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Linking agricultural extension, decision support systems and context:

Implications for knowledge management practice.

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Structured abstract

Purpose –

There exists a substantial knowledge management challenge for organisations with responsibilities to mediate public interests. This challenge relates to the means by which knowledge assets are managed to integrate a hierarchy of knowledge in a continuum from the micro-level (individual), group (institutional / organisational), formal (peer-authorised) to the macro-level of focus (societal norms). The purpose of this paper is to present an analysis of a specific program – FarmPlan 21. FarmPlan21 was introduced within the Australian state of Victoria to promote the uptake of whole-farm planning practices. Through this initiative an objective has been to mediate private and public interests related to the integration of commercial and sustainable land management practices. The analysis of FarmPlan21 is presented through the lens of two different knowledge hierarchies – one for a farmer and one for an agricultural extension officer engaged within the Victorian Department of Primary Industries.

Design/methodology/approach –

In considering a sheep farmer producing lamb and their involvement in the FarmPlan21 program, a conceptual framework related to a *shared knowledge context* is developed. This allows that solutions to what previously have been segmented problems can become co-created. However, this approach will become constrained unless some underlying principles for developing a shared knowledge context are adopted. Within the context of brokering a public interest, these principles are discussed under the headings of role clarity, shared organisational possibilities and purpose, coherence of extended network interactions and normative commitments to pluralistic values. The similarities of these principles with the Australian records continuum model are discussed in some detail. For industries with complex open network structures like agriculture, the final section extols the imperative of implementing contemporary records management practices as a means of brokering both public and private benefits.

Originality/value –

The integration of sustainability and commercial farming practices provides an example of a fresh challenge for knowledge management practitioners. If agriculture is to embrace an appropriate vision for the future, new frameworks, partnerships and information distribution channels must be developed that allow for the evolutionary emergence of co-created solutions to problems. The cross discipline perspective outlined in this paper and the linking of a knowledge hierarchy to the Australian records continuum model is new. The value of this approach is that it unlocks potential for investments in industry development and productivity to be integrated with objectives associated with natural resource management, sustainability and adaptation to climate variability. The claim is that this will lead to greater impact, by lessening the effect of operating silos across different government agencies and by leveraging the potential for benefits from both public and private investments and commitments.

Practical implications –

In working towards brokering a public interest, government agencies must not lose sight of the practical importance of working closely with the actual decision makers that can make a difference. But beyond this, the effectiveness of next generation knowledge management support systems such as the farm-planning tool - Farm Web 2.0 - referenced briefly herein will be conditional upon the extent to which they embrace contemporary records management protocols. This same principle can apply to any knowledge intensive industry whether the focus is at organisational, city, industry cluster or regional level. What is common across these industries is that contemporary records management must span the different levels of any knowledge hierarchy. This is likely to catalyse the need for a different type of innovation framework - discussed under the topic of a “public knowledge space”. This will involve people engaging in work practices and with technology in different ways than up until now.

Keywords – Knowledge assets, sustainability, practice change, records management, industry development

Paper type – Academic Research Paper

Bibliographical Notes

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Knowledge contexts

Victoria is Australia's largest exporter of food and fibre and its agricultural sector produces goods valued at around \$9 billion a year, or 26 per cent of the national total. The state's climate, high quality soils and clean water support world-class agriculture industries encompassing for example the dairy, beef, horticulture, poultry, sheep meat and wool industries (DPI Victoria 2011c). The challenge for the Victorian Government is to ensure that these industries remain productive whilst public concerns of, for example climate variability, globalisation, competition for resources and environmental stewardship are also adequately managed.

Public agencies such as the Victorian Department of Primary Industries (DPIV) however, do not have direct control over land or production management of which they have a concern. Practitioners of modern agricultural extension understand this and thus aim to work in ways that are respectful of the knowledge frameworks of farmers as managers of private land. To do this, they use a range of approaches to knowledge sharing to assist and enhance capability development to support development and adoption of effective "co-created" or win-win solutions (Jennings et al. 2011, sec.2 p 65).

But it remains the case that changing policy frameworks relevant to public agencies such as DPIV, are contributing to significant tensions within the agriculture industries (Alleyne 2011). This is especially the case when funding and operational models for agricultural research such as those promulgated through Australia's new national research, development, and extension (R, D and E) framework are changing so radically¹. For example, this framework recognises that basic strategic research (R) can be provided from a distance with regional adaptive development (D) and local extension (E) to improve the uptake of innovation within industry (DAFF, 2009, p3).

This represents a new knowledge management challenge for Victoria's agricultural industries. If agriculture is to meet its many challenges, new frameworks and information distribution channels must be developed that allow for the emergence of co-created solutions to problems involving multiple issues, various concerns and much tension.

Knowledge context of a lamb producer

Victorian lamb producers manage their farming enterprises to maintain an ongoing supply of quality lamb meat for the consumers of Victorian lamb in order to earn a financial income. To achieve this, a producer must consider multiple factors such as their labour availability and cost, the capacity of their pastures to carry flocks, the seasonal conditions of lambing. These variables along with many others make for a complex problem solving context.

In our example, the farmer takes action in tacit ways, for example by communicating with peers, accessing explicit and verbal information informally through social networks, learning to work with the variability of the farm paddocks and ultimately producing goods and services. Actions taken are adaptive in nature and aim to maximise benefits and to solve problems. There is always a context within which action is taken.

This highlights that an integrated approach to knowledge management must account for the context and situation in which knowledge is applied (Vines & Naismith 2002). The solutions that emerge do so in response to contextual factors and capacity of the decision maker to take effective action (Ellis 2001). The knowledge that is available to assist the farmer in sense making and problem solving is accessed via what is called a hierarchy of knowledge cycles (Figure 1). This consists of the individuals, networks and organisations that potentially relate to the problem solving context (English 2001; Vines et al. 2011).

