.
Enhanced capacity	Uptake of the DM guidance provided by this project assist researchers in meeting the DM expectations of their funders and will, more widely, support the developing desire to make their data more shareable and re-usable.
Basis for wider understanding	Liaison with the department and with other entities within the university will help accelerate the delivery and understanding of the message that the value of research data may be substantially increased – to the benefit of many – through good governance.
Basis for wider adoption	The presumption is made that the research data management needs of the participating department will intersect closely with those of similar departments in other research institutions, not only of higher education but in the wider commercial world and therefore the work will be transferable.

A number of outcomes of the REDm-MED Project were anticipated; these are enumerated in the table above. However, because of the relatively short timescale of the project, and the reliance on outcomes of the Research360 Project which will not become apparent until that project's end in April 2013, much of the potential identified therein remains to be achieved both in the local and more distributed communities. Locally, fulfilling the potential will depend upon the adoption of the ME-RDMP in part or whole. Adoption may itself be mediated by the outcome of the Research360 Project

with respect to the institution-level policies that are put in place, and the outcome of the formal approval process that would have to occur before the Department could adopt such wholesale methods.

In addition to the above, however, is additional knowledge gained, especially, in the development of the RAIDmap application, particularly with regard to using the Compendium information-mapping software, and the further understanding gained of the process of contextualization of research data for its better interpretation and, indeed, the difficulty of trying to capture the context.

2.2 How did you go about achieving your outputs/outcomes?

The REDm-MED Project work has fallen into two distinct parts. On the one hand is the development, with interaction from the Department (and guidance from and discussion with members of the Research360 Project) of a departmental research data management plan and associated documentation. On the other hand is the implementation of the RAIDmap Associative Tool, using an agile software development approach, modified as appropriate in the light of the small size of the team involved. Both aspects of the work have drawn on precursor work done by the team members in the ERIM Project.

Development of a Research Data Management Plan for the Department of Mechanical Engineering at the University of Bath[1] was underpinned by the 'engineering approach' of establishing a clear *requirements specification* upon which the resultant research data management plan (RDMP) would be based and against which its completeness could be formally checked. The requirement specification was informed by the earlier work done by the team in developing a draft data management plan for the Innovative Design and Manufacturing Research Centre (I*d*MRC) located in the Department and also through direct input by a panel made up of researchers from the Department. The panel members were selected carefully to provide a spectrum of experience and seniority as well as being representative of the very diverse research interests found in the department. The Department is representative of many that engage in engineering research, having a diversity of research areas including vehicle engines and transmissions, fluid power and power transmission control, aero-engine thermal dynamics and aerodynamics, biomechanics and biomimetics research, engineering design information and knowledge, materials and structures applications, and engineering for sustainable and renewable energy.

The DCC-developed CARDIO assessment tool was used by the panel to manage the data management plan requirement specification elicitation process. It is interesting to note that the REDm-MED team is amongst the very first users of CARDIO (feedback to the DCC constitutes part of the deliverables of the project). A full analysis of the process that was engaged in and the outcome can be found in the preamble to the requirement specification (Deliverable 1, see link above).

The resultant data management plan, the ME-RDMP, has two main sections. The first explains how to use data management plans at the project level: where they should be kept, how 'public' they should be, what is expected in terms of review and revision, and so on. The second provides a high-level template to assist principle investigators and researchers in writing a project data management plan. Both sections include recommendations of tools for planning and performing data management, and give pointers to more detailed advice.

Supporting the plan are a number of infrastructure tools (Deliverables 5 i, ii & iii, identified above) and a report (Deliverable 4) which identifies such tools and other elements of an infrastructure which might be necessary to supporting the implementation and governance of project-level data management plans. Of note is the customized template for use when using the DCC's DMP Online data management plan creation tool. This, essentially, provides the means by which a customized RDMP may be achieved for each research project which reflects the special RDM needs of the data that will be generated. Deliverable 3 is a generalized document which provides information to help others engaged in similar research activities – both in academia and industry – to implement their own research data management measures.

[1] Henceforth, for rather obvious reasons, the research data management plan for the Department of Engineering at the University of Bath will be referred to as the ME-RDMP and the Department of Mechanical Engineering at the University of Bath will be referred to simply as the Department.

The second part of the work resulted in the RAIDmap Association Tool, an implementation of the RAID Modelling approach, which is an incremental development of some of the functions outlined in RAID Associative Tool Requirements Specification (Darlington, et al., 2011). The RAIDmap application allows users to record the existence and development of and the relationships between the research data records created during a research project. The model identifies a set of the different sorts of data records commonly encountered in research work, and a set of 'information development' activities or processes by which data records come into being as research is carried out.

