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Moving a brick building: UK libraries coping with research data management as a 'wicked' problem

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Abstract

The purpose of this paper is to explore the value to librarians of seeing research data management as a 'wicked' problem. Wicked problems are unique, complex problems which are defined differently by different stakeholders making them particularly intractable. Data from 26 semi-structured in-depth telephone interviews with librarians was analysed to see how far their perceptions of research data management aligned with the 16 features of a wicked problem identified from the literature. To a large extent research data management is perceived to be wicked, though over time good practices may emerge to help to 'tame' the problem. How interviewees thought research data management should be approached reflected this realisation. The generic value of the concept of wicked problems is considered and some first thoughts about how the curriculum for new entrants to the profession can prepare them for such problems are presented.

Keywords

Academic libraries, data curation, library roles, research data management, research support, United Kingdom, wicked problems

Introduction

In the last five years managing research data has emerged as a potentially important new area of activity in United Kingdom (UK) universities (Corti et al., 2014; Pryor, 2012; Pryor et al., 2014). UK research funders have become concerned with improving the management of research data and increasingly stress the value of sharing research outputs, including data (Research Councils UK, 2011). Most now require a Data Management Plan as part of a funding application but they have also placed a responsibility on institutions to find ways to manage, share and preserve research data, in the absence of comprehensive national subject data repositories. This is in parallel with shifting policy agendas at the EC level and in the USA and Australia.

The scale of the challenge is significant, and can be grasped when one considers the variety and volume of research data that is potentially in need of management. The data that researchers create and use is extremely diverse across different fields of research. The very term 'data' is not commonly used in all disciplines. Standards for such data and methods of preservation are correspondingly diverse. The scale of the issue is also very large because of the number and the increasing size of datasets being produced even in small-scale research, and the sheer number of researchers and projects being undertaken across a single university. The way that data is used in the research process is also complex and the tools in use vary enormously across disciplines (RIN, 2009). Some fields, such as medical research, already practise sophisticated data management and others are just beginning to grasp the importance of the issue. Commercial and legal reasons not to share data are strong in some fields; whereas in others, such as physics, open data sharing even prior to

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publication is already second nature. Even what data sharing means is unclear (Borgman, 2012). It is in this highly-complex environment that institutions are beginning to establish policies and plan new services to support research data management (RDM) (Corrall et al., 2013; Cox and Pinfield (forthcoming); Pryor et al., 2014; Tenopir et al., 2012).

A number of authors have sought to define a library role in RDM (Alvaro et al., 2011; Corrall, 2012; Cox et al., 2012; Gabridge, 2009; Lewis, 2010; Lyon, 2012; Monastersky, 2013), but it is recognised that multiple professional skill bases need to be drawn on to address the whole issue, including, of course, those of researchers themselves. Librarians could be involved in developing institutional policy, a process that is likely to involve a large number of institutional stakeholders. They might also be involved in training and advisory roles – to some degree a natural extension of information literacy roles; this is likely to be in collaboration with IT services and research administrators. They could also be involved in creating institutional data repositories or data catalogues, again working with IT services. Although models of such research data services are emerging, there is still considerable uncertainty about what they should look like, as well as uncertainty about resourcing. This creates a very complex and challenging agenda. Funders introducing policies prescribing data management and sharing approaches gives the issue a degree of urgency. In this context there is a need for ways to conceptualise the nature of the challenge faced; at least on first encounter it is a significantly more complex problem than those usually encountered by libraries.

In their seminal paper Rittel and Webber (1973) proposed a distinction between the 'tame' problems of natural science and the 'wicked' societal problems faced by planners. A tame problem is one that has been seen before and, though challenging, is soluble often in well-understood ways. Many organisational problems are of this sort. The daily problems faced in running a library, even many of the more challenging ones, are essentially tame by this definition. Managing staff or stock or even implementing new systems or discovering user needs are well-understood types of problems for which the profession has developed well-known approaches over many years. A wicked problem in contrast is one that is unique and highly complex, whose definition itself is disputed by those involved, and whose solution is likely to remain unclear. A classic example is the problem of how to deal with climate change (Verweij et al., 2006, 2011). The concept has been widely applied in many fields, including information systems research, yet there are very few applications in librarianship (apart from in Bell's (2008, 2010) work on design thinking). The promise of employing the distinction is that it offers to put us in a different mindset when we realise the challenge is a qualitatively different type of challenge. In addition, there have been a number of ideas about how wicked problems need to be approached that could help practitioners. The purpose of this paper, therefore, is to explore how useful the notion of wicked problem is to understanding RDM and, if this is the case, whether useful suggestions about how to approach the problem differently arise from this understanding. Semi-structured interviews with librarians about RDM services in UK academic libraries provided a corpus of data through which to explore the question.

Wicked problems and social messes

According to Rittel and Webber (1973) wicked problems have 10 defining features:

1. There is no definitive formulation of a wicked problem. Different approaches to the problem see it differently. Different proposed solutions reflect the fact that it is defined differently.
2. There is a 'no stopping rule'. Unlike in an experiment where you can stop natural processes and control variables, you cannot step outside a wicked problem or stop it to contemplate an approach to answering it. Things keep changing as policy makers are trying to formulate their answers.
3. Solutions are not true or false, rather they are good or bad. There is no right answer and no one is in the position to say what is a right answer. The many stakeholders focus on whether proposed solutions are ones they like from their point of view.
4. There is no test of whether a solution will work or has worked. After a solution is tried the complex and unpredictable ramifications of the intervention will change the context in such a way that the problem is now different.
5. Every solution is a 'one-shot operation'. There can be no gradual learning by trial and error, because each intervention changes the problem in an irreversible way.
6. There is no comprehensive list of possible solutions.
7. Each wicked problem is unique, so that it is hard to learn from previous problems because they were different in significant ways.
8. A wicked problem is itself a symptom of other problems. Incremental solutions run the risk of not really addressing the underlying problem.
9. There is a choice about how to see the problem, but how we see the problem determines which type of solution we will try and apply.

10. Wicked societal problems have effects on real people, so one cannot conduct experiments to see what works without having tangible effects on people's lives.

