Evaluating the Recordkeeping Capabilities of Metadata Schemas

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Along with many other metadata communities, the recordkeeping profession is aware that sustainable, viable and cost-effective metadata creation requires investigation of strategies for its automated capture. The creation, management and use of records is ultimately dependent on the existence of authentic, reliable and accurate metadata that places documentary objects into their operational contexts and tracks the business and recordkeeping actions they undergo throughout their lifespan. This means that records management and archival processes need to be configured around automated data re-use. In electronic environments maintaining the authenticity, integrity and reliability of records is an ongoing active concern. There is a need for continual accrual of metadata to ensure traces of the transactions (at varying levels of granularity) that impact

on records' authenticity and integrity are captured and maintained for as long as necessary. In digital environments recordkeeping tools need to be designed and constructed to utilise existing metadata about records content, structure and context, as well as to be able to adequately capture evidence of business, records management and archival actions, and their impacts on electronic records. In this context the development of recordkeeping metadata standards and the standardisation of metadata through the promulgation of metadata schemas have been seen as essential in supporting interoperability of metadata, and enabling its automatic capture and re-use. But can the emerging standards and schemas deliver the desired capabilities? This paper reports on the development of a process to analyse the recordkeeping metadata capabilities of records management, archival control and related schemas as part of the Clever Recordkeeping Metadata Project. It shows how research issues unfolded throughout the prototyping process and discusses arising insights into requirements for recordkeeping metadata to assist future schema development.

Introduction

The creation and keeping of records is ultimately dependent on the existence of metadata that places documentary objects into their business contexts and tracks the business and recordkeeping actions they undergo throughout their lifespan. One of the key challenges for recordkeeping in digital and networked environments is to seek ways in which this metadata may be captured as part of recordkeeping processes and is inextricably bound to the recorded information to which it pertains, in order to establish and maintain its authenticity, reliability and integrity as a record. The very nature of information technologies, their dynamism and their volatility, suggests that the extent of metadata required for recordkeeping in electronic environments may be orders of magnitude greater than what we have been used to in the paper world. The ability to inherit data or metadata from that available within business process and systems as recordkeeping metadata may be the only sustainable and viable method of metadata creation in such environments. Automatically capturing metadata as part of the process to which it relates may not only be more efficient, but may also lead to better quality metadata, as its creation becomes an integral part of the process rather than being a post-hoc costly add-on. Being able to automatically re-use recordkeeping metadata in other business or recordkeeping processes is another part of establishing its viability through encouraging shared interest in its creation.[1]

A number of initiatives over the past decade have sought to elicit and codify recordkeeping metadata requirements. As part of redefining archival description in the continuum, the SPIRT Recordkeeping Metadata Project undertaken by the Records Continuum Research Group at Monash University in 1998-99 investigated the standardisation of metadata requirements for recordkeeping purposes through time and space.[2] Outcomes from this project included the *Australian Recordkeeping Metadata Schema* (Australian RKMS),[3] conceptual and relationship models of records in business and socio-legal contexts (SPIRT Conceptual Models),[4] and the development of a classification scheme of the purposes of recordkeeping metadata.[5] At around the same time the National Archives of Australia (NAA) was developing their *Recordkeeping Metadata Standard for Commonwealth Agencies* (RKMSCA),[6] and the VERS Project at the Public Record Office of Victoria (PROV) was defining a long-term preservation format for electronic records, *Standard for the Management of Electronic Records PROS 99/007*.[7] A key part of this specification is the VERS Metadata Scheme which defines the structure of encapsulated record objects for long-term preservation. The RKMSCA was designed to sit within the Australian RKMS framework created by the SPIRT Project, with the VERS Metadata Scheme incorporating the RKMSCA as the basis for metadata supporting records management, discovery and retrieval functions.[8]

These initial activities have led to the development of recordkeeping metadata standards in other jurisdictions, and the uptake of the SPIRT outcomes into the emerging *ISO 23081-1 Information and Documentation - Records Management Processes - Metadata for Records - Principles* (ISO 23081-1:2004) standard.[9] While these latter products represent a maturing of ideas based on the experience of earlier work, there is still much more to be understood, particularly if these standards are to lead to recordkeeping and archiving processes based on automated metadata capture and re-use.[10]

Advances in digital and networking technologies are overcoming traditional technical barriers between systems, making interoperability more viable.[11] If such advances are to be exploited in records creation and management practices, then there is a need to understand the kinds of recordkeeping metadata currently captured in business, records management and archival schemas. There is a need to determine where,

and in what forms, metadata in recordkeeping and archiving processes may already exist; as well as a need for determining where and when recordkeeping metadata may be of use in other processes in integrated environments. Such insights can help determine the recordkeeping metadata inherited from schemas used in business processes, as well as the metadata recordkeeping and archiving schemas can supply to one another or make available for use by other business schemas. There is also a need to reflect on the capabilities of existing schemas for records management and archival description, particularly in terms of their capacity to interoperate and support automated capture and re-use of metadata.

This paper reports on the development of an analysis process to identify and assess the recordkeeping metadata capabilities of schemas undertaken as part of the Clever Recordkeeping Metadata Project (CRKM Project).[12] It begins with a brief description of the prototyping of such a process as a research tool to identify where and how metadata of interest is created and captured in schemas governing, and being utilised in, business, records management and archival control systems. This is followed by a discussion of the results of applying the prototyped analysis process to a selected set of metadata schemas, and how further evaluation and reflection on the analysis process itself served as a critique of the emerging warrants[13] for recordkeeping metadata used in its construction, raising questions as to their capacity to facilitate automated metadata capture and re-use.

Prototyping of the analysis process

The prototyping of a method for determining the recordkeeping and archiving capabilities of metadata sets was undertaken as a joint activity between the CRKM Project and the InterPARES2 Description Cross Domain as part of the development of a metadata schema registry.[14] The technique of warrant analysis was used to determine the capability criteria (against which judgements as to the recordkeeping and archiving capabilities of metadata schemas could be made).[15] The SPIRT Conceptual Models, Australian RKMS, Classification of Recordkeeping Metadata by Purpose Scheme, ISO 23081-1:2004 and the Benchmark and Baseline Requirements from the initial InterPARES Project[16] were identified as authoritative sources in which requirements for recordkeeping metadata are articulated. The strategy adopted was to study each warrant in turn

with the aim of extracting a series of pertinent questions relating to its recordkeeping metadata requirements. These were then brought together as a worksheet with its structure, the nature of the individual questions and the analysis process as a whole defined and refined through iteration and testing.[17]

The questions in the worksheet were applied to a sample of schemas to test their feasibility, granularity, usefulness, and the meaning of the response. Schemas in the sample were selected on the basis of ability to help in determining whether the analysis could make distinctions between recordkeeping and non-recordkeeping schemas, between the number of types of recordkeeping entities[18] a schema uniquely identifies, and between schemas operating in different dimensions.[19] Table 1 provides details of the schemas and of characteristics that informed their inclusion within the sample.