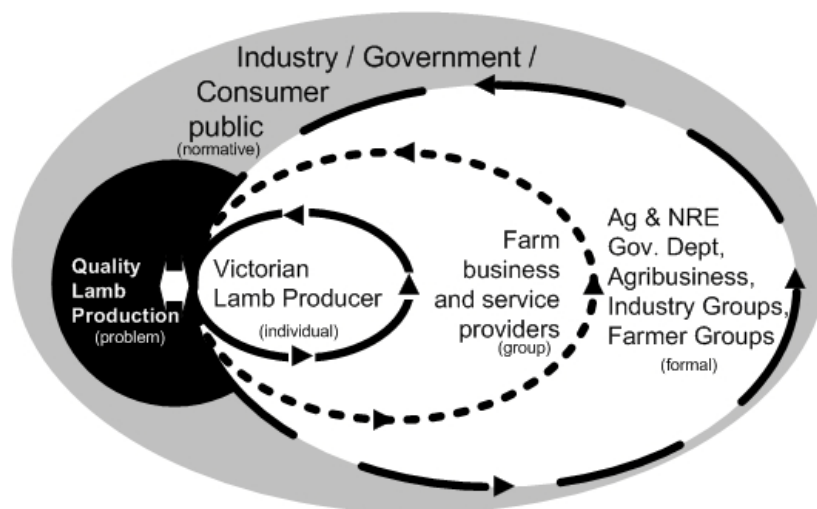
The first level of the knowledge hierarchy is the **individual** level. For example, a farmer may hold an existing set of expert (and local) knowledge often developed through years of working the enterprise beginning with a parent who passed on the skills and know-how that enables the successful ongoing

¹ The Primary Industries National R, D and E Framework was developed by the Federal, State and Territory governments in Australia; the rural research and development corporations; CSIRO; and universities, through the Primary Industries Ministerial Council (PIMC).

management of the farm. This personal knowledge is the first stage of the knowledge hierarchy. It is the living knowledge of the individual that determines the types of actions taken and what can be done to solve or manage a problem (Vines & Hall 2011, p.7).

However, in an ever more complex problem context, farmers are seeking to expand their individual knowledge to find new ways of doing things. In this, farmers look to the support of specialist providers to assist them in managing specific aspects of the farm business (Pratley 2012, p.5). Thus, they seek to benefit from the **group knowledge** held by those around. In the hierarchy (Figure 1), individual knowledge can extend through groups of social and professional networks linked by a *common objective, outcome or aim* within the problem solving context (Vines & Hall 2011, p.17). For example agronomists, marketers and accountants all aim to assist their farm business clients through the provision of production, sales and taxation services respectively. These agribusiness and local organisations provide their own knowledge, both tacit and explicit in nature that enables the farm to operate and trade.

Figure 1: Example hierarchy of knowledge cycles of a Victorian Lamb Producer



At a higher level of focus, there exists a **formal knowledge** level. In the hierarchy formal knowledge amounts to records that have been socially critiqued and approved in an organisational context. Such knowledge is therefore explicit in nature and includes artefacts such as customised resources, instruction manuals, policies, research publications and formally established business processes. As per the other levels, knowledge here is also defined by its relevance or usefulness in assisting the decision maker to focus on solving or managing a problem in a particular context (Vines & Hall 2011, p.18).

This formal knowledge is created on the basis of records that accurately reflect the reality of the problem context in which they were created and the types of contexts to which they might apply. As such these records contain contextual information that informs the reader in practical ways. An example of this is the FarmPlan21 workbook. In 2010, the Farm Services Victoria (FSV) Division of DPIV implemented FarmPlan21 – a program that aimed to support the adoption of whole farm planning services for Victorian farmers. The formal knowledge that supported this program is presented in the course workbook. This workbook describes good practice, for example, soils management relative to each region in which the course is delivered. But, beyond this, the authoritative information about soil types management built up within DPIV over many years is as important as any advice about actual practice. Thus, the FarmPlan21 program provides not just the content of good management practice, but also soils data and information specific to the context of program delivery. Thus, the services delivered via the FarmPlan21 program addresses the DPIV objectives in relation to the management of private land, but in ways that assist the participating farmers achieve their goals at the same time.

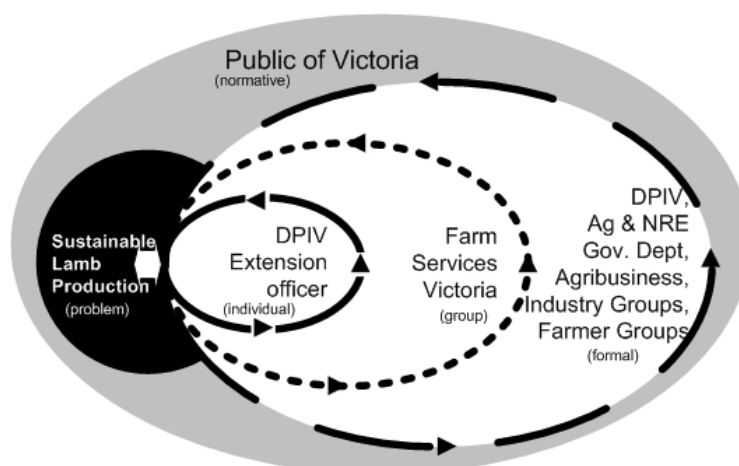
At the **normative** level² there exists a range of public and societal norms associated with acquiring, applying and creating new knowledge. These emerge because of the utility such norms play in shaping the decisions (actions) taken across the different levels within the knowledge hierarchy. These norms can be behavioural in nature or they can be more formal – encompassing voluntary or legally enforced standards. As new knowledge emerges, so these norms will also evolve over time. Examples include standards for tracing lamb production from the farm to the abattoir and then the retailer to provide evidence of food safety and animal welfare standards. They also include commitments to food labelling regulation to support customer interests.

Knowledge context of government policy in Victoria

The Victorian Government has a public responsibility to ensure that, for example, the quality-lamb farmers described in the preceding section manage their farms in productive and sustainable ways. It is in the public interest that land-management practices are competitive in international markets, productive for the Victorian economy, sustainable for the natural environment, and safe for the community (DPI Victoria 2011a, p.8).