Since it was proposed, the notion of a wicked problem has proved a fertile idea and authors have applied it to a wide range of social problems from crime to global warming. Horn and Weber (2007) usefully add to our sense of the character of such problems in their description of what they refer to as 'social messes'. Six specific features of such issues are worth adding to the earlier list:

11. As well as there being no single definition of the problem, there are multiple value conflicts wrapped up in it.
12. There are also multiple ideological, political or economic constraints on possible solutions.
13. There is great resistance to change.
14. With social messes, in addition to the complexity of the problem itself, data to describe the problem is often uncertain or missing. It may be difficult actually to collect information. There is no one expert with the answer.
15. Because the problems are complex, there are multiple possible intervention points.
16. The consequences of any particular intervention are difficult to imagine.

Conklin and Weil (1997) have some interesting reflections about the nature of the process of decision making with wicked problems. They suggest that it is unlike the classic decision-making model with stages of gathering data, analysing it, and then formulating and implementing a solution. Decision making with wicked problems is non-linear. The decision maker is still going back to collecting data or re-analysing data at a late stage. The authors also emphasise that until we find a way of dealing with a wicked problem we do not understand the problem. Sometimes problem solving ends merely because one has run out of resources to consider further actions. Some suggest that wicked problems cannot be solved, only resolved (Holt, 2004).

The work of Verweij with various colleagues (Verweij and Thompson, 2006; Verweij et al., 2006) takes the wicked problem concept one step further by proposing that such messy issues have their roots in the existence of four divergent, indeed incommensurable viewpoints; four viewpoints that have been identified in Mary Douglas' cultural theory: an egalitarian approach, hierarchical approach, individualistic approach and fatalistic approach. Cultural theory maps different ways of organising and justifying social relations onto two dimensions: group commitment and grid of control. Group commitment is about incorporation in a bounded group; grid of control is the degree to which an individual's actions are governed by externally imposed rules (Mittleton-Kelly, 2004; Verweij et al., 2006). In Verweij et al.'s (2006) use of the concept, each of the four viewpoints offers a plausible account of the problem and its solution, but there can never be a resolution of these perspectives because they embody very different assumptions and values. All four viewpoints or discourses are present in thinking about society. Thus, in very simple terms, an egalitarian approach (strong group commitment, weak grid of control) is to build consensus among all social actors. A hierarchical approach (strong group, strong grid) relies on experts, but tends to ignore direct representation of stakeholders. The individualist approach (weak group, weak grid) is simply to allow competition between individuals to reach a solution. The fatalistic view (weak group, strong grid) takes a wait-and-see strategy. Each approach has its strengths, but ultimately it is hard to fit them together since they embody very different ways of thinking. In the climate change debate, for example, Verweij et al. (2006) identify an account of the problem from each of the perspectives which is in itself entirely plausible, yet fundamentally at odds with the other accounts.

There is an additional parallel and potential link between ideas around wicked problems and the precepts of complexity science, with its notions such as non-linear change in systems and self-organisation. Some authors such as Conklin (2005) and McLeod and Childs (2013) link the two ideas. Snowden's Cynefin framework offers an alternative categorisation of problems and approaches to analysing them (Snowden, 2010; Snowden and Boone, 2007) that is used persuasively by McLeod and Childs (2013) to provide an initial exploration of RDM.

Getting clumsy, bricolage and design thinking

The point of the distinction between tame and wicked problems is that if we know a problem is wicked we operate differently. Verweij sees part of the answer to lie in 'clumsy' solutions and organisations. Unlike the elegant solution possible for a clearly definable problem, we can only hope for a clumsy solution to a wicked problem, one that partly satisfies different stakeholders. No consensus is possible. Organisations should correspondingly be loosely coupled so that the inherent contradictions between such viewpoints can be accommodated and aligned.

Grint (2008) proposes that we need a different type of leadership when trying to handle wicked problems. This is far from the clichéd model of a heroic leader; but also different from the four models suggested by each viewpoint identified in cultural theory. Leadership in wicked problem spaces must counterbalance the weaknesses of each of the egalitarian, hierarchical, individualistic and

fatalistic approaches by drawing on strengths from each. It is a bricolage of approaches, an improvisation, rather than a purely 'rational' planned approach. He suggests the following principles for leadership in the context of wicked problems:

1. Questions not answers – the leader's role is asking questions in order to help define the complexity of the problem facing the organisation and create conditions for 'collective responsibility' in addressing it, rather than the traditional expectation that they jump straight to offering a solution.
2. Relationships not structures – solutions are found through developing trusting relationships rather than adjusting formal power structures. Relationships within organisations are key to success, and 'make the structure work'. It follows that the common response to problems of restructuring organisational hierarchies will fail because it often leaves relationships little changed.
3. Reflection not reaction – classically the leader is required to be decisive; with wicked problems there is value in reflecting and studying the situation. This is to be distinguished from doing nothing.
4. Positive deviance not negative acquiescence – this points to the value of not taking an easy line of acquiescing to organisational policy, but fighting for what you believe is right.
5. Negative capability – being able to operate even in conditions of uncertainty.
6. Constructive dissent not destructive consent – 'destructive consent' commonly exists where people in organisations comply with leaders but do so in a way that will harm the organisation. Creating a context in which dissent can be constructive is key to operating in wicked problem spaces.
7. Collective intelligence not individual genius – turning to individuals to solve problems through their individual creativity is less successful than people working together to develop ideas.
8. Community of fate not a fatalist community – this is about accepting that one has to work with the other people implicated in the problem and making the best of it, rather than just feeling that the group are doomed to suffer.
9. Empathy not egotism – wicked problems require that we grasp the perspectives of others rather than pursue our own interest or viewpoint.

In a later paper, Grint (2010) adds some more ideas about the 'emergent leader': the need to build trust, exchange information, embrace emergence and explore new territory and create new knowledge. Leaders are 'enablers, facilitators and coaches' not in the position to command and control.