Sample Schema	Publication Date	Characteristics
Recordkeeping Metadata Standard for Commonwealth Agencies Version 1.0[20] (RKMSCA)	May 1999	A 'one-entity' recordkeeping metadata schema for use in Commonwealth agencies developed by the National Archives of Australia (NAA).
New South Wales Recordkeeping Metadata Standard 1.0[21] (NSW RKMS)	2001	A 'three-entity' recordkeeping metadata schema for use in New South Wales government agencies developed by the State Records Authority of NSW.
South Australian Recordkeeping Metadata Standard 2.4[22] (SA RKMS)	January 2004	A 'three-entity' recordkeeping metadata schema for use in South Australian government agencies developed by the State Records of South Australia.
VERS Metadata Scheme 2	July 2003	A 'one entity', schema for the long-term preservation of electronic records developed by the Public Record Office of Victoria (PROV).
Commonwealth Record Series System (CRS)[24]	1999	The 'multi-entity' archival descriptive schema of the National Archives of Australia (NAA).
Dublin Core Metadata Element Set Version 1.1 (DCMES)[25]	June 2003	A 'one entity', resource discovery schema.

Table 1. Metadata schemas used to instantiate the analysis process

Assessing the degree of support for a recordkeeping metadata requirement

As the iterative development of the analysis process unfolded it became clear that an assessment of the degree of support a schema had for a recordkeeping metadata requirement was needed in order to make distinctions between recordkeeping capabilities. For example the DCMES, as a resource discovery standard, would be expected to have less support against the detailed ISO 23081-1:2004 requirements for metadata relating to records entities than a schema designed from a recordkeeping perspective, like the RKMSCA. In addition 'multi-entity' schemas, like the New South Wales and South Australian standards, which allow for the representation of recordkeeping metadata using separate linked entities, are also expected to provide a greater level of support for recordkeeping requirements than 'single entity' schemas like the RKMSCA which only allow for representation of other recordkeeping entities as attributes of record objects.

Being able to distinguish the degree of support for a metadata requirement goes to the heart of the purposes of recordkeeping metadata. Recordkeeping metadata is a record of the contexts in which records are created, managed and used, and so its creation, capture and ongoing preservation should result from the application of appraisal frameworks to business and recordkeeping activities. The recordkeeping metadata schema employed as part of the recordkeeping processes associated with any particular activity must be capable of supporting recordkeeping metadata requirements to the extent that the appraisal framework dictates. Choice of schemas therefore needs to be informed by understandings of their level of support for recordkeeping metadata requirements.

The following scale was devised for assessing the degree of support:

- None - there is no support for the recordkeeping metadata requirement.
- Minimal - there is some support for the recordkeeping metadata requirement, eg it may allow for a recordkeeping entity to be named or it may allow for part of the requirement to be met.
- Adequate - there is enough support for the recordkeeping metadata requirement, eg it may allow for both the naming of a recordkeeping entity and description of its properties to meet the requirement.

- Comprehensive - there is comprehensive support for the recordkeeping metadata requirement, eg the schema allows for both the recordkeeping entity and its relationships to be named and described.[26]

A major consideration throughout the iterative development and instantiation of the analysis process was whether these judgements (as to the degree of support) could be easily and consistently applied.

Reflective evaluation

The development phase ended once the analysis worksheet had reached a degree of stability such that it could be documented and made available for use, and further evaluation and refinement, in other contexts.[27] The instantiation process used in its development had resulted in assessments of recordkeeping metadata capabilities for the sample schemas being completed. Evaluation therefore encompassed reflection on both of these outcomes. What do the individual results of the analysis of the sample schemas show? What do they reveal about understandings of recordkeeping metadata, the implementation of recordkeeping metadata, and of requirements for interoperability? What do they say about the state of recordkeeping metadata standardisation activities? What insights, if any, does the development of the analysis process give us into the warrants used in its construction? What issues does the prototyping raise about the idea of analysing the recordkeeping metadata capabilities of schemas and about those recordkeeping metadata capabilities themselves?

Analysis results

Despite shortcomings (discussed in the next section), the analysis process did provide a systematic way in which judgements about compliance with recordkeeping metadata capabilities expressed in the warrants could be determined and resulted in the discovery of some useful information about the recordkeeping metadata capabilities of the analysed metadata schemas.[28]

The analysis determined that:

- As expected, the DCMES only meets some very minimal requirements of recordkeeping metadata. It clearly shows that a resource discovery standard does not have the capabilities to

capture functional context, such as function, mandate, and aggregation relationships, nor any history of business and recordkeeping events associated with ongoing management and use.

- The RKMSCA has adequate to comprehensive support for metadata relating to records but minimal support for metadata relating to other recordkeeping entities. The schema allows for the unique identification of record objects and their aggregations with metadata about other recordkeeping entities represented as elements of these objects. Relationships between these other recordkeeping entities and record entities are either encapsulated within the definition of the element or specified in values for its components. Undertaking the analysis did raise questions as to whether the structure of the RKMSCA element set should better represent the interrelationships and dependencies between the elements as highlighted in the appendices and illustrated in examples.

- As expected, the 'multi-entity' schemas of the NSW RKMS and SA RKMS offered more support for metadata relating to other recordkeeping entities. However some inconsistencies and ambiguities in these schemas were also highlighted. In the case of the SA RKMS the lack of distinction between element qualification and element components was identified as a potential source of ambiguity that could impact on its implementation, and in both cases some missing elements or encoding scheme values and inconsistencies in element semantics were also noted. As with the RKMSA, questions were raised as to whether the structure of the schemas adequately represents the dependencies and interrelationships amongst the elements. These are noted in the element descriptions but are not independently highlighted or emphasised with examples as in the RKMSCA. For these multi-entity schemas this issue is of particular relevance to the RELATION element which captures the relationship of an object to another object. Is there a requirement for these relationships to be bi-directional or uni-directional? In order to fully capture the relationship does there need to be reciprocity? If a RELATION element is created for one object then does a corresponding RELATION

element need to be created in the related object? While the analysis process shows that the schema may have the capacity to capture relationships amongst recordkeeping objects, the behaviour encoded in the implementation will determine whether it then actually meets the recordkeeping requirements based on those relationships.