The FarmPlan21 program acts at an **individual level** (Figure 2) through an extension officer who is responsible for encouraging knowledge exchange and development. This is a developmental role in that it involves facilitation, science communication and independent knowledge broking in order to support the uptake of desired capabilities amongst the farmer community. In order to capture formal records of the farm plans developed in response to personal circumstances or problem contexts (Shaw & Wilson 2011, p.12; Wilson et al. 2010, p.3), FSV chose to provide a commercial GIS application called iFarm. This allowed farmers to develop their records in a digital environment.

Figure 2: Knowledge hierarchy related to DPIV extension services for lamb producers



FSV operates at the **group level**, within the knowledge hierarchy by establishing and managing the FarmPlan21 program. This involves developing project plans to support the investment case for FarmPlan21 and then implementing and monitoring the impact of the initiative over a number of years.

Protocols developed to support the description of records within the iFarm software application provide an example of the knowledge created at the **formal level** within the hierarchy. These protocols are developed by reaching negotiated agreements of standard descriptions for different layers of farm entities such as land class, paddocks, pipes and vegetation.

At the **normative level**, the citizens of the State of Victoria expect that research and extension undertaken by government is independent in nature and will contribute to the idea of “public interest”.

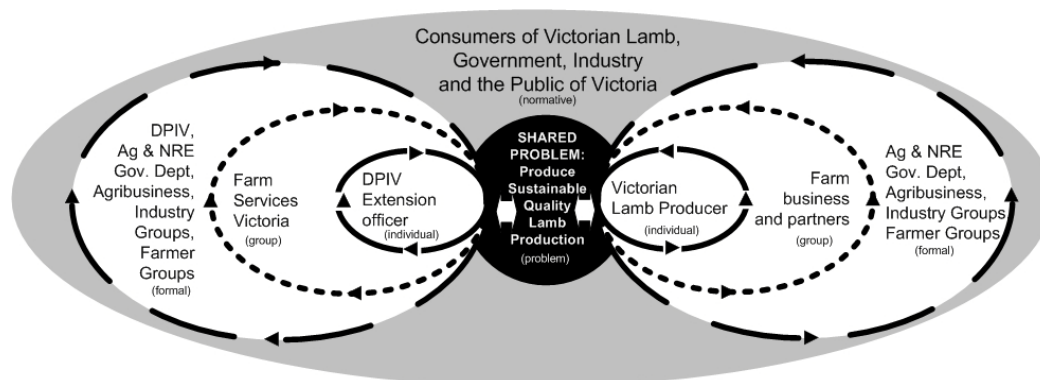
² This topic of normative commitments within the knowledge hierarchy requires a publication in its own right. It forms an important underpinning to the model for a public knowledge space outlined in Figure 9. One aspect of the underlying theory of this extends back to the Karl Popper’s Addendum to Volume 2 of his *Open Society and its Enemies* (p 743) in which he discusses the relationships between facts and standards and what he called the “liberal tradition”. These views have much to contribute to foundational design principles for decision support systems.

These norms carry across all levels within the knowledge hierarchy by shaping the behaviour of all DPIV staff.

Towards a shared knowledge context

In our example of a farmer involved in lamb production and their involvement in FSV's FarmPlan21 program, a shared context is created by merging the problems of quality management and sustainable lamb production. In other words, the solutions to the separate problems of concern to both the farmer and DPIV can be co-created. It is through the generation of this shared knowledge context that common interests can be identified. In developing a shared knowledge context in this way, a knowledge system begins to evolve that encompasses the farmers and DPIV. This is because the conditions are being created for decision making and action based on pluralised understandings of the problem being addressed. The conceptual framework through which co-created solutions may emerge is outlined in Figure 3.

Figure 3: Example of a shared knowledge hierarchy (context) between Victorian DPIV extension services (Left hand side) and Lamb producers (Right hand side) (from Vines et al. 2011, p.181)



As part of the emergence of co-created solutions, it might seem obvious that there would be benefit if a Government agency like DPIV were able to harvest the records of farm planning activities – including information about the specific location of these farms. Because there exists within the iFarm application, a common network of entities and entity descriptions used by farmers as a basis for farm planning, such possibilities do exist. Further, as part of the FarmPlan21 program management framework, including the workshop registration process, a basis of trust is established with farmers. This extends to agreements covering privacy and data and information sharing.

Within this shared context, the FarmPlan21 program is highlighting the potential benefits of effective records management. On the one hand, the creation of farm records forms a vital part of the decision support environment for farmers- and developing whole-farm plans aims to maximise the private benefit of the farmer. On the other hand, the creation of FarmPlan21 records aggregated across multiple farms and regions allows government agencies to provide evidence of public benefit. A shared problem context provides possibilities for realising shared benefits.

However, it is suggested that the generation of this type of win-win outcome will not emerge unless other actions are taken. It is hypothesised this has to do with the hierarchical nature of knowledge. The complexity of developing shared solutions increases as the focal level extends beyond the individual towards the normative level. Farmers will become less and less likely to share their farm records if they do not have the assurance that these records will be used only for the purposes other than for which they were provided. This extends to benefiting from access to aggregated data and information from farm records.

The power dynamics of such systems go to the heart of the challenges associated with developing knowledge management solutions in a shared context. The core challenge is to ensure the focus for action remains at the level of the individuals that have the capacity to act in order to realise shared benefits. The substantial danger is that those that operate across the higher level of focus within the knowledge hierarchy can act to constrain the ability of farmers to take actions that will make a difference. Or, without necessarily meaning to do so, stakeholders located in the higher levels of

hierarchy might reframe the nature of the shared problem in ways that serves their benefits, but not the farmers.