Ney and Verweij (2014) examine a number of methodologies for solving problems using cultural analysis to explore which are messy enough to produce clumsy solutions. Some of these methods are relatively familiar to information science such as Action Science and Soft Systems Methodology, others are much less well known. Of these methodologies it is worth particularly mentioning Design Thinking, because of its recent popularity in business schools (Brown, 2008; Dunne and Martin, 2008). Although doubt has been cast on whether the concept of design thinking really has any basis in what designers actually do (Kimbell, 2011), it does offer some interesting precepts for solving wicked problems (Bauer and Eagen, 2008). Design thinking in management is a creative process, in which after gathering information (often through ethnographic techniques) the manager approaches problems through imagining possible solutions, rather than analysing the existing issue reductively. Solutions are prototyped for practical trial before implementation. One of the gurus of design thinking in organisations, Tim Brown (2008) suggests that the designer needs:

- Empathy
- Integrative thinking
- Optimism
- Experimentalism
- Collaboration.

Design thinking is an optimistic perspective on solving wicked problems. Unlike the view that they cannot be solved or Verweij's notion of clumsiness, design thinking does seem to suggest wicked problems can have elegant solutions.

Applications of the wicked problem concept in information science

Although one of the original authors of the wicked problem concept wrote specifically about its relevance to information science (Kunz and Rittel, 1972), it has filtered into the field only in a patchy way. There have been a number of applications in information systems thinking. For example, McLeod and Childs (2013) have recently examined electronic records management (ERM) as a wicked problem. A second paper by the same authors also briefly considers whether RDM could be considered a wicked problem (Childs and McLeod, 2013). Design thinking specifically has also been taken up in information systems (e.g. Gleasure, 2013; Hevner et al., 2004) and human computer interaction (e.g. Zimmerman et al., 2007), as has complexity science (e.g. Benbya and McKelvey, 2006). However, there seem to have been fewer applications of these conceptualisations for understanding issues in academic librarianship. Bell (2007, 2008, 2010) has written

about design thinking for the library and information science (LIS) context. This is linked to his ideas about how a professional needs to blend skills of academic librarianship with instructional design and technology skills (Bell and Shank, 2010). Howard and Davis (2011) have examined how design thinking may be combined with evidence-based librarianship.

There are few other library-focused analyses of wicked problems, yet the context in which academic libraries operate is recognised to be 'wicked'. Gourley (2008) has plausibly applied the concept to exploring the nature of the interface between higher education (HE) and further education (FE) at a strategic level and Watson (2000) analyses different problems in HE as a whole as wicked. Zenke (2014) proposes that leaders in HE should take design approaches. Bell (2010) also blogs about how design thinking might make HE different. Most practitioners would recognise that through processes such as globalisation and the complexifying of context by technologies that connect people across barriers of time and place, many problems we face today have the intractable quality of wicked problems. It is a professional truism that a successful practitioner needs to be flexible and creative and have skills in collaboration and multi-professional working. These beliefs recognise the importance of skills needed to tackle messy contexts. Yet perhaps something of the pragmatism and rationalism (Gorman, 2000) of library professional thinking is an obstacle to incorporating notions of complexity or clumsiness. Nevertheless, the very popularity of the wicked problem concept in other fields, demonstrated by how often it has been cited, suggests that it is an inherently fertile distinction and so seems to create a case for applying it to the LIS context.

The purpose of this paper, therefore, is to explore how far librarians see a current issue, research data management, as 'wicked' and consider whether their responses to RDM reflect advice from the literature about how we need to operate differently in such contexts.

Research questions

Reporting data from semi-structured interviews with library practitioners associated with RDM, this paper addresses the following research questions:

1. Do interviewees' characterisations of RDM as an agenda suggest that it fits the criteria for a wicked problem?
2. Are the ways interviewees are approaching RDM appropriate if it is to be considered a wicked problem?

For the purposes of the analysis a wicked problem was defined as having the 16 attributes identified above. The article follows Grint's (2008, 2010) suggestions about the implications for leadership of recognising an issue as wicked.

Methodology

The data analysed for this paper are 26 telephone interviews with practitioners conducted as a follow-up to a web-based survey of academic libraries about RDM services and plans, reported in Cox and Pinfield (forthcoming). All the participants were based in a library and most had a direct responsibility for RDM for their library service. As a self-selecting sample they are probably to be seen as primarily those institutions directly engaged with the agenda, although some participated even though they were just getting to grips with the issue. As a consequence they cannot be said to be fully representative of all the views in the sector. They certainly under-represent the perspective of those in new universities, less engaged with the whole agenda. The interviewees do, however, represent a significant proportion of institutions in the sector, with a range from the pioneers of research data services through to those who by their own admission have barely begun to respond. For the purposes of this paper, therefore, they represent an appropriate sample.

The interviews were conducted by telephone (one was face to face) and completed between March and June 2013. Their design was approved according to the University of Sheffield's ethics procedures and based on the principle of voluntary informed consent. Each in-depth semi-structured interview explored three main topic areas: the current state of support to RDM, respondents' perceptions of the skills needed to support RDM and the story about how the local policy had been developed. They lasted on average around 40 minutes.

The interviews were recorded and the recordings transcribed and then coded in NVivo. All three authors read the interviews and contributed to the coding and analysis. It was after conducting a descriptive thematic analysis (Braun and Clarke, 2008) that the wicked problem concept was identified as a potential framework for understanding the phenomena. The data was re-examined in the light of the concept. It was not seen as providing a framework for fully describing the data originally collected, the claim is just that the data could be read productively through wicked problems as a lens.

RQ1: Do interviewees' characterisations of RDM as an agenda suggest that it fits the criteria for a wicked problem?

This section describes how actors saw RDM and links these descriptions to the 16 features of wicked problems identified above. For clarity links to the features are in italicised text.

Many stakeholders

It was clear from the interviews that multiple stakeholders were involved in developing an institutional response to the RDM agenda. Interviewees were librarians, and whilst there was widespread agreement that the library should be involved in RDM, they did not see librarians as a profession as having all the answers. There was disagreement about whether librarians should have a leadership role. The library's position was unclear:

> This is one we are trying to figure out ourselves here, work out exactly what the library's role is.

Other professional services were always involved. For example in narratives of policy development interviewees mentioned working with:

- Computer/IT services
- Research support services
- Legal advisory services
- Records management services
- Research leadership, such as pro-vice chancellors (PVCs)

In addition to the different professional perspectives there were different responses to the problem based on organisational level and role. It was evident that the library director or members of the senior team may sometimes have had a different view from liaison librarians or other library staff on the role of the library in RDM.