- The VERS Metadata Scheme offers the most comprehensive support for the technical metadata relating to record objects. Its documentation was also the most comprehensive, reflecting the multi-million dollar investment in the strategy by the PROV.
- The CRS, as a schema designed for paper records, only has minimal support for recordkeeping metadata at the item level when assessed against metadata requirements for electronic records. Description of record series is more extensive than record item description, with, in particular, relationships to agent and business entities only capable of being documented at the series level. This reflects paper environments where these essential linkages would be inscribed on the record items or be derivable from their physical location and where the costs of extracting this metadata into an archival control system would be far too high. In addition the results of the analysis of the CRS also raised questions as to whether the requirements for recordkeeping metadata in archival dimensions were adequately articulated in the warrants.

Reflection on the analysis results

Reflection on the results of the analysis as a whole, and on the development process itself, provided some insight into the current status of theoretical understandings and practical implementation of recordkeeping metadata.

Diversity in schema documentation

Firstly the results revealed some diversity in the documentation defining a metadata schema. This added to the complexity of the analysis process as with each schema the structure of the associated documentation needed to be understood so that it could be readily consulted for completion of the worksheet. While in a research context this is not of

much concern, in other environments such diversity could be a potential barrier to implementation. Instead of consulting a standard set of documents a potential implementer would first have to locate, and then work through, all the varying pieces of documentation to understand their internal structure and their relationship to one another, in order to extract the information needed to make judgements about the use of the schema. It highlights the need for standardisation in schema publication and presentation practices.

The different ways in which they are published and presented have various strengths and weaknesses. The trend towards only providing descriptions of elements and a seeming deprecation of information regarding the conceptual framework on which the element semantics and structure are based is considered a weakness. It is premature at this early stage of overall development to assume that this context is common knowledge. A clear connection to the conceptual model underpinning a schema aids in its interpretation and may help to resolve ambiguities. The development of recordkeeping metadata standards and their implementation should be seen as ways to test and refine the conceptualisations on which they are based.

A lack of this context may also increase the potential for misinterpretation in an implementation environment. Many communities are interested in capturing and exploiting metadata, but with many differing perspectives on what that metadata entails.[29] It is therefore vital that the conceptual model on which a metadata schema is based is either clearly referenced or articulated within its documentation. This can aid in understanding both the meaning and purpose of the elements and in determining structural and behavioural relationships. In addition if interoperability is one of the goals of such schemas then it is also desirable to ensure the frameworks from which element semantics, structures and values are drawn are made as explicit as possible. This includes establishing a clear connection with the conceptual framework and documenting relationships to other schemas and encoding schemes that have informed the construction of the schema. If interoperability is a goal then its promotion must begin in the articulation of the schema.

Lack of metadata about the metadata

Most of the analysed schemas did not meet requirements for metadata about the metadata, vital in order for recordkeeping metadata to be itself

a record.[30] The lack of consideration for metadata about the metadata can be traced back to the framework on which the schemas have been based. Version 1.0 of the Australian RKMS, which has informed the construction of the Commonwealth, New South Wales and South Australian recordkeeping metadata standards, does not incorporate elements for the capture of such metadata. It illustrates the potential detrimental effects on schema design if the frameworks on which they are based are not inclusive of all necessary concepts and reflects that they are in an early stage of development. As the recordkeeping profession is still searching for understandings of recordkeeping metadata it is vital that critiques of the emerging frameworks are also part of the discourse so that conceptualisations continue to grow and mature.

'Single' and 'multi-entity' schemas

Another outcome from the sample analysis is to question the 'single entity' versus 'multi-entity' schema terminology that has arisen with respect to recordkeeping metadata schemas. The RKMSCA has been referred to as a 'single' or 'one entity' schema because it allows for the identification and description of one kind of recordkeeping entity, namely record objects, whereas the NSW and SA standards have been described as 'three entity' schemas as they allow for the identification and description of record, agent and function objects. The analysis results suggest that this terminology may be misleading. In asking which recordkeeping entities and which relationships a schema is capable of documenting, the results for the RKMSCA show that it encompasses the description of agents, business, mandate and recordkeeping business entities as properties of record objects. Their representation as attributes also intrinsically captures relationships between records and these other recordkeeping entities. Therefore to say that the RKMSCA is a 'single entity' schema is a misnomer from a recordkeeping entity perspective. It has been designed to uniquely identify and describe one kind of object, ie record objects at varying levels of aggregation, but within its description is encompassed the description of other recordkeeping entities and their relationships to the record object. If it did not encompass such description then it would not be a recordkeeping metadata schema. Thus the difference between the RKMSCA and the NSW and SA schemas is not the number of recordkeeping entities described, but the extent of the description of those entities and the relationships allowed between them.

Constructing a recordkeeping metadata schema involves making choices as to how to represent recordkeeping entities and relationships. The schemas analysed show that a recordkeeping entity may be represented as a discrete object or as an attribute of another object. If represented as an attribute of another object then the nature of the relationship between the two entities may be captured in the semantics of the attribute. For example, in the RKMSCA the relationship between Business and Records entities are specified in the definition of the FUNCTION element - ie 'The general or agency-specific business function(s) and activities which are documented by the record'.[31] Alternatively, allowance may be made to capture it as a component of or qualifier to the attribute. In the RKMSCA the AGENT element has an AGENT TYPE sub-element which allows for the role the agent plays in relation to the record to be specified.[32] In addition the sub-element structures of the AGENT and FUNCTION elements allow for the capture of other attributes of Agent and Business entities within the description of record objects.

The analysis also shows that a recordkeeping metadata schema developer must also make decisions as to which layers of aggregation to support. Having decided which layers are to be included in the schema, how the layers and the relationships between them are to be represented then needs to be determined. In the case of the RKMSCA, relationships between layers of aggregation of record objects are captured through the RELATION element. The sub-element structure allows for description of the nature of aggregation relationships between record objects. In the case of the CRS, relationships between record series and the items making up that series are captured via the SERIES element of Record Item objects. Here the nature of the aggregation relationship is specified in the definition of the element.