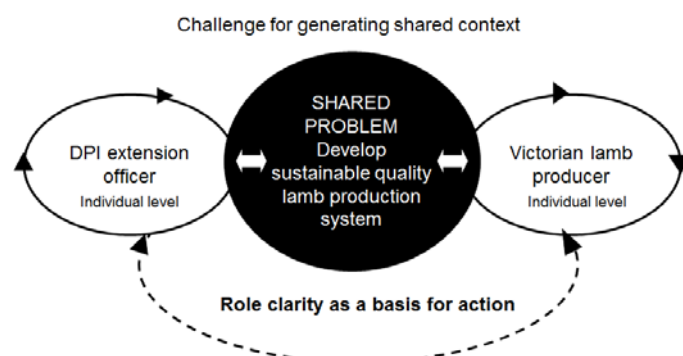
Principles for generating a shared knowledge context

Role clarity as a basis for action

The most important principle in working towards developing a shared context is to clearly identify who are the critical decision makers that have control over the actions that will directly impact the nature of a problem. As shown in Figure 4 this identification must occur at the individual level. This is vital if the clarity required to form a basis for action is to be achieved. Role clarity and basis for action involves recognition of who has the control and authority to use appropriate knowledge in a way that actually solves the problem of concern. This must always be the starting point in the development of any knowledge management based solution.

In the case of the FarmPlan21 project, the role of the farmer was to attend the farm planning workshops, learn, discuss and subsequently develop their own personal whole-farm plans. It is not the role of government agencies such as DPIV, to take such decisions on behalf of farmers. Rather their role is to create the conditions within which quality decisions, and thus action, can be taken by the farmer themselves. Effective engagement with decision makers and those that influence their decisions is required to gain clarity about the problem. The extension officer's role is to access and customise targeted, relevant and authoritative information and provide it such that the farmers may use it to fulfil their role. The subtleties and importance of role in itself is often overlooked and is fundamental to the D(evelopment), within Australia's National R, D and E framework.

Figure 4: Challenge of developing a shared knowledge context at the individual level

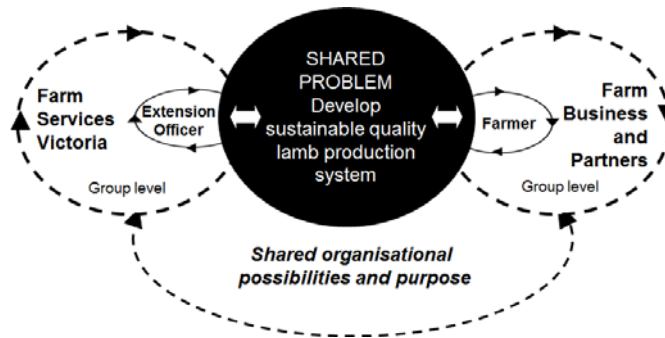


Shared organisational possibilities and purpose

The creation of solutions to problems between Farm Services Victoria and farm businesses involves developing a process for working through questions like *what is the shared problem?* *what might be the possible solutions?*; and *what are the shared benefits?* Finding answers to these questions is premised on how the relevant knowledge is identified at the organisational level and is socialised to become common knowledge amongst a community of interest. In essence the approach seeks to co-create solutions for shared problems.

In the case of FarmPlan21, farmers engage with DPIV with the objective of strengthening knowledge that may contribute to farm businesses and sustainability outcomes. In doing so, they take into account a wide range of perspectives including their livelihoods perspective. They engage in a process of acquiring and applying new knowledge – of testing the assumptions of their current farm and business practices. The Farm Extension officer engages by following an investment decision-making framework, securing organisational commitment to the project objectives and by developing a network of farmers and related service providers whose actions will collectively contribute to common objectives and public interest outcomes.

Figure 5: Challenge of developing a shared knowledge context at the group level



Solutions to problems in the shared context are developed through co-creation, collaboration and sharing. Furthermore, as previously discussed, the shared problem context itself is constantly changing and moving. Shared contexts, shared problems and shared solutions are evolutionary. Therefore, the knowledge systems designed to operate within such contexts must also be evolutionary. Providers must therefore take a long-term continuous improvement approach to system development. As in biological development, systems must begin small and *grow* big. Any evolutionary pathway cannot be controlled and sustained growth can only develop if there is potential for the integration of other problem contexts as this growth unfolds (Vines, et. al, 2010, p14-19). This is why it is necessary to take into account the interests of stakeholders at the next level in a knowledge hierarchy.

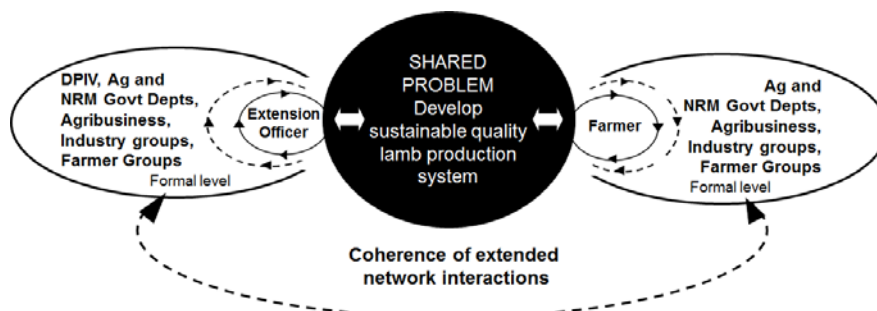
Coherence of extended network interactions

As the level of hierarchy increases, so the challenges associated with developing a shared context also increases. This is because the complexity of network structure encompassing the various stakeholders with interests in the shared contexts increases.

In Victoria, the Department of Sustainability and the Environment (DSE) maintain oversight of Victoria’s ten catchment management authorities (CMAs). Each of these CMA’s has separate contractual agreements and protocols with farm groups such as Landcare groups. This is problematic for DPIV when running programs because there is no way of integrating the records of activities carried out in different catchments across both private and public land. The management of public land assets is more the jurisdiction of DSE and CMAs. The FarmPlan21 program is providing some lessons as to how to work towards a public interest that must encompass outcomes for both types of land class. One key learning for example is the necessity of developing and adopting a common set of entity terms to capture farm-records and the context within which they are created. But to expand this to encompass public land imperatives, requires DPIV and DSE to reach negotiated agreements about a common list of entities relevant to their own interests. In doing this there develops an enhanced capacity to provide evidence to support the CMAs DSE and DPIV business objectives.