In most cases, RDM initiatives were reported to be led by the Pro-Vice-Chancellor for Research (or equivalent) and overseen by the institutional research committee, with research support services and IT services being the most commonly mentioned support services to be involved. In many cases, a working group or task force chaired by the PVC had been set up reporting to the research committee. Yet the pattern of who was working on the problem was different between different institutions. Some participants reported involving senior academics on working groups or carrying out an audit or consultation process; however, in general it was a common theme of the interviews that engagement with the academic community had to date been limited. This was seen as an immediate major challenge, since researchers were also themselves central stakeholders.

It was generally felt that there was no professional services stakeholder for whom RDM support is a core capability. Everyone had part of the answer, there was lots of relevant expertise already but parts of the answer were missing:

> There is no one person who has all the detailed expertise across everything in RDM.

> Nobody can own this on their own. They are going to have to really appreciate what those other partners' roles might be and where their expertise is and where that expertise needs to be drawn in and listened to.

Specifically it was often felt to be unclear who should own/lead RDM. Who was leading varied between institutions.

Equally, some people consulted within institutions refused to give the agenda any credence. Some respondents reported scepticism from other support services:

> So from the academic point of view it's big, from our point of view it's big because we flagged it up as a major issue from the beginning. The computer centre would deny there was a problem.

A larger number reported scepticism (or at least lack of engagement) from the academic community.

Other priorities seemed much more pressing for some stakeholders. A common comment was that the Research Excellence Framework (REF), the UK-wide research quality assessment exercise, was a more immediate priority for research offices, at least until the census date in December 2013:

> …we really need to get REF out of the way before we start trying to push with this.

> I think the PVC for research isn't really recognising or driving any of this. He is very REF focused, and I don't think he can really see beyond that at the moment. I think there is just so much going on there that everything else is taking second place.

The distributed power structure of many universities, where there is no single point of decision and many are loyal to disciplinary (or professional) communities beyond the institution means that reaching decisions in an area of multi-professional concern is complex. Some participants expressed frustration with the governance complexity and ambiguity characteristic of universities where it took a long time for decisions to be made and even if made these decisions were not easily implementable across the institution:

> Well, yes I am seeing my director again tomorrow, to follow this up. When I first put something to him about 9 months ago, it did seem to strike a chord, and he was absolutely agreed we had to do something and it is very worrying etc., very important. And then nothing really happened for 6 months, until he said he was going to take it up to the new [institution] management, but then nothing happened, so I have been pushing it again this year. And last time, he agreed some action, and then still nothing has happened, so there is commitment, but he didn't actually seem to commit to action.

The list of stakeholders identified in the interviews suggests some unusual partnerships: professional groups that do not usually work in tandem were trying to come more

closely together through RDM. So finding who were the right contacts to build basic networks was one of the early challenges that seemed to be encountered. There was a sense of going backwards and forwards through committees and discovering new layers or groups that had to be consulted, further delaying action.

Some participants reported that the devolved nature of universities made communication difficult. This caused problems with engaging academics in particular and meant the sharing of good practice already going on in the organisation was challenging. One participant reported:

> A lot of good practice, innovative, creative problem solving practice, but is shared by one person and their three research colleagues in their research group. It doesn't make it to the other discipline, so something that will help us facilitate better sharing of that kind of knowledge.

Asked to rate the importance of a number of key drivers (storage, security, sharing, compliance and preservation) most interviewees recognised all as important to some stakeholders. But it seemed that the drivers were stronger for some actors than others. IT staff focused on active data storage and security whereas librarians were more interested in preservation and sharing. Thus stakeholders saw the problem differently. One would expect such differences to reflect differences in professional roles, values and cultures (Verbaan and Cox, forthcoming).

These points suggest central aspects of why RDM could be seen as a wicked problem. The sheer number of stakeholders is an unusual feature of this agenda. Although this is not identified as a feature of wicked problems as such, it does make it likely that some very different perspectives on the issues coexist (feature 1). Indeed it was recognised by participants in this study that stakeholders in RDM had a different perspective and define the problem differently in the different weight they gave to different drivers. Thus there is no definitive statement of the problem (feature 1) and how the problem is defined shapes what is seen as the solution (feature 9). It could be argued that there are fundamental value conflicts wrapped up in how the problem is defined and prioritised (feature 11). There is no correct answer, only ones more or less satisfactory to different stakeholders based on what they assume to be important (feature 3). Since RDM falls between or outside established professional areas, it is not simply solved by recourse to existing competencies – a wicked problem is bound to have something of this quality. Knowledge of who to contact and what they know was lacking in the situations described in this research: echoing the point that a lack of information about the problem being characteristic of wicked problems (feature 14).

Yet RDM might only be considered a wicked problem if it emerges that viewpoints are truly incommensurable and it is impossible to reach a consensus. It could be argued that indeed RDM is not one agenda, but a number of separate issues entangled together: the problem of storage, the problem of information security, the problem of openness etc. Each is highly relevant to RDM but there are also instances of the same issues being long-standing problems in other areas. Trying to fix any one issue for RDM has implications for how the same problem is addressed in these other areas. For example, managing research data is an example of the problem of managing institutional data in general: a long-standing issue. Similarly, data sharing/open data is an example of the challenge of content sharing/openness in general, which has many wider implications. *This echoes the way a wicked problem is linked to other problems. It may even be a symptom of other problems (feature 8).*

Multiple possible solutions

A variety of different solutions to the RDM problem were mentioned by interviewees. These ranged from deployment of new technologies to the creation of new advisory services. Although there was some recognition that an institutional data repository system was a likely part of a solution, it was very unclear what this might look like: who would run it, what sort of datasets it would house, and what subject fields it would cover. A data catalogue, providing metadata describing datasets and possibly giving access to them, might be an alternative. Training and advisory services were also seen as key. *This reinforces the sense that there was no one solution (feature 6). Rather, very different types of approach were available. This follows naturally from the divergence of stakeholder perspectives.* The problem was also seen to be different for different institutions.