Abstract schemas, representations and implementations

Reflection on the analysis results served to highlight the differing degrees of abstraction of the sample metadata schemas. The Clever Recordkeeping Metadata Project (CRKM) used the Layers of Interoperability Model developed by the DELOS Network of Excellence on Digital Libraries, Working Group on Metadata Registries to position these and other recordkeeping metadata standardisation activities across abstract, representation and transport and exchange layers as illustrated in Figure 1.[33]

<table>
<tr><td rowspan="2">Layer 3
Abstract</td><td>Conceptual Models
eg SPIRT Conceptual Models</td></tr>
<tr><td>Recordkeeping Metadata Standards/Schemas
eg Australian RKMS, RKMSCA, NSW RKMS, SA RKMS, VERS Metadata Scheme, ISAD(G), ISAAR(CPF), Metadata requirements in functional specifications for records management systems</td></tr>
<tr><td>Layer 2</td><td>Representation
eg EAD, EAC, VERS DTD, CRS Database Schema</td></tr>
<tr><td>Layer 1</td><td>Transport and Exchange
eg SOAP, REST</td></tr>
</table>

Figure 1. Recordkeeping metadata standard initiatives positioned on the Layers of Interoperability Model

The RKMSCA, NSW RKMS and SA RKMS standards only exist in the abstract layer, while the VERS, CRS and DCMES extend into the representation layer.[34] The analysis worked with the abstract definition of the schemas, and so, in answering the questions, there was always a degree of uncertainty. While the abstract definition may have the potential to handle the requirement, the degree of support could be dependent on how it is represented and, given element inter-dependencies, aggregation and obligation issues in the recordkeeping metadata standards, on how the schema is actually implemented.

Assessing the degree of support for the recordkeeping metadata requirements was problematic as there were concerns about whether it would hold across representations and implementations of those representations. This reflects on the complexity of recordkeeping metadata. It is not just isolated, static, simple object description but description that is capable of representing a complex and dynamic network of recordkeeping entities and relationships, integral to the record objects themselves and contingent on operational, legal and accountability requirements. It became apparent that part of the problem

was related to the degree of precision with which recordkeeping metadata requirements were articulated in the warrants themselves. Do they support such precise judgements being made?

Evaluating the analysis process

These issues came to the fore as the analysis process was extended beyond the immediate research context. The development of the MADRAS registry within the InterPARES2 Description Cross Domain opened up the process to a wider user group and the analysis results to a wider audience.[35] As this work unfolded the ISO/TC 46/SC 11/WG 1 also became interested in developing it as Part 3 of the ISO 23081 standard.[36] The idea emerged of using the process as the basis for the creation of a self assessment tool that recordkeeping and other information professionals could use to assess the ability of their metadata schemas to meet the records management metadata requirements defined in ISO 23081 in support of *ISO 15489: Information and Documentation - Records Management.*

Feedback from the use of the analysis worksheet by InterPARES2 Description Cross Domain researchers and members of ISO/TC 46/SC 11/WG 1 highlighted and reinforced concerns with:

- Its complexity.
- The repetition of similar questions across the warrants.
- The amount of background knowledge about a schema and the amount of data entry required to complete the questions.
- The potential for inconsistency in the application of the scale for the degree of support of a recordkeeping metadata requirement.
- The difficulty in applying questions to metadata schemas based on conceptual models less aligned with those in the analysis warrants.

Reflective evaluation of the analysis process itself was undertaken to see whether, where and how it could be refined in order to address these issues.

Background knowledge

Undertaking an analysis requires detailed knowledge of all the warrants that make up the worksheet, along with a detailed understanding of the metadata schema under assessment. This is reasonable for its use within its research context, but problematic for its application by recordkeeping and other information professionals less conversant with the warrants and their interpretation that has informed the construction of the analysis worksheet. The issue for the use of the process outside of a research context is whether it can be refined so that the understandings of the analysis warrants are built into the tool rather than being something that the person undertaking the analysis brings to the process. However it should be noted that while there is a need to simplify the process it cannot be made too simplistic as the integrity and usefulness of the results would then be questionable.

A detailed understanding of the metadata schema to be assessed may still be a reasonable expectation. Comprehension of the conceptual basis and familiarity with elements and how they are structured are necessary for implementing any schema in any context. It can be argued that those seeking to undertake an analysis of the metadata schemas they have been involved in developing will have this detailed knowledge already in place. Those wishing to see whether a schema that others have developed can be applied in a recordkeeping context can use the rigour of the analysis process to improve their understanding of its conceptual foundations and descriptive capabilities and become more familiar with its elements and its structure. Gaining this knowledge would be part of the overall process in which an assessment of recordkeeping metadata capabilities occurs.

Manual processing

The manual nature of the analysis process is a particular hindrance to its broader application. Further development of the MADRAS registry and its support of the analysis process can investigate creating interfaces to foster more efficient entry processes. For example the ability to drag-and-drop elements against recordkeeping requirements can be envisaged, particularly if machine processable forms of schemas were available for automated ingestion.[37] Constructing a tool based on this possibility in the current environment would exclude many, if not most, extant metadata schemas from the process given the diversity of ways in which

schema documentation is presented and the limited availability of machine processable forms. This emerges as a barrier to the creation of infrastructure to support schema assessment and use.

Repetition and complexity

The complexity of the worksheet with the repetition of similar questions within and across the warrants reflects the research requirements and the emerging nature of understandings in this area. Construction of the analysis process from the various warrants revealed that, while they overlapped at some points, they also diverged at others. The focus of the development of the analysis tool within a research context was on making the existing warrants operational rather than creating a newly merged one, which would then itself need to be validated and critiqued. Maintaining the separate sections for each of the warrants enabled clear statements of where and how a schema meets its requirements. This allows the results of the analysis to be fed back into evaluation of the warrants themselves. Reconciliation of divergent viewpoints can then occur at the source.

Mapping of the warrants used in the worksheet was undertaken to give insight into their points of convergence and divergence and as a possible way to validate the analysis results. For example if an ISO 23081-1:2004 requirement correlates to a benchmark or baseline requirement then some consistency in the answers to relevant questions for each in the analysis worksheet would be expected. This revealed some accord and discord between the warrants,[38] but its inconclusiveness reinforced issues regarding the precision with which recordkeeping metadata requirements are made. The latitude in both warrants for interpretation of what a requirement may or may not mean or entail made it difficult to produce conclusive mappings.