Some of the lessons from FarmPlan21 are thus pointing towards the importance of establishing appropriate governance between stakeholders with interests in a shared context, including farm-based organisations. Such agreements provide the coherence for mediating operational tensions that arise via network interactions at the formal knowledge level (Figure 6).

Figure 6: Challenge of developing a shared knowledge context at the formal level



Different types of agreements are likely to be required –for example encompassing network, operational and records management governance (Table 1). Each of these types of agreements has a separate role in creating the conditions for overall coherence.

Table 1: types of stakeholder governance arrangements in knowledge management

Governance Type	Description / role
Network	Requires senior management representatives and CEOs to negotiate and implement memorandums of understanding that enable collaboration and give permission for staff to interact across organisational networks. This lays a foundation for the development of operational and technical governance agreements.
Operational governance	Requires the development of cross institutional strategies and action plans to support exchanges and resource allocations amongst the stakeholders involved in relevant projects.
Records governance	Requires the negotiation of agreements about the creation, distribution, use and management of records of activities that shapes the spirit and intent of project / program contractual agreements.

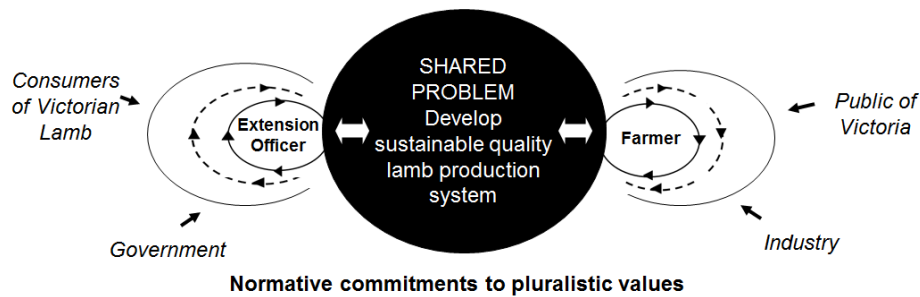
Normative commitments to pluralistic values

At the highest level of hierarchy, commitments to the principles of public knowledge become of paramount importance. Merton (1973, p.267–78) suggested a normative structure of inquiry required commitments to ensure the advancement of reliable knowledge. He summarised these commitments using the acronym CUDOS. The production of reliable knowledge is reliant on the principle that research is a collective pursuit—thus the norm of (C)ommunalism. The norm of (U)niversalism entails that anyone can participate in the research process, thus the research field remains open to all competent persons. Commitments by (D)isinterested agents are required to ensure that findings are not skewed by the personal interests of those involved. The quality of knowledge is dependent on the (O)riginality of those that contribute to the outcomes. A spirit of (S)cepticism and scrutiny is required to ensure claims are appropriately critiqued—thus safeguarding the quality of knowledge.

But committing to these sorts of norms is challenging because in any knowledge hierarchy, there is often a propensity towards maintaining the status quo and the self-interest of organisations. Organisations usually have a vested interest in shaping the systems to be adopted within any new network collaboration as each agency aims to constrain the impact of change on their own organisational systems and networks. This is particularly the case in information and communication technologies (ICT), where there is urgency across all organisations to ensure their investments in ICT are not made redundant and become sunk costs.

The values of openness, flexibility and evolutionary ICT development, are of fundamental importance if such propensities are to be counteracted. This is because at heart, developing a shared context means being willing to incorporate new perspectives and practices – of working within a pluralistic framework. Thus normative behaviours modelled when developing any shared context need to incorporate a respect for organisational, professional and cultural difference. In Figure 7, we highlight that these normative commitments vary according to the particular focal level – whether this be at the “Public of Victoria”, to “industry”, “consumers” of Victorian Lamb, and “Government” levels.

Figure 7: Challenge of developing a shared knowledge context at the normative level



Principles for records management in a shared knowledge context

Lessons learned through the use of iFarm in FarmPlan21 provide some preliminary insights into the challenges to be faced by Government agencies when facilitating knowledge management in a shared problem context. For example FSV staff found there was a need to develop standards for GIS to enable data provided to be beneficial to both the farmer and DPIV (Wilson et al. 2010, p.5). This need extended to the provision and collection of context information such as the date and location of a course or the profile of participant interests (eg. farm size, industry sector, specific topics). In the information management world, such information is called “metadata”. The capture of this metadata allowed for enhanced analysis and improvement activities that gave rise to expanded service quality (Sudholz, Shaw, et al. 2011).

In developing an approach to records management, knowledge management practitioners must consider the difference between “recorded information” and “records”. The differences here relates to the evidential qualities, purposes and functionality of records. Record keeping involves building and managing frameworks and systems which assure the preservation, and accessibility of accurate, complete, reliable, and authentic records “in” and “through” time and space (McKemmish et al. 2009, McCarthy et. al., 2006). The objective is to ensure there is sufficient preservation of knowledge to explain the context, structure and meaning of information and as well as to prevent the loss of records, due to the physical changes or destruction of either the medium or the supporting technology that render these records unusable (McCarthy, et. al, 2006).

By implication, it is being suggested that the focus on records management will become increasingly important to agriculture. Without effective records management it becomes difficult to undertake empirical research on a systematic basis. Without empirical research, the ability to lobby for public resource allocations to support innovation in Australian agriculture will be diminished.

Thus in the development of next generation farm planning tools such as Farm Web 2.0³ that is being supported by DPIV, it will be essential that effective records management becomes a cornerstone principle in the design of such systems. We further suggest that such infrastructure needs to develop in alignment with national records management models, experiences and international standards.