RAIDmap provides a means by which data records can be mapped, using the model's elements, and provides a visual representation of the data development context to help users make sense of the research data records and data sets associated with a particular research project or Research Activity. The purpose of this is to assist the researcher or research team in during-project data management activities, and to support post-project re-use of research data by those who have had no prior familiarity with the research project and the research data that have been gathered and generated. RAIDmap allows the simultaneous mapping of both the research data proper and the contextualizing documentation which provides the basis for its interpretation.

Central to the use of RAIDmap is the RAID Diagram, which illustrates visually the data records in the 'data case' and their relationships, associations and time line. A RAID diagram is developed by the user using the graphical and text interfaces provided by the application, supported by semi-automatic harvesting of document metadata which describes each data record.

The RAIDmap application is built using the Compendium information-mapping software in combination with the National Library of New Zealand's Metadata Extractor Tool. In addition, a stand-alone application, RAIDwatch, has been devised which alerts the user when new records – which may require mapping – are created or when the user attempts to delete a data record that is part of an existing RAIDmap record.

Seven objectives were identified in order to achieve the intended aims of the project (these objectives largely being manifested in the deliverables identified above); details of their fulfilment are given below. Where appropriate, comments convey where changes were made in the original plans.

Objective 1. The research data management plan (DMP) requirements specification was the result of a requirements analysis and elicitation activity carried in liaison with the panel members. The CARDIO tool was used, principally, for data collection and analysis together with informal interactions.

This requirements specification identified a number of key information items for each element of the RDM plan, including such things as the rationale for inclusion of the element in the specification, the rôle supported by the element and, importantly, the supporting information or resource implied by the requirement as being necessary to support that aspect of the plan. In due course each of these elements, and others, would be mapped to the element of the RDMP which satisfied them.

Objective 2. The data management plan reflects the operational requirements of the department and the requirements necessary for supporting post-project re-use of data as established during the requirement specification elicitation process. A data-lifecycle view was taken, thus providing RDM which supports data management from project start to post-project archiving. The DMP consists of a description of desired practice and DM objectives, with guidance on how to achieve these aims with the tools selected. Thus, it is in effect a 'specification' for the department, which will allow an individual project readily to develop a bespoke data management plan as suits their own needs and constraints.

Objective 3. The technical system and infrastructure to support implementation of the data management plan has been identified in the ME-RDMP and further developed in a more general document (see Deliverable 4, linked above); it consists of tools and techniques developed during the ERIM Project and by such other data management organizations as the DCC.

Given the short time frame in which to achieve the aim, it was intended that infrastructure elements of the work would be based on light-weight web-based services interfacing with existing file storage space, where possible using existing software and tools, the computational support and data storage being based on that implemented already within the Department of Mechanical Engineering and

supported by BUCS. This has been largely achieved excepting that the RAIDmap tool, which was intended to be web-based is, in fact, a stand-alone Java implementation.

The intention had been that we use where possible tools and guidance already available at the University of Bath. Again this has largely been achieved. However, the intention to use the Sakai virtual research environment platform (implemented at the University as iSusLab), which had already be developed and trialled within the university, turned out to be impracticable because of the limitations of the existing implementation. It would be possible, however, given an appropriate requirements specification and the necessary resources, to develop a Sakai platform that was more in line with the emerging needs of data management both at departmental and institutional level.

Objective 4. Provision of documentation of the implemented DMP and the supporting infrastructure have been provided as a 'blueprint' to assist the adoption of similar DMP solutions by other entities engaged in engineering research. These items are identified above. Specifically the Engineering Research Data Management Plan and the Infrastructure Report have been provided as generalised developments of the department-specific documentation to support others in developing their own data management plans in similar research contexts.

Objective 5. As part of the technical system and infrastructure, one very particular tool has been implemented. This is the RAID Associative Tool the specifications of which were drawn up in the ERIM Project; the tool is now known as RAIDmap. As noted above, originally intended as a web-based application, RAIDmap runs as a stand-alone application running on a Java platform. Currently installation files are available for both 32-bit and 64-bit Windows-based machines. The change in intention was based on practicalities, the time-frame for development and the fact that the Compendium software was selected for the core development.