No institution claimed to have solved the problem or was seen by others as having solved the problem. Some institutions were recurrent reference points as examples of advanced practice although staff within those institutions themselves did not always share this perception. It was in this sense 'early days' for everyone, with a sense of feeling their way without very clear models. *Thus there was no list of solutions (feature 6) and no certainty about what worked (feature 4).*

Having recognised the differing views about drivers for RDM and differing institutional responses, it was widely acknowledged that a key stimulus to activity was research funders mandating effective RDM including the requirement for DMPs in research proposals. In particular the deadlines set by the EPSRC (Engineering and Physical Sciences Research Council) were frequently mentioned as a trigger of activity. In some cases, the EPSRC requirements were reported to have complemented existing institutional activity:

> I think the ground was ready, and there was a bit of activity, but what really prompted people to do things was the EPSRC mandate…

In other cases, activities particularly around policy development were acknowledged to have been prompted by the

EPSRC. When asked about major drivers for current activity, one interviewee replied:

> The EPSRC road map. I don't think we would have necessarily thought about developing one if it hadn't been for the road map acting as a real and big driver. That is not to say we might not have got round to it eventually as experience built up but that has acted as a real catalyst.

This mandate was essentially an external driver with strong coercive power. But it also created some uncertainty, partly because the requirements were seen as ambiguous and partly because it was unclear if compliance was really going to be audited. *In so far as there was a single, external coercive driver, the problem could be seen as non-wicked: a tame problem. How to comply might be difficult but if there was no choice but to comply, the problem would be less intractable. However, participants also regarded other drivers as important. Whilst research funder requirements may have been an immediate trigger for activity, other causal factors will also be important (including storage, security, preservation and sharing*), adding layers of complexity.

RDM tended to be constructed as a problem: a risk, more than something likely to give an institution competitive advantage:

> Key drivers were risk, basically the risk of not complying with funders' requirements. Risk of losing critical research data, risk of not being able to share data, so it's basically a risk averse thing…
>
> …before the term 'Data Management Plan', the university, as part of its own risk management assessment, decided that they needed to do more to manage the risks around data…

This characteristic fits the wicked problem concept. It was not something that was driven by desire for strategic advantage. The concept of a wicked problem does imply a context viewed as a challenge that must be solved, not an environment containing opportunities. It is a risky context.

The sense of risk was heightened by some anxiety about time passing towards the 2015 deadline set by EPSRC:

> 2015 will be on us before we know what has happened.

Added to this, the sense of risk around RDM was further increased by the fact of the rapidly increasing 'volume, variety and velocity' of data being generated by research activity. There was a perception that the problem was growing more quickly than solutions could be developed to address it. *This mirrors feature 2 of wicked problems, a sense that we cannot really stop and think about solutions to a wicked problem because the problem is evolving.*

Interviewees very frequently mentioned the activities both of Joint Information Systems Committee (JISC) projects and the advisory role of the Digital Curation Centre (DCC) (http://www.dcc.ac.uk/). Some of those without a JISC project were finding it hard to follow the examples, but they remained key reference points. While RDM was seen as posing unique issues for each institution so that best practices are hard to translate, nevertheless both JISC and DCC were positive factors in the situation producing clarity, model solutions, reusable material such as training materials. *In a sense this points to a list of possible solutions beginning to emerge in contrast to the idea that there is no comprehensive list (feature 6).*

The nature of the issues

One of the key issues associated with the RDM problem is that there is still little information about some of its key aspects. Interviewees had inadequate knowledge about local practices and attitudes of researchers. *This suggests again that RDM has the **14th** feature of a wicked problem: there is a lack of information about its real scope.*

RDM was seen as a large-scale and far-reaching problem. It was seen as large scale not merely in the sense of data itself growing in size and complexity, but also in the sense that RDM touched on the activities of every researcher – hundreds of people in every institution. It was seen as far reaching in that it affected the daily practices of those researchers in fundamental ways. This meant RDM was a different sort of issue from many of those which have previously confronted libraries and which have allowed more independent action by the library even if that action has significantly impacted on users outside the library. *It is not explicit in the list of features, but it is implicit that a wicked problem is big in scale and significant in its impact. The nature of the problem and variety of possible solutions meant that feature 16 seemed to hold: that the consequences of interventions are hard to imagine* (*though this was not explicitly commented on by interviewees*).

Finding a solution was perceived to be important. There was a strong sense of a need for the problem to be addressed in a serious way. *This mirrors the sense that for a wicked problem there is a moral imperative to get it right. Failure would have specific consequences. This aligns with feature 10 of wicked problems, though RDM does* not, *of course, have the moral weight of some public policy wicked problems.*

The problem does not have a single solution. Many things have to be accomplished to address it. The problem was such that RDM was seen as requiring a 'culture change' which implies not just a few, surface behaviour changes, but many, fundamental changes to activities and thought – both for professions themselves and researchers:

> It will be a huge cultural change for a lot of people.

Culture change is complex especially where there are already multiple cultures, as in a university. Interviewees anticipated complex responses from researchers. In some disciplines the whole agenda would be received with incomprehension, while some researchers already knew a lot more than interviewees themselves. A number of respondents reported a lack of engagement from the academic community on RDM. In one case a draft RDM policy had been put out for consultation but had prompted very little comment:

> Nobody in the [institution-wide] survey commented on the policy, and nobody has been e-mailing in commenting on the policy, and as I say when it went to the faculty research and innovation committees, it went to every faculty … and it went through the research and innovation board and the research data steering group before it went to Senate, and the changes were really minor, so I think because it was such a high-level document, people were just shrugging and like 'Yes, whatever'.

> You need to be able to move that brick building that doesn't want to be involved.

It was implicit in much of what interviewees said that they anticipated resistance (either passive or active resistance) to change (feature 13).

Library responses

Attitudes were reported to differ on the specific question of the library's involvement with RDM. One interviewee, speaking of academic researchers' attitudes to library involvement, commented:

> I don't think they have any idea that we have any role in this. I think it will be a surprise.

> So I think they see the library as being on the periphery really at the moment rather than being an important part of it.