The issue of precision is an important one. The analysis can only reflect the precision of the warrants on which it is based. Are the requirements for recordkeeping metadata in the warrants specified to the extent that allows for an unambiguous judgement of the recordkeeping capabilities of a schema to be made? Questions have already been raised as to whether the degree of abstractness of the schema being analysed also impacts on the accuracy and the precision of the results. The concern in analysing the more abstract schemas was that their implementation could make their recordkeeping capabilities significantly better or worse. Even with

a schema like VERS where a canonical representation is provided there is still scope for variation in the recordkeeping metadata capabilities of an implementation (depending on choices made) regarding obligations and element interdependencies. These choices need to be governed by appraisal decisions reflecting operational, legal and accountability requirements.

This suggests that a more accurate and precise assessment of recordkeeping metadata capabilities will require reducing the degree of abstraction in both the metadata schemas and in the warrants themselves. Both tend to feature high level and broad statements of metadata requirements that are open to interpretation. The understandings regarding recordkeeping metadata arising from making the warrants operational can help determine the kinds of standards and statements of recordkeeping metadata requirements needed within them.

In addition the difficulties in trying to correlate ISO 23081-1:2004 and the Baseline Requirements further reinforced the question raised earlier about how well the archival perspective was addressed.[39] In accord with continuum thinking the idea behind the ISO 23081 principles is that they apply throughout the records lifespan and encompass operational records management along with archival perspectives.[40] This would appear to be at odds with the principles being an expression of the metadata requirements in support of ISO 15489, given that this standard 'does not include the management of archival records within archival institutions'.[41]

Archival description, particularly from an Australian Series System perspective, suggests that metadata regarding the contexts in which records are created and used can accrue independently of records and that it is in recordkeeping and archival processes that linkages between records and this context are established. The question is whether, in defining metadata in terms of 'at records capture' and 'after records capture', the ISO 23081-1:2004 requirements encompass the accrual of this kind of metadata or whether only a records management view has been covered. Mapping the ISO requirements to the SPIRT Conceptual Models was undertaken to see if this was indeed the case.

Mapping ISO 23081-1 to SPIRT Conceptual Models

This mapping involved attempting to place each detailed requirement from Section 9 of ISO 23081-1:2004 onto the SPIRT Conceptual Model to indicate which recordkeeping entities and/or relationships it refers to, and at what layers of aggregation.[42]

The resultant mappings were less than precise. For many of the requirements there is scope for interpretation as to what it would mean in terms of recordkeeping entity and relationship metadata. Some requirements are fairly straightforward to place. For example, 9.2.1 a) requires the date and time of record creation to be captured and is hence mapped as an attribute of a Records entity.[43] Others are much broader and far-reaching. For example, 9.2.4.1. a) states that security metadata is needed 'to identify the access restrictions that apply to records and their aggregations, business processes and agents'.[44] This is mapped to attributes of Records, Agent, Business and Business Recordkeeping entities. Requirements like 9.2.3.1 d) (to document 'links between records, agents and processes')[45] raise questions of: what attributes of these relationships need to be documented and along what layers of aggregation are they required? It also raises the question of: how does the notion of processes translate to, or even beyond, the transaction, activity, function and ambient function layers of Business and Business Recordkeeping entities?

With the use of the SPIRT Conceptual Models as the framework for the types of metadata in Section 9 of ISO 23081-1:2004, there was an expectation that each section would systematically cover metadata attributes for that entity and for its relationships. However the mapping exercise showed that the requirements within each of the sections relate to more than just the recordkeeping entity in their heading. For example incorporated in ISO 23081-1:2004 Section 9.2 (requirements for metadata about records) is metadata describing attributes of agent, business and recordkeeping business entities along with the relationships between these entities and record entities.

The overall impression from the exercise is that the statements of metadata requirements in Section 9 of ISO 23081-1:2004 tend to be 'record-centric'. With requirements for metadata about records entities incorporated in almost all the sections, the statements seem to focus on the business of managing records rather than the business of managing recordkeeping.[46]

The mappings also indicate that the archival perspective has not been taken into account. The need for, and needs of, metadata beyond the 'organise' layer (in the records continuum sense of the term) of aggregation for the recordkeeping entities does not seem to be addressed.[47] Also, when the need for metadata to document relationships between organisational and functional contexts is raised, it seems to be only specified for the transaction layer.

Conclusions from evaluating the analysis process

This evaluation of the analysis process reveals the complexity of recordkeeping metadata and the ambiguity present in its current warrants. In the face of this complexity and ambiguity it is therefore not surprising that concerns with the consistency of application of the judgement as to the degree in which a schema meets a metadata requirement were raised. Evaluation and reflection suggest that some of the complexity of the analysis process is unavoidable but that resolving inconsistencies and reducing its complexity requires refinement of the warrants themselves.

Reflective evaluation of the process also indicates that making an assessment of whether a schema 'adequately' meets a metadata requirement is inherently problematic. Adequate for what recordkeeping contingency? In some cases minimal recordkeeping metadata capabilities may be adequate, in others more comprehensive capabilities may be in order. Does the analysis process, instead of coming to any final judgement, need to instead provide results that can be input into appraisal frameworks to determine whether a metadata schema's recordkeeping and archival capabilities are 'adequate' for the recordkeeping situation?

Representing recordkeeping metadata requirements

The understanding about ways of representing recordkeeping metadata requirements emerging from the development, use and evaluation of this analysis process led to the idea of adopting a decision tree approach to its incorporation in the development of the MADRAS registry and as Part 3 of the ISO 23081 standard.[48] A strong driver of this development was a desire to shield users of the tool from unnecessary complexity and detail. The aim was to develop a tool that did not require the user to have detailed understandings of recordkeeping metadata and the warrants in

which its requirements are articulated in order to assess a metadata schema.

Constructing the analysis in the form of a decision tree could overcome complexity by shielding the user from paths which they do not need to traverse. In addition the paths taken could be used to measure the degree to which a metadata schema satisfies a particular recordkeeping requirement. This approach would also serve to foster the clear and consistent logic needed for its implementation using computing technologies.