As expected, in light of the time-frame available, the implemented functionality of the RAID tool is limited, providing only the basic capacity for each *research data record* to be associated using a minimal metadata set (informed by the ERIM Project work and arrived at from the user-base requirements analysis, and including some of the above data development processes) with precursors and successors together with versioning, and classification as one of the ERIM-defined research data record types *(research data record, context data record, associative data record, research object data record or experimental apparatus data record). Nevertheless, though limited in functional scope, the implementation provides the basis for demonstrating the potential of the RAID mapping approach, as well as validating to some extent the RAID model. Code and developer guidance for the RAIDmap approach have been made available under an appropriate open software licence to allow others to explore and, it is hoped, develop the ideas related to RAID modelling and the application itself.*

Objective 6. Provision of on-line or other guidance and user-support documentation has been developed as intended for the application of the departmental data management plan and usage of the infrastructure. There are no special issues with this and a number of guide documents, tools and services were created. However, adoption of the DMP and the tools for its implementation at a department level will, as noted above, require departmental approval. In addition, adoption will be dependent on the institution-level policies in development at present, especially as outputs of the Research 360 Project. The time frame for doing this, as anticipated, is outside that of the project and outside the control of the project itself. It had been hoped that an opportunity for experimentation by researchers during the project of the emerging data management tools and guidance would be possible. This, however, did not occur both because of time limitations and the associated limited resources of not only the REDm-MED team itself but also those of potential participants.

Objective 7. A report providing feedback to the DCC of issues that arose, particularly with regard to use of the CARDIO tool, has been submitted.

2.3 What did you learn?

REDm-MED is not strictly a research project, rather it is an 'implementation' project and therefore formal findings are, accordingly, limited. There were, however, a number of insights that emerged that are worth recording; they are noted here in brief (further context for some of these items can be found in posts in the REDm-MED Project blog).

2.3.1 Current understanding of Research Data Management

It is clear that, at least in the local research community, what is meant by research data management, and the ramifications of its implementation as a part of normal research practice, is largely only tenuously grasped by researchers; essentially, the experience of most of RDM is limited and they have little or no understanding of what will shortly be expected. For many the term 'research data management' remains synonymous with 'research data storage'. As a result discussions about their rôle in RDM and the resources and costs associated with RDM tend to have a limited scope and they have difficulty making useful predictions about future data management support needs based on current understanding and experience. A concomitant level of understanding of the terminology used is demonstrated. In fact, the knowledge of the participants is no better than might be expected given the limited extent of data management with which they have hitherto been expected to engage. It is likely that researchers and research managers will have to go through the experience of a 'first-generation' of data management before the common experience is sufficiently developed to provide really useful insight into data management needs and how to deal with them.

2.3.2 Requirements Specification

Because of the background of the REDm-MED Team, drawn predominantly from an engineering environment, it was natural for an 'engineering approach' to be taken to the development of a RDMP by means of the creation of a Requirements Specification. It is probable that a similar approach would have been taken had the team been based in software development.

Whilst the emergent RDMP has not been validated yet by use, the team believes that taking this approach has been beneficial in guiding development of the plan. Indeed, it is difficult to imagine a better way of approaching the creation of such a plan, the details of which must fit the special, local, requirements of a particular research entity, as represented by the Department. In short, this approach is heartily recommended to others who wish to fit a RDMP to a particular research context, especially until such time as a body of experience has been acquired through a period of consolidated research data management practice.

2.3.3 Putting the Cart before the Horse

Following the point made above in Section 2.3.1, it has become apparent during this work that a pan-institution understanding of research data management will be necessary before properly 'joined-up' RDM will be achievable; that is to say, the requirements and demands of RDM at the different levels of the university hierarchy, for different purposes and during different stages in the data life-cycle yet at the same time being mutually supporting, must be understood before they can be met. In the current environment, parallel exploration of RDM's many facets is being carried out more or less independently by the individuals involved.

Fulfilling the objectives will require that not only are the goals of RDM clear, but that the infrastructure and tools are not only available but are fit and of sufficient maturity to achieve the objectives. This will necessarily be an iterative process. Currently the entire RDM enterprise is sufficiently immature as to make really good practice difficult to implement – it is perhaps too early to justifiably refer to 'best practice' – not least because it has yet to become clear what is really wanted and how useful will be the outcomes, and who will foot the bill. At the same time, whilst there does exist some guidance and tools to support and execute data management at the project level, mature, intuitive tools and practice-based guidance documents do not exist for all the tasks necessary for good data management. It is recognized, though, that much work is in progress to remedy this situation and the expectation would be that JISC's MRD Programme Phase 2 will furnish tools to fill some of the gaps as well as identifying others. Furthermore, the integration of such tools as there are is almost non-existent.