Other participants were more optimistic about positive reactions from researchers because of recognition of existing areas of expertise within the library:

> Amongst the researchers, I don't know if that's the case for them as well. I think there is an understanding that we have skills and expertise with repositories, with the preservation of research outputs, we have skills and expertise with the provision of third party data, and how to get hold of particular data sets that people want. So whether or not they join the dots between those and see us as the natural leaders on this issue, I don't know, but I think that's really how we will be putting ourselves forward…

This makes the problem wicked for the library, in that it is not simply about applying skills to a problem but also persuading user groups that they are relevant.

Providing an RDM service implies many challenges. The complex technical issues (such as how to build a data repository or which metadata standards are suitable) are tangled up with organisational, political and economic issues. RDM cannot be reduced to a technical problem. Furthermore, there was a sense amongst interviewees that RDM was not a familiar type of problem. It was unclear what the analogy with past problems was. Often people had been given responsibility for RDM because of their involvement in open access. Indeed open access was usually recognised by interviewees from a library's perspective to be a somewhat analogous and also a linked problem. Yet it was also recognised to be dangerous if RDM were to be seen as the same problem or requiring the same approach, despite the connections and parallels. The ideological baggage of openness and the need in RDM for commercial confidentiality or to protect personal data meant that openness was often not the best argument for a more centrally-supported RDM. Some participants recognised this and reported that they had attempted to decouple the issues in communicating them, particularly to academics. The prominence of open access work at the time of the interviews was, however, a cause of confusion. *This is consistent with the seventh feature of wicked problems: the problem is unique and past solutions are not very helpful in learning about how to resolve it.*

Resourcing for RDM projects and services was also generally unclear for the library and more widely. There were many constraints on solutions, such as funding, the cultures of academic disciplines and lack of information. *This is consistent with the idea that wicked problems have multiple constraints (feature 12).* In some cases, interviewees expressed scepticism about whether new resources would be made available to address RDM as such. *Indeed, a key aspect of the wickedness of RDM was the sense that the lack of clarity about funding made it also impossible to scope the problem in a sensible way.*

Some interviewees reported library organisational restructuring would be necessary in the context of RDM. In many cases, however, such requirements were seen as part of a bigger picture, in some cases associated with the more effective management of digital resources, in others improvement of support for research. There also seemed simply to be a wider context of restructuring occurring across the sector and which was the context for decision making specifically about RDM. It can be hypothesised that the economic pressures as much as new service requirement lay behind such developments. *Thus for each stakeholder dealing with the problem is connected to other professional problems, particularly ones strongly shaped by resource constraints. The position of the stakeholder is itself unstable. Perhaps these are common features of wicked problems.*

Strategies and initiatives

Although research data has been collected and managed for many years, sometimes very effectively, providing

professional support is relatively novel. The RDM agenda revolves around providing a new service in a context of ingrained pre-existing practices. There were no pre-existing RDM services and rarely a history of thinking about the issue. There was uncertainty about where to start: should it be by engaging with researchers in an exploratory spirit, by collecting information about practices and attitudes (a Data Asset Framework survey of researchers data-related practices and attitudes), by agreeing policy, or by trialling services? *This matches feature 15 that wicked problems have multiple intervention points.*

One common approach was to develop a draft policy and use this as a basis for discussion within the institution. This was partly driven by the imperative created by the requirements of the EPSRC to produce an institutional roadmap. However, there was some uncertainty amongst those institutions which had developed a policy about next steps. In many cases there were issues associated with moving from projects and pilot to institution-wide services. There was a debate about whether the approach should be top-down or bottom-up. Most concluded that both approaches were needed. One respondent spoke of the continual need to balance top-down and bottom-up approaches:

> It came top-down initially in terms of 'We will draw up a vision statement for the institution, this is what everyone will do', but it has to be done bottom-up. It's got to be supported from above, and academics have to be persuaded, possibly, from above, but it's got to be driven bottom-up. They have got to see the need for it, and the way we try to go about it is to convince them of the benefits for them, the advantages longer term if we do this work with them at the beginning. So, it's got to be bottom-up really, but it has to have support from the top. Otherwise the reluctant ones just won't come on board.

This is consistent with the notion of intervention points being unclear (feature 15).

Institutions tended to try a few things and see how it worked and then gradually seek to build on successes. This was seen often to be achieved through investigative or pilot projects. *This is consistent with the idea that it is hard to anticipate the effects of interventions (feature 16 of wicked problems) and that there is no ultimate test that proves a solution works (feature 4). There has to be an element of trial and error.*

Feature 5 of wicked problems is that they are '*one shot*' *operations because any intervention changes the situation itself. In the case of RDM, however, outcomes of any intervention tended to be positive in terms of discovering what works and* in *gathering information and contacts. There was not generally a sense of there being a risk making the problem worse* except perhaps in reputational terms for the library. Yet it was recognised that there were risks associated with creating demand when resourcing was unclear. *This reflects the way interventions reshape the problem rather than solving it and also the interventions have real effects (feature 10).*

Summary

Thus RDM has many attributes associated with a wicked problem. It seems to be significantly more complex than most information problems. For example, it could be seen as more complex than ERM, complex though that is (McLeod and Childs, 2013), partly because of the number of stakeholders and the variations in their perspectives. Stakeholders do not define the problem in the same way (feature 1) indeed there are value conflicts bound up in trying to define it (feature 11). There is no single definition of the problem (feature 9) or agreed solution (feature 3). The problem is unique and cannot be tackled by simply following a formula developed before (feature 7) and there is no definitive list of solutions (feature 6). The problem is large in scale and linked to other problems (feature 8) and partly for these reasons there is a lack of critical information needed to understand it (feature 14). There are many possible intervention points (feature 15), but major constraints on resources available to apply to the problem (feature 12). Also it is significant that the agenda is changing and changed by interventions: these are key features of wickedness (features 2 and 5).

Nevertheless, in some senses it does not feel as fundamentally intractable as a truly wicked problem or so critical (feature 10) compared to climate change, for example. The stakeholders ultimately work for the same organisation, so value conflicts will be moderated by the need for the organisation to function. We are familiar with problems with multiple stakeholders; the issue is whether they can reach a consensus about how to define the problem and what to do or whether for some reason this is impossible. How we think about this is linked to the issue of the way each driver for RDM is tangled up with similar issues in other contexts or whether one sees the same common driver, funder mandates, necessitating similar solutions.