Logic for the decision tree as an assessment tool

The prototyping of the analysis process and instantiation using a sample of metadata schemas showed that there are different ways in which a recordkeeping metadata requirement can be met. These different ways impact on the level of support the metadata schema offers each requirement. Working with the SPIRT Conceptual Models and the results of reflection on both the analysis results and the analysis process suggests that an assessment of a metadata schema for its recordkeeping capabilities involves a determination of whether and how it represents recordkeeping entities and their relationships. This may provide a firmer foundation on which a consistent judgement of the degree of support for a recordkeeping metadata requirement could be based.

Recordkeeping entities and relationships can be represented as the subject of a schema, (ie it is the object which a discrete set of metadata assertions describes), as an element of a schema, or possibly by some other mechanism. If a recordkeeping entity or relationship is represented as an element then either an encoding scheme or sub-element structure allows for more detailed and structured description. The logic for the decision tree is presented in Figure 2.

The mappings of Section 9 of ISO 23081-1:2004 to the SPIRT Conceptual Models can be used to identify the particular requirements for each of the recordkeeping entities and relationships. This basic structure can be supplemented with other questions - for example requirements for metadata about the metadata record - to complete the assessment.

Could/does the schema describe this recordkeeping entity, ie Records, Mandate, Agent, Business and Business Recordkeeping?

a) At what layers of aggregation?

- How? As an element set, as an element of another element set, as an element of another element augmented with a structural encoding scheme or in some other way?
- What requirements of the relevant section of Part 9?

b) What relationships to other recordkeeping entities does it describe?

- How? As an element set, as a RELATION element, as another element or in some other way?
- What relationship metadata is included?
- What requirements of the relevant section of Part 9?

Repeat a) for each layer of aggregation and repeat b) for each type of recordkeeping entity the schema can describe.

Figure 2. Logic for decision tree

Revised analysis worksheet

Constructing a revised analysis worksheet along these lines reiterated the gaps in ISO 23081-1:2004 that the mapping to the SPIRT Conceptual Models had identified and reinforced its focus on records management rather than recordkeeping management metadata requirements. It also showed how difficult it would be to make an assessment about the representation of a recordkeeping entity or a relationship amongst recordkeeping entities given the way the requirements are articulated in the warrant as discussed in the previous section.

The revised analysis worksheet was passed on to the developers of the MADRAS registry and used to inform the development of a production version of an assessment tool to become Part 3 of the ISO 23081 standard. Such developments need to be encouraged but their limitations also need to be acknowledged. The tool can only encode our current understandings and this research is suggesting that the underlying warrants are not yet robust enough to make precise and definitive statements about the recordkeeping and archiving capabilities of metadata schemas. It is also

questioning whether the contingencies of recordkeeping actually require such a judgement to be made in the context of the particular situation - a relative rather than an absolute measure that takes into account appraisal criteria and risk assessments.

A particular concern with the revised analysis worksheet itself is that it is looking for the capabilities of a schema to capture binary relationships. This raises the issue of whether a set of binary relationships adequately captures the multi-entity nature of recordkeeping metadata relationships. The uncertainty surrounding this issue is reflected in ISO 23081-1:2004. There are repeated statements about the need to capture links between records, agents and business and recordkeeping processes but no real detail about what that entails. This is an area for further investigation and resolution.

Conclusion

This research highlights the complex nature of recordkeeping metadata and questions whether we have adequately come to terms with it in existing warrants and standards. It has discussed how their level of abstraction and the degree of precision with which recordkeeping metadata requirements are articulated makes it difficult to produce a reliable assessment of a schema's recordkeeping metadata capabilities. Furthermore it questions whether the contingencies of recordkeeping require such an assessment to be relative, rather than absolute, and responsive to appraisal criteria governing recordkeeping processes. It suggests an approach to the assessment of recordkeeping metadata capabilities that could also be used for incorporating recordkeeping metadata capabilities into a schema, based on the systematic identification and codification of recordkeeping metadata entities and relationships. It highlights the importance of modelling, informed by both practical and theoretical considerations, to recordkeeping metadata schema development and suggests that there is more work to be done to articulate the depth and breadth of requirements for recordkeeping metadata to ensure the authenticity, integrity and reliability of records in electronic environments.

Endnotes

[1] David Bearman, 'Documenting Documentation', *Archivaria*, vol. 34, Summer 1992, 1992, pp. 33-49.

[2] *Archival metadata standards for managing and accessing information resources in networked environments over time for government, social and cultural purposes;* Chief Investigators Sue McKemmish and Anne Pederson, Principal Investigator Steve Stuckey; funded by an Australian Research Council SPIRT Grant and industry partners State Records NSW, National Archives of Australia, Queensland State Archives, Australian Council of Archives and the RMAA, <http://www.sims.monash.edu.au/research/rcrg/research/spirt/about.html>, (accessed 1 June 2003), 1998.

[3] Sue McKemmish, Glenda Acland, Nigel Ward and Barbara Reed, 'Describing Records in Context in the Continuum: the Australian Recordkeeping Metadata Schema', *Archivaria*, vol. 48, Fall 1999, 1999, pp. 3-43.

[4] The *Conceptual and Relationship Models: Records in Business and Socio-Legal Contexts* have been published online as a deliverable of the SPIRT Recordkeeping Metadata Project at <http://www.sims.monash.edu.au/research/rcrg/research/spirt/deliverables.html#conceptual> (accessed 13 July 2003). They are also discussed in McKemmish et al., *Archivaria*, 1999.

[5] Katherine Cumming, 'Purposeful Data: The Roles and Purposes of Recordkeeping Metadata', PhD thesis, Monash University, 2005, 525pp. See chapter 4 'Derivation of the *Classification of Recordkeeping Metadata by Purpose Scheme* and classification of the RKMS by purpose', pp. 143-184.

[6] National Archives of Australia, *Recordkeeping Metadata Standard for Commonwealth Agencies Version 1.0,* Canberra, May 1999, 136pp, originally <http://www.naa.gov.au/recordkeeping/control/rkms/summary.htm> (accessed 1 June 2003), the link is now: < http://www.naa.gov.au/records-management/create-capture-describe/describe/rkms/index.aspx>.

[7] Public Record Office Victoria, Standard for the Management of Electronic Records PROS 99/007 (Version 1), 1999, <http://www.prov.vic.gov.au/vers/standard/version1.htm> (accessed 26 July 2005).