2.3.4 Provision of Services

Because of the parallel activities of REDm-MED (working at the departmental level) and Research360 (working at the institutional level) and the fact that the timescale of the second project is much longer than that of the first, some important questions remain to be answered about the details of institutional infrastructure and policies. This has meant that some of the decisions regarding the departmental infrastructure and policy have had to be provisional or left open pending completion of the R360

Project. It is likely that similar situations would arise in other institutions and enterprises, especially where the motivation for early provision of data management interventions is less keenly felt in some parts of the organism than others and, thus, where then data management measures at one level are ahead of supporting data management measures at another. Fundamentally, for research data management to achieve its main objective (making data usable again) it will have to be integrated across all levels of an enterprise; this will be achievable only in the fullness of time. It might also be observed that different parts of the enterprise will interpret the demands of RDM differently; the different agendas will require different mechanisms to fulfil and sometimes the agendas will be in tension.

2.3.5 Understanding Contextualization of Research Data

The work of ERIM and other RDM research projects has made it clear that preserving research data in isolation is insufficient to allow its proper interpretation if re-use is to be maximized. Implementation of the RAID modelling approach in the RAIDmap application has demonstrated that we are not only early in the process of understanding the role of contextualizing information in making research data re-useable, but that the understanding of how to handle the contextualization of, especially large and heterogeneous data sets, is in its infancy. What is quite clear is that for full effectiveness, this understanding needs development before a full specification and implementation of contextualization support – in the form of appropriate software pioneered by RAIDmap – will be possible.

2.3.6 The Research Data Management Overhead

Following from the observation in Section 2.3.1, it continues to be a widespread belief that the cost of research data management consists essentially in the cost of the provision and use of data storage space. It has yet to be grasped fully (even by some who should by now know better) that this is only one – perhaps the least expensive and most easily predicted – part of the costs that will be expended. Other costs will accrue from the management of the management of research data, and from the activities by researchers and data managers before, during and after the research is carried out necessary to ensuring that the value of the data can be maximized by its re-use. Currently there is little or no practical experience of incurring these costs, therefore little in the way of guidance in predicting these costs.

2.3.7 Research Data Inflation

There is some evidence (see http://go.bath.ac.uk/bkct) that the quantity of data that might hitherto be stored or require storage for a project will in the future be inflated as a result of the mandating and formalization of research data management. To ameliorate inflation, best-practice guidance will be needed which assists researchers in making good decisions about what data (and contextualizing information) they choose to keep, and what they might safely throw away. For good decisions about retaining and discarding information to be achievable there must exist sound guidance on assessing the current and future value of information; currently there is little, indeed the exploration of what might constitute information value is in its infancy.

2.4 Immediate impact

There was no expectation that the work done in REDm-MED would have a widespread immediate impact because the outcome of application of the measures developed would only become clear after full implementation and that this would not occur during the time frame of the project.

Nevertheless, involvement in the project by researchers in the Department, especially members of the panel, and the feedback into the Research360 Project, specifically in liaison with that project's project and technical managers, will have expanded their general awareness and knowledge of research data management requirements and detail at the departmental level. Thus, the general preparedness of those involved to meet future RDM requirements will have been increased.

2.5 Future impact

It is expected that future impact of the project will be as identified in the following table.

Impact Area	Anticipated Impact Description
Researcher- and project-level DM planning	Improved during-project data management, leading to better use. This will also enhance management for potential re-use and re-purposing, through increased accessibility and interpretability.
Post-project 'local' research re-use	Better during-project management will increase the potential for post-project re-use and re-purposing of research data
Institutional and Academic governance	Conformance with regulatory and governance requirements on data management are reliant on the necessary mechanism being available, this includes local data management support of the sort provided by REDm-MED outputs
'External' party data use	Improving the way in which research data is managed for the purposes of re-use and re-purposing, and archiving will, necessarily, enhance the potential of application of that data amongst a wider user group. This will include re-use and re-purposing and will assist in making research more easily validated and more transparent.
Research cost	Re-use will reduce costs.
Response to Funder Requirements	The data management measures developed and submitted for use by the Department will provide a means by which it may – if it chooses the proposed measures – fulfil its data management obligations to its funders (principally the EPSRC).
RDM Tool Development	The provision of the prototype RAIDmap Associative Tool, together with the open-source code for the tool, provides the basis by which others can **a)** explore the practicability and usefulness of the sort of research data contextualization provided by the tool, and **b)** develop the tool to implement all the functions identified in the RAID Associative Tool Functional Specification (Darlington, et al., 2011) and any additional functions that may become apparent as a result of progress in **a)**.

3 Conclusions

Analysis of the CARDIO process and interaction with researchers within the Department has shown that the current capability of the Department with respect to data management is low, even given the quite modest expectations of the participants of their data management duties. Likewise, the capacity of the institution to provide support is limited, being in a state of flux and development in response to the demands being made for the provision of data management policies, procedures and support services.