Furthermore, there was a sense among interviewees that however problematic now, solutions would emerge, partly because of the external drivers and partly because of community work on solutions and good practices, led by JISC and the DCC in the UK and other similar agencies as well as institutions elsewhere. The lack of information and competing viewpoints would be resolved over time. Resources would have to be found. Perhaps this means that it is the type of wicked problem that could be tamed, given time and resources. The point is that now with so few resources it is hard for those responsible to get a grip on it or even to know where to start. On balance, therefore, there seems to be a strong sense that interviewees saw the problem in 2013 as having a strongly wicked flavour even if they saw aspects of it being tameable in future.

RQ2: Are the ways interviewees are approaching RDM appropriate if it is to be considered a wicked problem?

The point of the distinction between tame and wicked problems is to trigger different behaviours. How one operates in a wicked problem context, the argument goes, is quite different from how one should work with tame problems (Grint, 2008, 2010). In a number of their common orientations to RDM, interviewees showed that they had instinctively grasped how to operate in the context of a wicked problem.

Interviewees talked a lot about trying to better understand the positions of other stakeholders and other professional knowledge bases were respectfully acknowledged. Solutions would emerge through collective intelligence, not individual brilliance (Grint, 2008: point 7). It was logical that people and collaboration skills were seen as key skills for potential RDM employees:

> Networking and collaboration, there is a lot of working with other services required, so understanding of other people's positions, listening skills.

> So I think it's really a joined-up process, so maybe you can't have all the skills residing in one single team.

Relationships are key to facing wicked problems, not hierarchical structures, Grint (2008: point 2) suggests. This seemed to be partly mirrored in statements such as:

> You do need to have an understanding of the landscape of your institution […] you should be able to knock on doors, but also be able to join up the dots and who to talk to. Not just the human skills, but the actual organisational awareness, and the politics.

> And the communication is very, very important in this role, because you cannot just direct research staff and PhD students that they have to give you the data, but it's influencing them. So they are willingly then depositing data in the repository.

One participant reported the organisation of a meeting for staff from various support service departments in the institution focused on establishing relationships across different departments and provisionally agreeing roles:

> What we are going to be doing is putting together a day session, just for our internal teams, so that they can all come to the same place on the page: what the issues are, what we think the issues are, what we think everybody's individual roles might be, where we think the collaborations across the university might need to be, from a very front-line perspective, even though a number of people that will be involved in that will be concerned with directing the policy, but we thought it was really important that the people on the ground had a kind of opportunity to meet each other, and talk and kind of get a sense of what they think the issues or problems are or, you know so that we don't feel like we are treading on anybody's toes, everybody gets a chance to say what they think, and take it from there really.

This reflects features of many of the approaches to wicked problem solving explored by Ney and Verweij (2011), although it could be suggested that the process would benefit from drawing on some of the detailed guidelines of such methodologies.

It was certainly seen as a change management problem. Interviewees were actively seeking to connect with others within the institution, accepting that they were 'fated' to work with these others because of distributed expertise (Grint, 2008: point 8):

> It's been really a partnership between the library, the research division, and the IT department, each recognising that there is an aspect of each of those services, which relates to research data and a need to cooperate really to provide something that is coherent.

Information gathering about who were key contacts was intense. Small joint pieces of work were seen as valuable to develop trust 'between hierarchies (Grint, 2010).

Interviewees also saw the importance of building an empathic understanding of the perspective of researchers (Grint, 2008: point 9):

> I think it probably does help if you have had some either exposure to or experience in doing research yourself, at some kind of advanced level, because otherwise you might be overly shy. If you have experience of doing research in one area, then it's easier to have empathy in another area, where if you come cold you might just feel daunted.

> I think [library staff] need an understanding of the research life cycle, which I think we all need more training on and reskilling. I think they need to understand researcher workflows. I think we need to understand more about the whole funding scenario: how projects are born, and how they are bidded for, how funding is requested, because I know there is quite an internal cycle of analysis before bids are even put to research councils. We need to know a lot more about that so we can talk the researcher's language.

Yet at times it seemed the focus of activity was among professional services. Researchers were outside the equation. This was partly because of the variety within disciplines and partly because of communications gaps in institutions.

There was also intense inter-organisational knowledge sharing within their professional group to understand what work was being done elsewhere and a search for good practice in other institutions and awareness of support provided by national organisations such as DCC. Nevertheless, the thirst to talk to colleagues at other institutions to

discover best practices sometimes conflicted with the sense that each institution would experience the problem differently.

There was a recognition of the need to dive in and respond as things evolved (embracing emergence as Grint (2010) puts it), rather than hoping that one could wait till a solution was available before acting. This involved the negative capability (Grint, 2008: point 5) to operate effectively even where there is uncertainty:

> Prepared to jump in and take a little bit of a risk without all the answers necessarily being there, and without there being a very formal structure and process for them to follow. So staff are going to have to be quite creative.

> Flexibility and a willingness to learn new things, and to learn through trial and error.

> Flexibility is key, because what I did in my job only 12 months ago is very different from what I am doing in my day to day job at the moment.

> I suppose it's all of the interpersonal skills and the attitude to learning new things, and being open to being in a job where initially nothing is going to be very clear. They can be working in not necessarily a vacuum, but in a space that is not already occupied, so they will need that flexibility of attitude and willingness to get in and do things with a mindset that fits in our educational context, that would allow them to work sensibly with a range of people in both libraries, within IT, within research development, and with researchers themselves.

There was this sense that the issue lay in the space not being already 'occupied' and yet also not entirely a vacuum. Most participants were candid about acknowledging lack of clarity about what the institution was doing or should do. Progress was felt to be slow. These points echo Garritano and Carlson's (2009) suggestion that e-science librarians need to be creative, flexible and willing to take risks. Implicit in interviewees' responses was that these sorts of skills were not always the ones that librarians had. At the same time the need to reflect on the widest context not just react decisively in the style of an old fashioned hierarchical leader was recognised (Grint, 2008: point 3).