[8] The RKMSCA is the basis for the RECORDSMETADATA element of the VERS Metadata Scheme. VERS uses the naa: prefix to identify elements from the NAA standard.

[9] International Organization for Standardization, *ISO/TS 23081-1:2004 Information and documentation - Records management processes - Metadata for records - Part 1: Principles,* 2004, 18pp. Over the course of this research, this ISO technical specification moved through balloting and revision processes to become a fully fledged ISO standard. These principles adopted the SPIRT Conceptual Models as the basis for recordkeeping metadata requirements and in Section

9 enumerate descriptive requirements for the different recordkeeping entities identified in the models.

[10] The term 'recordkeeping and archiving' is used in this article to avoid confusion with narrower usages of 'recordkeeping' outside of the Australian context as discussed in Sue McKemmish, 'Placing Records Continuum Theory and Practice', *Archival Science,* vol. 1, no. 4, 2002, pp. 333-359.

[11] Web services, which utilise XML for the representation of structured data and lightweight communication protocols like SOAP for systems to exchange structured messages, are emerging as a key technology for interoperability.

[12] Joanne Evans, Sue McKemmish and Karuna Bhoday, 'Create Once, Use Many Times: The Clever Use of Recordkeeping Metadata for Multiple Archival Purposes', *Archival Science,* vol. 5, no. 1, March 2005, pp. 17-42.

[13] Warrants are authoritative sources containing statements of requirements and/or mandates relating to professional practice, see Wendy Duff, 'Harnessing the Power of Warrant', *American Archivist,* vol. 61, Spring 1998, pp. 88-105.

[14] Anne Gilliland, Nadav Rouche, Lori Lindbergh and Joanne Evans, 'Towards a 21st Century Metadata Infrastructure Supporting the Creation, Preservation and Use of Trustworthy Records: Developing the InterPARES2 Metadata Schema Registry', *Archival Science,* vol. 5, no. 1, March 2005, pp. 43-78.

[15] Warrant analysis involves analysing authoritative sources of professional practice for mandates relating to the practice under investigation, see Anne Gilliland and Sue McKemmish, 'Building an Infrastructure for Archival Research', *Archival Science,* vol. 4, no. 3-4, December 2004, pp. 149-197.

[16] InterPARES Authenticity Task Force, 'Appendix 2: Requirements for Assessing and Maintaining the Authenticity of Electronic Records', in *The Long-term Preservation of Authentic Electronic Records: Findings of the InterPARES Project,* InterPARES, September 2002, <http://www.interpares.org/book/index.htm> (accessed 6 October 2004). The Benchmark requirements are detailed on pages 4-7, the Baseline Requirements on pages 7-12.

[17] Greater explanation of the development of the analysis process and worksheet can be found in Chapter 4 of Joanne Evans, 'Building Capacities For Sustainable Recordkeeping Metadata Interoperability', PhD thesis, Monash University, 2007.

[18] The term recordkeeping entity refers to the Records, Agent, Mandate, Business, and Business Recordkeeping entities of the SPIRT Conceptual Models.

[19] The schemas were also chosen because of their relevance to the overall aim of the CRKM project to create a demonstrator of automated recordkeeping metadata capture and re-use for the industry partners.

[20] National Archives of Australia 1999, *op. cit.,* as per footnote 6 above.

[21] State Records Authority of New South Wales, *New South Wales Recordkeeping Metadata Standard, June 2001, Standard No 5,* 2001, <http://www.records.nsw.gov.au/publicsector/erk/metadata/rkmetadata.htm>. (accessed 1 June 2003).

[22] State Records of South Australia, *South Australian Recordkeeping Metadata Standard (SARKMS),* January 2004, 140pp, <http://www.archives.sa.gov.au/files/management_standard_metadata.pdf> (accessed 24 March 2004).

[23] Public Record Office of Victoria, *Management of Electronic Records PROS 99/007 (Version 2) Specification 2 VERS Metadata Scheme,* July 2003, <http://www.prov.vic.gov.au/vers/standard/version2.htm> (accessed 28 October 2003).

[24] National Archives of Australia, *CRS Manual, Registration and Description Procedures for the CRS System,* 1999, <http://naa12.naa.gov.au/Manual/Index.htm> (accessed 28 August 2003).

[25] Dublin Core Metadata Initiative, *Dublin Core Metadata Element Set, Version 1.1: Reference Description,* 2 June 2003, <http://dublincore.org/documents/2003/06/02/dces/ > (accessed 22 August 2003).

[26] Initial instantiations showed that there also needed to be an allowance for exceptions. For example the NSW RKMS was judged to have comprehensive support for agent metadata at point of capture because it can identify, describe and relate agents. It does, however, lack elements for capturing security metadata associated with an agent. This exception was indicated by recording 'Comprehensive' (except for security) as the degree of support.

[27] The resultant analysis worksheet and guidelines were made available to the InterPARES2 Description Cross Domain and to members of ISO/TC 46/SC 11/WG 1, the ISO committee responsible for ISO 23081.

[28] The results of the analysis for the Australian recordkeeping metadata standards was used as a basis for an issues paper submitted to the Standards Australia IT 21/7 Recordkeeping Metadata subcommittee as part of the development of a national recordkeeping metadata standard. The outcomes from this subcommittee's work were incorporated in International Organization for Standardization, *ISO/TS 23081 Information and Documentation - Records Management Processes - Metadata for Records Part 2,* 2007, 34pp.

[29] Wendy Duff, 'Metadata in Digital Preservation: Foundations, Functions and Issues', in Frank M Bischoff, Hans Hofman and Seamus Ross (eds), *Metadata in Preservation, Selected papers from an ERPANET Seminar at the Archives School Marburg, 3-5 September 2003,* Archivschule Marburg, Marburg, 2004, pp. 27-38.

[30] Heather MacNeil, 'Metadata Strategies and Archival Description: Comparing Apples to Oranges', *Archivaria,* vol. 36, Spring 1995, pp. 22-32.

[31] National Archives of Australia, 'Element 9 - Function', *Recordkeeping Metadata Standard for Commonwealth Agencies Version 1.0,* Canberra, May 1999, <http://www.naa.gov.au/recordkeeping/control/rkms/function.html> (accessed 19 March 2004) now at: <http://www.naa.gov.au/records-management/create-capture-describe/describe/rkms/index.aspx>.