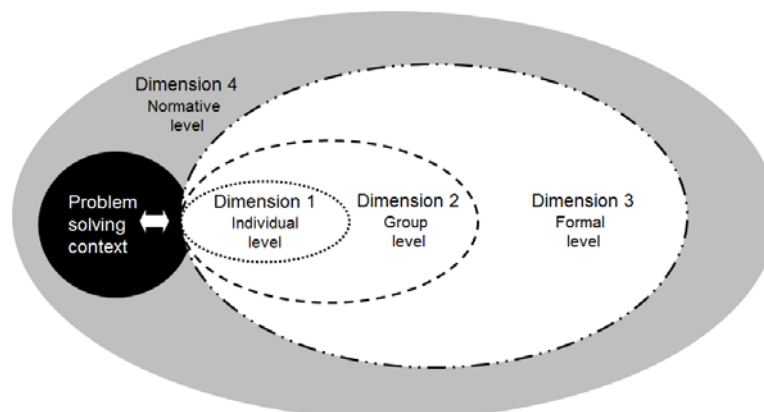
Records continuum model

To address the challenges of capturing contextual information related to records we reason there is a direct alignment between the levels of the knowledge hierarchy and the dimensions of the Australian Records Continuum model (Figure 8). This continuum view of records description, informs the development of national and international metadata standards and schema. The model Australian Recordkeeping Metadata Schema was implemented in standards developed by the State Records NSW and the South Australian Archives and subsequently, in works undertaken by Standards Australia which was adopted as Part 2 of the 2009 International Standard for recordkeeping metadata, ISO 23081.

³ The FarmWeb 2.0 concept aims to deliver spatial information for improved management of individual farms, entire landscapes and sub-regions critical for productivity improvement, land use management and to support farm extension activities (DPI Victoria 2011b).

The continuum model (Figure 8) consists of four dimensions and each dimension can equate to the different levels in the knowledge hierarchy in Figure 1. Short descriptions of each dimension is summarised as follows (McKemmish et al. 2009 from table 1).

Figure 8: The four dimensions of the records continuum model expressed within the context of a knowledge hierarchy



Dimension 1: Create documents and content as trace. This first dimension encompasses the actors who carry out the act (decisions, communications, acts), the acts themselves, the creation of content and documents which records the acts and the evidential trace to these acts (ibid, 2009).

Dimension 2: Capture records-as-evidence. This encompasses the personal and corporate record keeping systems which capture records in ways which support their capacity to act as evidence of the social and business activities of the units responsible for the activities (ibid, 2009).

Dimension 3: Organise records-as-corporate memory. This encompasses the organisation of record keeping processes. It is concerned with the manner in which a corporate body, organisation or individual defines the record keeping regime and in so doing constitutes the archive as memory of its business or social functions (ibid, 2009).

Dimension 4: Pluralise records-as-collective memory. This dimension concerns the manner in which the records are brought into an encompassing framework in order to provide a collective, social, historical and cultural memory of the institutionalised social purposes and roles of individuals and corporate bodies (ibid, 2009).

In the discussion that follows, we are concerned with the continuum of records as this relates to the generation of shared knowledge context.

Records creation in an individual knowledge context

At the individual level, stakeholders make shared commitments to the creation of project records. According to the records continuum, this would include locating these records within the context of action in ways that allows for their retrieval (ibid, 2009). The FarmPlan21 program has maintained a focused effort on developing processes to facilitate records management at this level (Table 2).

Table 2: Examples of initiatives used by FarmPlan21 for records creation in dimension one of records continuum model (Sudholz, Challis, et al. 2011; Shaw & Wilson 2011)

Farmer	Examples of protocols to enable effectiveness of shared knowledge context	Extension officer
Creation of paddock identifiers and soil type using iFarm	<ul style="list-style-type: none"> • Workshop Registration process providing participant details, location and interest • Signed privacy agreements regarding access and use of data • Standardised GIS layers for capturing record level data • Negotiation of follow up workshop to support plan implementation and project impact monitoring. 	Building farmer capability to use knowledge management approaches to create normalised records
Creation of records of plans regarding NRM focused activities such as pest management, shelter belt creation and wetlands using iFarm.		Access and preparation of GIS imagery accessed via coordinated imagery program for individual participant businesses.
Creation of records of land use plans associated with farm productivity using iFarm.		Creation of agreements and contractual documentation relevant to participant registration.
Creation of production goals and guiding management principals involving NRM, Productivity and Social outcomes.		Creation of records of attendance at different workshops and client interactions including location information

Records as evidence in a group knowledge context

The records continuum indicates that record keeping in the group context requires the capture and maintenance of metadata in order to assure the quality of records as evidence of business and social activity. This dimension two activity, involves the use of metadata to place records in relation to other records and to link them to the context of decisions and actions taken – in other words, by mapping a network of contextual information of (McCarthy & Evans 2008; McKemmish et al. 2009). To locate records in this contextual framework requires commitments to the use of context entities. The 2001 ‘Toronto Tenets: Principles and Criteria for a Model for Archival Context Information’ provides details of this requirement (Pitti 2001, p.96):

Context information is not metadata that describes other information resources, but information that describes entities that are part of the environment in which information resources (i.e., records) have existed.

It also requires commitments to the use of creating relationships between context entities (ISO 2009):

Contextual linkages between records can be unwritten and dependent upon individual and group memory. Such reliance on unwritten contextual understanding is not dependable; some people have more access to more knowledge than others, over time the usability of records will be compromised by staff movement and diminishing corporate memory.

There are a small number of metadata elements that are required to establish the identity of these context entities. For example, the name of the entity, a short description, a date range from and to as to its existence. But beyond this, also the need is to establish relationships between context entities. For example:

Context entity: Event
Farm planning workshop

Relationship
forms part of

Context Entity: Project
FarmPlan21 Project

or

Context entity: Project
FarmPlan21 project

Relationship
is related to

Published resource
FarmPlan21 program manual

In the development of Farm Web 2.0, farm planning has been identified as one of the use cases to illustrate its application. It defines farm planning as (DPI Victoria 2012a):

The capture of farm activities and assets to identify opportunities for future development to achieve farm goals. It is also used for planning regulations for local governments.

Potential protocols to enable the development of a shared knowledge context to support farm planning and other objectives are outlined in Table 3.