Many were taking a pragmatic, 'bootstrapping' approach developing both bottom-up projects and top-down policy and, at the same time. Finding the key points for intervention is a classic issue with a wicked problem. Small projects could begin to clarify issues, but taking on too much was risky:

> And our biggest challenge with that project was managing the scope, particularly with regard to creating an infrastructure, because some research data elements are so large, it was very difficult to say 'No, this is only a small project. We are concentrating on that data that will eventually be associated with publications', to try to manage it. In that project, we are not looking at the […] whole research outputs of the institution because that's killing the project with complexity, so I think that was perhaps the biggest challenge for the programme.

Although the funder mandates opened up the possibility of stressing the stick over the carrot, interviewees seemed inclined to avoid punitive approaches, recognising the complexity of the challenge and the need to maintain goodwill.

However, there were some times when interviewees perhaps betrayed a lack of adjustment to the wickedness of the problem. Evident in a number of responses was a failure to grasp the scale and complexity of the problem with solutions being put forward relying on single individuals or small numbers of staff. Arguably the emphasis on technical skills gaps represented excessive focus on the technical side of what is in reality a multi-level problem. In some cases, developments such as the creation of an RDM policy were seen as a priority without sufficient recognition that the existence of a policy may not necessarily lead to meaningful changes of behaviour amongst academic or support staff.

Summary

On the whole, interviewees recognised how different RDM was from many previous agendas in the profession. Most interviewees felt uncertain about how things were developing. They perceived clearly that a specific mindset and particular soft skills were needed to operate in this environment. This mindset was often compatible with approaches appropriate for addressing wicked problems, reflecting many of the suggestions Grint (2008) makes about the special nature of leadership in such contexts.

Discussion: The value of seeing RDM as a wicked problem

This paper has sought to demonstrate the value of seeing RDM (as an example of an issue in academic librarianship) through the lens of the concept of the 'wicked problem'. Whilst not being the only way of looking at RDM, it may be seen as productive at an analytic level. The analysis has shown that, with some provisos, the ways in which RDM is described by interviewees is consistent with the characterisation of a wicked problem. It has a complex, intractable character. Further, how librarians thought it was necessary to operate in the RDM context echoed much of the wisdom that has been developed in the literature about working with wicked problems, such as styles of leadership that work in this context. These are not ways of working that typify most day-to-day library dealings with known, 'tame' problems.

Using the label of 'wicked problem' has practical utility. It helps give us a language to talk about why a particular

problem is hard to handle and to signal that we should operate differently because of its complex nature. In particular, it helps manage expectations. Using the term helps clarify the nature of an issue, avoiding the trap of thinking that it can be reduced, for example, to technical solutions. The specific attributes of a wicked problem identified by Rittel and Webber (1973) and later by Horn and Weber (2007) help us reflect on the nature of such wickedness in a clearer way.

Methodologies for analysing and developing solutions are rather different from those for normal problems. Here we have focused on Grint's suggestions about leadership. Childs and McLeod (2013) provide a good initial analysis of how the Cynefin framework could help institutions sort out RDM. Ney and Verweij (2011) point to a number of methodologies for analysing wicked problems and developing solutions. These include processes that might be useful in achieving practical solutions for RDM. All this suggests that bringing the term 'wicked problem' into our vocabulary as a profession adds value. RDM can be seen as a wicked problem; but a large and probably increasing number of our future problems will, arguably, have a wicked character because of increasing interconnectedness and social complexity.

If more of our problems are wicked, the logic is that organisations may need to be different. An organisation needs to be as complex as the environment it operates in. We can expect universities as contexts to become more complex. Libraries as organisations need to be more flexible and adaptive. There is a lot of professional literature that reflects that perception, but the concept of the wicked problem adds a little more detail to our understanding of what this means and what to do about it.

From an information science perspective, the centrality of lack of information about the problem evident from this research is intriguing. Do we need to gather information in particular types of ways in wicked problem situations? One would expect an open-ended process to be the most effective. This prompts thoughts for future research, perhaps focusing on the information-gathering process associated with the design of solutions to the RDM problem area.

Conclusion: The wicked curriculum

It follows from this analysis that the skills and attitudes we acquire as professionals need to include the attributes that help us to deal with wicked problems. This is a major challenge implying significant culture change for the whole profession. From an Information School perspective, the concept of wicked problems prompted the authors to consider how new entrants to the profession can be educated to operate effectively in the context of the complexity of wicked problems. In fact this chimes with the sense of how the employability agenda in general has shifted towards a stress on collaboration skills, creativity, flexibility, etc.

Most of the literature on teaching skills to operate in wicked problem spaces arises from the design thinking literature. Yet there are many challenges here. Skills needed to deal with wicked problems are themselves 'wicked' and so hard to develop or measure in a simple way (Knight, 2007). What makes a design thinker is elusive (Razzouk and Shute, 2012). Trying to develop the kind of mindsets needed for operating in wicked problem spaces shifts attention to ways of operating and away from more easily assessable outcomes. One of the gurus of design thinking, Roger Martin, believes his ideas contain a radical message for Business Schools (Dunne and Martin, 2006). Does the design approach fit the historical stress on analysis and criticality in HE at all? Can you teach creativity? More specifically for our context, is knowledge work fundamentally a different way of thinking from design thinking as suggested by Rylander (2009)? It is certainly quite unlike project thinking, so prevalent in the professional culture of librarianship today. A project is about managing resources towards clearly defined goals; dealing with wicked problems rarely has this clear cut direction.

One plausible approach to developing the skills to deal with wicked problems might be to follow Snyder et al.'s (2009) notion of bringing studio-based learning from Art education into Information Science teaching. Modules can be rebuilt around cycles of activity, rather than on a linear structure. At Sheffield we see learning wicked skills as something of importance. Supporting development of such skills can be linked to our placing of inquiry and research at the centre of our approach to learning and teaching. Inquiry-led learning implies supporting groups to work together to investigate complex, real-world problems. An increasing stress on interdisciplinary perspectives on problems fits in with design thinking too. Reflecting on this in the light of the wicked problem concept, if anything is missing from the design thinking model, it is the prototyping stage of development. In the RDM module at Sheffield, developed in the RDMRose project (http://www.sheffield.ac.uk/is/research/projects/rdmrose), we teach RDM as a wicked problem: the final session works through a complex case study. We are developing a new set of exercises within this that explicitly introduce a design thinking approach to engaging with RDM, borrowing on tools from Stanford's (2010) bootcamp bootleg.

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