[32] National Archives of Australia, 'Element 1 - Agent', *Recordkeeping Metadata Standard for Commonwealth Agencies Version 1.0,* Canberra, May 1999, <http://www.naa.gov.au/recordkeeping/control/rkms/agent.html> (accessed 19 March 2004) now at: < http://www.naa.gov.au/records-management/create-capture-describe/describe/rkms/index.aspx>.

[33] For details of the Layers of Interoperability Model see Thomas Baker, Christophe Blanchi, Dan Brickley, Erik Duval, Rachel Heery, Pete Johnston, Leonid Kalinichenko, Heike Neuroth and Shigeo Sugimoto, *Principles of Metadata Registries,* A White Paper of the DELOS Working Group on Registries, DELOS Network of Excellence on Digital Libraries, 2002, <http://delos-noe.iei.pi.cnr.it/activities/standardizationforum/Registries.pdf> (accessed 26 May 2004). For a discussion of its use in the CRKM Project see Evans, McKemmish and Bhoday, p. 24-31.

[34] The PROV publishes the latest version of the VERS DTD, which defines the standard representation for a VEO, at <http://www.prov.vic.gov.au/vers/standard/vers.dtd> (accessed 29 August 2006). The Dublin Core Metadata Initiative has published XML Schema and RDF Schema versions at <http://dublincore.org/schemas/> (accessed 19 January 2004). The standard representation for the CRS is the schema of NAA's *RecordSearch* database as detailed in the *CRS Manual, Registration and Description Procedures for the CRS System* (available at <www.naa12.naa.gov.au/Manual/Index> footnote 23 above).

[35] A description of the prototyping leading into the development of the MADRAS Registry can be found in Joanne Evans and Lori Lindberg, 'Describing and Analysing the Recordkeeping Capabilities of Metadata Sets', in *DC-2004: Proceedings of the International Conference on Dublin Core and Metadata Applications October 11-14 2004 Shanghai, China,* Shanghai Scientific and Technological Literature Publishing House, Shanghai, China, 2004, pp. 75-80 and in Joanne Evans and Nadav Rouche, 'Utilizing Systems Development Methods in Archival Systems Research: Building a Metadata Schema Registry', Archival Science, vol.. 4, no. 3-4, December 2004, pp. 315-334.

[36] Within ISO, the TC 46 Information and Documentation, Subcommittee SC 11 Archives/Records Management has the responsibility for the development of standards governing archives and records management processes. Working Group 1 is responsible for developing the ISO 23081 standard for Metadata for Records and Records Management Processes.

[37] Although as a way of gaining familiarity with the structure and semantics of a metadata schema the compilation of the preparatory worksheet is a useful exercise.

[38] That ISO 23081-1:2004 did not address authentication or identification of authoritative versions of records as in the benchmark requirements became feedback into the refinement of the principles as they moved through the ISO standard development process.

[39] In the case of ISO 23081-1:2004 the question is whether the requirements in Section 9 address the archival perspective whereas with the Baseline Requirements the question is whether archival documentation requirements are specified in enough detail.

[40] This scope is best expressed in latter versions of ISO 23081-1 than the 2004 TS (Technical Specification) version used in the development of the analysis process. The scope in the 2006 publication of the approved ISO standard states:

'This part of ISO 23081 covers the principles that underpin and govern records management metadata. These principles apply through time to:

- records and their metadata,
- all processes that affect them,
- any system in which they reside, and
- any organisation that is responsible for their management'.

Standards Australia, *AS ISO 23081-1:2006 Information and documentation - Records management processes - Metadata for records - Part 1: Principles,* Sydney, New South Wales, 8 May 2006, 29pp.

[41] See '1 Scope' of Standards Australia, *AS ISO 15489.1 2002 Records Management - General,* vol. 1 of 2, Sydney, New South Wales, 2002, 22pp. A discussion of some of the reasons behind the exclusion of the archival perspective from ISO 15489 can be found in Chapter 4 of Gillian Oliver, 'Information In Organisations: A Comparative Study Of Information Cultures', PhD thesis, Monash University, 2005.

[42] The combined Conceptual Model of Recordkeeping Metadata in Business and Socio-Legal Contexts was used in this mapping exercise, see Figure 4 of McKemmish et al., *Archivaria,* 1999. The mappings are available in Appendix A of Joanne Evans, 'Building Capacities For Sustainable Recordkeeping Metadata Interoperability', PhD thesis, Monash University, 2007. An attempt was made to place each Section 9 requirement onto the diagram by indicating entities and/or relationships to which it referred. If the requirement related to an entity, an attempt was made to also determine the layers of aggregation.

[43] *ISO/TS 23081-1:2004,* p.12.

[44] *ISO/TS 23081-1:2004,* p.13.

[45] *ISO/TS 23081-1:2004,* p.13.

[46] The exception is 9.3 Metadata about the business rules, policies and mandates.

[47] The use of 'organise' here refers to the third dimension of the Records Continuum Model. (For more information see Frank Upward, 'Structuring the Records Continuum Part One: Post-custodial Principles and Properties', *Archives and Manuscripts,* vol. 24, no. 2, 1996, pp. 268-285 and Frank Upward, 'Structuring the Records Continuum Part Two: Structuration Theory and Recordkeeping', *Archives and Manuscripts,* vol. 25, no. 1, May 1997, pp. 10-35.)

[48] The incorporation of the prototype analysis process into the MADRAS registry was undertaken by members of the Description Cross Domain of InterPARES2 from the Graduate School of Education and Information Studies, Department of Information Studies at University of California, Los Angeles. Funding for this work was provided by the US InterPARES Project. This development process also involved working with ISO/TC 46/SC11/WG 1 so that the analysis tool could form Part 3 of the ISO 23081 standard. The decision tree approach to the tool was initiated from discussions at Monash University, Melbourne, 24-25 November 2005, associated with a CRKM Workshop, between Hans Hofmann, Sue McKemmish and Joanne Evans. It has been further refined through discussions of the InterPARES2 Description Cross Domain and its implementation as part of the MADRAS registry by UCLA researchers in 2006. The beta version of MADRAS registry is available at <http://www.gseis.ucla.edu/us-interpares/madras/> (accessed 15 June 2006).

[49] *ISO/TS 23081-1:2004,* Sections 9.2.3.1 d), 9.5.1 b), 9.6.1 h).

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