With the exception of storage management within the Department and its resultant effect on data availability, which shows evidence of fairly widespread capability, the management of data is either not supported at all or supported only in a limited fashion. In addition to eliciting the views of participants on current data management capability in the Department of Mechanical Engineering, it had been hoped that evidence would be obtained of good practice that might be more widely adopted. Participant comments suggest that some data management activity occurs, but the scope is limited and the extent varied between projects. Most data management is informal in that the practices are ad hoc and not dependent on clearly laid down and carefully followed procedures; it would be difficult to build directly on practices such as these.

So it is clear that the relatively undeveloped capacity for research data management is matched to limited experience of researchers in associated management activities. In general, then, there is ample room for improvement at the departmental level – the current situation being one that should be

easily improved as a result of the introduction of improved data management measures – and at institution level.

A key element of research data management – in order to support interpretation of the research data proper – is the preservation of information about the context in which the data were generated including records that provide the contextualization. One method of achieving this is through the RAID modelling approach as demonstrated by the prototype RAIDmap Associative Tool. It is clear from what has been learnt during the implementation, that providing an associative record of research data which is truly useful post-project in making the data more understandable will require further work. The RAIDmap application can be considered an early exploration of this process which requires further development before it is made available for widespread adoption.

The REDm-MED Project work has resulted in the specification and development of a research data management framework expressly fitted to the needs of the Department of Mechanical Engineering. Given the diverse nature of the research undertaken, but the very general nature of the research data generated, it is clear that the framework (consisting of the DMP and the supporting infrastructure necessary for its implementation) would be readily and usefully adopted by others – both in academia and in industry – carrying out research of similar character.

4 Recommendations

For effective research data management that fulfils the spirit of the endeavour – that is, to make research data available, accessible, retrievable, interpretable and re-usable – it is clear that appropriate procedures must be adopted and that supporting infrastructure be implemented.

The presumption is that before any data management plans are adopted or mandated by any department at the University of Bath they would have to go through an iterative process of consultation, piloting and approval not only at departmental level but perhaps, too, at institutional level.

Given the immaturity of research data management in the Department and the University it would be unwise either to mandate the ME-RDMP in its current form or to offer it for piecemeal uptake by enthusiastic researcher leaders or teams. It is recommended that the outputs of the REDm-MED project are considered for piloting at departmental level amongst a selected research group, as a basis for the later general adoption of those parts, or modifications thereof, that are seen to be useful. As a precursor to this an assessment would have to be made of the resources required for the plan to be implemented, taking into account the policies having been adopted as a result of the Research 360 Project.

There are a number of key documents that have been identified as being needed to support RDM planning; all are identified above. Of particular importance is a document that provides guidance on how to estimate reliably the through-life cost of managing the data that are expected to be generated by a specific research activity. Without this guidance it will be impossible for those preparing bids to request appropriate support; and those who provide the funds to understand how the costs have been derived. Therefore it is recommended that efforts be directed at creation of the necessary guidance with input, necessarily, from expertise external to the University itself.

5 Implications for the future

As noted above, whilst a number of disciplines have a long RDM track-record, we are in the ‘first-generation’ of research data management across the academic disciplines. Any application of the data management measures proposed in the REDm-MED outputs should be considered exploratory; the experience of their use will contribute to a developing understanding of the real purpose of research data management, its actual – rather than supposed – value, and the most effective and efficient of carrying it out for the emerging purpose.

Any lessons learned from adopting these RDM practices can be shared firstly with other research enterprises of a similar character, and then with other disciplines, especially in the engineering sector, whose data are characteristically similar. Once the general approach has been validated and

improvements made, then the 'package' could be offered for adoption elsewhere – including by the Department as a whole – as best-practice guidance.

As recorded above, a prototype RAIDmap Associative Tool has been implemented which illustrates a number of the functions necessary to provide a visualization of the data records and their relationships generated during a research activity. The current implementation of the tool is limited in functionality and interface sophistication. However, it does provide the basis for others to develop the software first to complete the earlier specified functionality and to make best use of the power of the underlying Compendium host application, and then to explore additional ways of recording and conveying the 'context' of data creation during research.

6 References

Mansur Darlington, Alex Ball, Tom Howard, Steve Culley and Chris McMahon. (2011). RAID Associative Tool Requirements Specification (version 1.0). ERIM Project Document erim6rep101111mjd10. Bath, UK: University of Bath. http://opus.bath.ac.uk/22811/