Table 3: Potential protocols related to the collation of records as evidence in dimension two of the records continuum model

Potential protocols related to a Farm Business	Potential protocols to enable effectiveness of shared knowledge context	Potential protocols related to FSV and DPIV
Creation of farm-based and organisational context entities and unique identifiers to (a) identify existing features (topography, natural features, build features, soil types and conditions such as erosion. (b) Identify future conditions (intended use of specific areas, location of proposed buildings and other improvements such as dams and fences) (c) Provide standardised descriptions of intended farm practices, development of nutrient, environmental, risk management or irrigation management plans etc (DPI Victoria 2012a; DPI Victoria 2012b)	<ul style="list-style-type: none"> • Governance agreements between DPIV and farmers put in place to allow for metadata harvesting to collate records of activities and their relationships to context entities • Ability to exclude context and records based on legal obligations including privacy (made possible by use of different relationship type descriptions) • Collation and sharing of event information to monitor the types of events, attendance at workshops, regional spread of these events etc. 	<p>Creation of project approval documentation</p> <p>Creation of project and organisational context entities and unique identifiers to provide a scaffold for records management. Examples include (a) the name of the project, (b) the events held (including event locations) (c) resource inventory provided including use of spatial and other types of data sets related to soils, water, biodiversity, biosecurity and risk management</p>
Establishment of relationships between context entities and the records that provide evidence of action	<ul style="list-style-type: none"> • Provision of context metadata attached to knowledge artefacts to allow decision makers to understand the context within which knowledge has been created 	Establishment of relationships between context entities and the records that provide evidence of action.
Use of authoritative knowledge artefacts including spatial data sets related to soils, water, biodiversity, biosecurity and risk management to enhance the quality of decision making at the farm and catchment levels		Implementation of publications e-repository to allow access to knowledge artefacts (including grey literature and information packages) of relevance to the shared context.

Records as corporate memory in a formal knowledge context

In this dimension, recordkeeping involves identifying the evidential requirements for records to function as “corporate memory”. Corporate memory refers to the “ends” – the creation of new knowledge that is to be co-created as part of the shared knowledge context. What sort of recordkeeping regimes will be required to achieve this end? What types of knowledge repositories and classification schemes will need to be considered? What sort of storage and migration strategies will be required to

carry the records forward in time, including beyond the life of the project? What sort of access strategies will be appropriate? (McKemmish et al. 2009 from table 1).

Table 4: Potential protocols to support the collation of corporate memory as part of dimension three of the records continuum model

<p style="text-align: center;">Ag and NRM Govt Depts, Agribusiness, Industry groups, Farmer Groups</p> <p style="text-align: center;">(from farmer’s perspective)</p>	<p style="text-align: center;">Potential protocols to enable effectiveness of shared knowledge context</p>	<p style="text-align: center;">DPIV, Ag and NRM Govt Depts, Agribusiness, Industry groups, Farmer Groups</p> <p style="text-align: center;">(from FSV perspective)</p>
<p>Negotiation and development of cross industry collaborations with farm groups and agribusiness organisations to support the uptake of records managements in farm planning packages such as Farm Web 2.0</p>	<ul style="list-style-type: none"> • Implementation of multi-directional metadata harvesting to allow for flexible and distributed approach to data and information sharing 	<p>Continued emergence of harmonised context entity descriptions, relationship mapping and records management governance based on cross departmental metadata harvesting and impact monitoring</p>
<p>Negotiation of common funding agreements with farm organisations, research and development organisations, agribusiness organisations and DPIV. Develop terms of contract agreements and contractual obligations to support of sector wide metadata harvesting activities with the interests of agricultural industries in mind</p>	<ul style="list-style-type: none"> • Emergence of harmonised context entity descriptions that provide a broad scaffold for action and for impact monitoring in a range of different domains. For example collections of entities that support: <ul style="list-style-type: none"> -Whole farm planning records management and impact monitoring (for example the development of Farm Mark-up Language) - NRM, productivity, bio-security and OHS, crop diagnostic impact monitoring, credence values market assurance systems 	<p>Develop of common funding agreements and protocols to ensure consistency in the collection and collation of metadata across government departments</p>
<p>Negotiate metadata harvesting models and business models, data and information sharing protocols, including regional governance arrangements</p>		<p>Develop metadata harvesting models and business models with industry stakeholders in mind.</p>

Records management within a public knowledge space

In this final dimension, the records continuum model requires developing social and cultural mandates for essential evidence to function as a collective memory of a collaboration (ibid, 2009).

In the case of Victoria’s agricultural industries, mandates would extend to the development of network governance agreements between a number of stakeholders. Agreements would be struck around commitments to the advancement of public knowledge. The notion of ‘public’ is quite broad in this fourth dimension. In some cases, where government funding mandates this, public would mean a citizen centric approach - the public of Victoria. In some other cases, public might mean that benefit sharing is restricted to only those who participate in the project collaboration for example, farmers or farm groups. This is likely to require farmer centric governance arrangements, because the farmers themselves would contribute to set the terms and conditions for data and information sharing. This is because the whole system is dependent upon their willingness to share evidence of actions that other stakeholders would require. This type of collective engagement of multiple stakeholders has been called a public knowledge space (McCarthy 2011; Vines et al. 2011, p.174).

These agreements around mandates in the fourth dimension also necessitates establishing recordkeeping regimes that carry, store and migrate the records beyond the life of any collaboration, organisation or person (McCarthy & Upshall 2006). It will be important also to establish access strategies across different state jurisdictions (McKemish et al. 2009 from table 1) in line with Australia's national R, D and E framework. In this framework, it has been agreed that strategic research (R) can be provided from a distance with regional adaptive development (D) and local extension (E) required to improve the uptake of innovation within industry

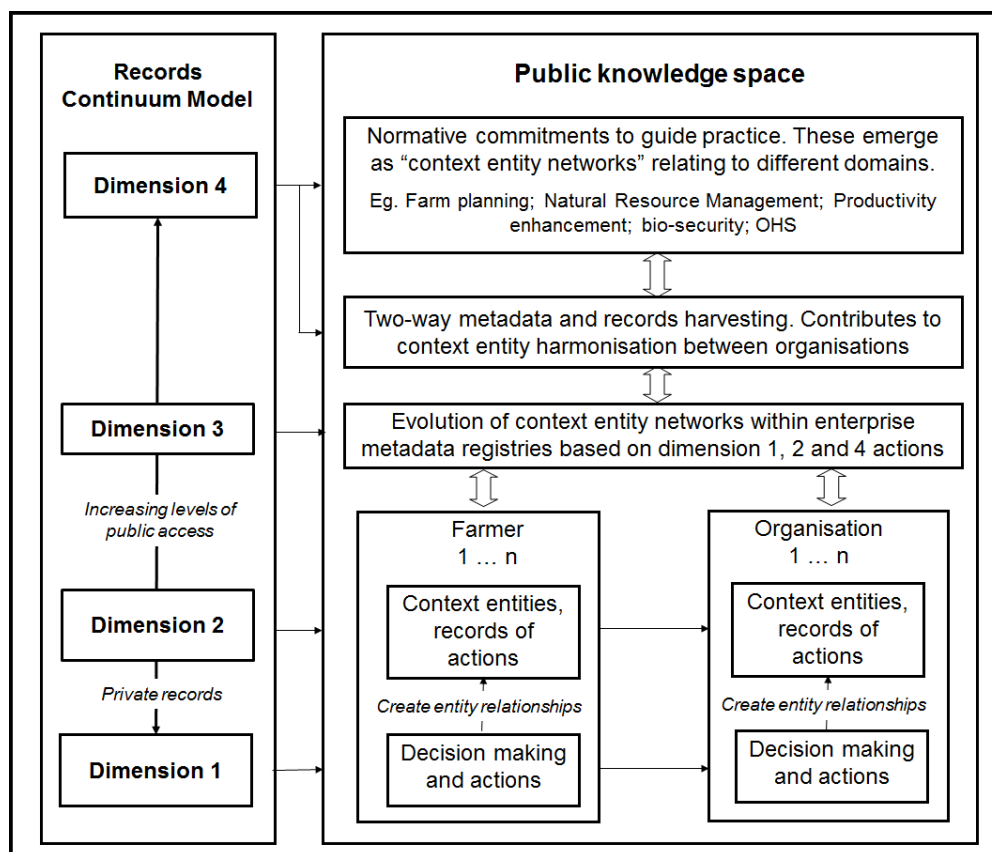


Figure 9: The relationship between the records continuum model and a public knowledge space⁴

Conclusion

There exists a substantial knowledge management challenge for organisations with a remit to mediate public interests in areas such as adopting sustainability practices, adapting to climate variability, enabling industry collaboration or brokering access to resources during times of significant constraint. This challenge relates to the means by which knowledge assets are managed to integrate a hierarchy of perspectives from the micro-level (individual), group (institutional / organisational), formal (authorised) to the macro-level of focus (societal norms).

⁴ The authors would like to particularly acknowledge the contribution of the eScholarship Research Centre at the University of Melbourne and their long years of work in helping frame what may one day become an operating model for this type of generic approach to public knowledge management. This same approach to public knowledge management and commitments to networks of context entities has been scoped out in some detail as a conceptual model for reducing burden in the Victorian Community Services Sector (Vines et al. 2009, p.33). It is also in alignment with the service aggregation model developed as part of the National Library's TROVE aggregation service. Eight years in the making, Trove is a search engine developed by the National Library that aggregates the information from 1000 libraries, art galleries, archives, research repositories and museums in Australia (Vyver 2010). The eSRC have played an active role in the piloting of TROVE, via their involvement in the "People Australia" project which has now become part of TROVE. The TROVE model including its use of the Open Archives Initiative Protocols for Metadata Harvesting (OAIPMH) forms part of the policy framework of the Primary Industries Standing Council National R, D and E knowledge management framework (DAFF 2009).

To do this, public agencies such as DPIV and farmers alike have an opportunity to recognise that the complex challenges they both face occur within a context in which they both share an interest and responsibility. Thus there is utility in working together to identify a shared problem context and to work towards the co-creation of win-win solutions. Such solutions can only emerge if those who influence and control the actions that lead to mutual benefits become the focus of primary attention. Therefore, in the case of DPIV those concerned with achieving public interest outcomes are advised to work in ways that are inclusive of the knowledge frameworks of the farmers who have decisional rights over the management of private land.

The example of the DPIV FarmPlan21 program is used as a basis for analysis. This analysis demonstrates how modern archival records management concepts can provide a foundation for integrated approaches to the co-development of sustainability practices within new industry frameworks. Effective records management, including a focus on integrating contextual aspects of archival and records management, is fundamental to establishing and implementing knowledge sharing across shared knowledge contexts. Without records management there can be no empirical evidence of impact over time and without such evidence, the ability to argue for resource allocations to research and extension is diminished. There can be no good knowledge management without good records management.

Of particular relevance is the Records Continuum model. We reason that the four dimensions of this model align directly with the four levels of a knowledge hierarchy described. This creates a purpose and direction for stakeholders who seek win-win solutions for shared problems. The framework includes principles that should be considered at each level of the hierarchy in order to achieve effective knowledge sharing outcomes. In doing so, multiple parties can collaborate effectively at their own relevant level to achieve win-win solutions at all levels.

The challenge is to work across all levels of the knowledge hierarchy whilst not losing focus on the individuals who enact the on-ground actions required for win-win solutions to emerge. The dynamic nature of these shared contexts requires that a knowledge system must be allowed to evolve. As in biological development, these knowledge systems will only emerge if they begin small and grow big. Any evolutionary pathway cannot be controlled and sustained growth can only develop if there is potential for the integration of other problem contexts as this growth unfolds (Vines, et. al, 2010, p14-19).

This type of approach to knowledge management and extension support systems can apply to any knowledge intensive industry whether the focus is at organisational, city, industry cluster or regional level. What is common across these industries is that contemporary approach to records management must span the different levels of any knowledge hierarchy. This is likely to catalyse the need for a different type of innovation framework - discussed under the topic of a “public knowledge space”. The analysis of the FarmPlan21 program provides insights into how this approach to innovation will involve people engaging with technology and work practices in quite different ways than up until now.

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