Enhancing Nitrogen Use Efficiency For Victoria And The World: A Combined Knowledge And Innovation Systems Perspective

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Abstract

Since September 2012, knowledge management specialist staff within Agriculture Victoria, (Department of Economic Development, Jobs Transport and Resources and its predecessor institutions) have been developing a number of different digital applications to foster more effective online collaborations across the public, research, private service provider, community and education sectors. Adoption of these work practices and systems, including governance systems has the potential to improve the means by which those involved in the design, deployment and monitoring of research, development and extension programs and projects can reach and engage audiences, facilitate co-design of solutions with target audiences and improve access to information and expertise.

In this paper, we explore these possibilities and articulate the benefits for adopting these innovations in line with the overarching theme of this conference: that is through the aspiration of developing s*olutions to enhance nitrogen use efficiency for the world.* The context will be the Victorian dairy sector and in particular a project called: *Manure Technologies To Drive Resource Efficiencies*. This project is situated within a policy context that intensification of all agricultural industries including the Victorian dairy industry is desirable and inevitable. This global trend towards agricultural intensification is increasing place-based conflicts involved with securing a social license to underpin a 'right to farm'. The Victorian Government State Government in Australia is grappling with the complexity of the trade-offs between these two policy objectives.

The central claim of the paper is this. Embedding principles of good practice knowledge management into the way programs and projects are designed and managed will do much to ameliorate the tensions inherent between the policy objectives of enabling agricultural intensification and securing a social license underpinning any 'right to farm'. The complexity associated with the trade-offs between these dual objectives involve many technical challenges. To enhance nitrogen use efficiency in the dairy sector, solutions are required across many domains –for example in facilitating the re-use of nutrients, addressing soil nutrient accumulation, reducing gaseous emissions and odour and eliminating nutrient contamination of water and air, particularly those where there are larger herds and intensive operations involved.

It will be concluded that effective knowledge management needs to address two overarching challenges (Snowden 2003). The first is to create the conditions within which innovation can emerge via effective sense-making, collaboration and innovation systems thinking that apply in both face to face and online environments. Practical examples from other sectors will be discussed to highlight how technology can be harnessed to create the conditions within which representatives of "communities of practice" (CoPs) can co-learn and co-evolve with representatives of "communities of interest" (CoIs) in order that solutions to problems involve principles of co-design. It will be emphasised that such approaches have significant potential in the realm of manure technologies and enhancing nitrogen use efficiency. The second is to enhance the quality of decision support systems. In the case of agriculture such support systems need to be flexible and extensible enough to apply at different levels in integrated ways (i.e. across farms, catchments, industry development, community based and public policy levels). The problem at the moment is that current decision support systems do not take into account the need to integrate and value the many different types of evidence to support decision making across these different levels.

Key Words

Nitrogen, knowledge management, innovation systems, innovation systems thinking, digital application development, communities of practice, communities of interest, learning networks, collaboration platforms.

Introduction

The changing nature of Australia's primary industries research, development and extension system

Mick Keogh, Executive Director of Australian Farm Institute (cited in Beilharz, 2014) has highlighted that there is a major transformation is occurring across Australian agriculture a

> *"It's particularly noticeable in the grains sector, but really right across agriculture, that since about '97 or '98, the rate of productivity growth, even taking into account the centennial drought, has slowed. The difficulty is that we've moved away from a public extension model, to one that's now ostensibly a private one.*

Keogh is emphasising that the networks through which current innovations emerge are evolving away from being primarily a public sector responsibility towards a more pluralistic system involving many different stakeholders including private service providers. This is the case for those leading the manure technologies to drive resource efficiencies project. The project involves international manure management specialists from the Netherlands, Canada and the USA, technical and scientific specialists, farm economists, dairy industry development, digital application and knowledge brokering specialists.

The need for new types of institutional and network configurations

However, for a project leaders to enable contemporary service models, new types of social, institutional and technological configurations are required. These need to span at least four different types of knowledge networks.

- **Science-based knowledge network** configurations involve the parties and personnel involved in identifying a research need, developing a research hypothesis, collecting and analysing data to test this hypothesis, peer reviewing findings and publishing of content in scientific journal articles and making these available via global scientific publishers.
- **Collections-based knowledge network** configurations involve the parties and personnel involved in identifying accessing, creating and using a vast aray of content in the form of information notes, web pages, printed materials, data sets - all targeted for specific audiences. Part of the function of collections development and management is to cultivate a culture of evidence-informed decision making. Services involve creating and describing content in order to making it to discoverable, accessible and re-usable. These services extend to managing the intellectual property agreements associated with the use and re-use of this content in on-line environments – something which traditional approaches to development and extension even just ten years ago did not have to contend with.
- **Knowledge and innovation-brokering network** configurations involve the parties and personnel involved in re-configurations of for example social, technical and capital investment networks to support innovation, business and organisational performance objectives – in both online and physical environments.
- **Knowledge capability-development and education network** configurations involve different institutions and personnel involved in facilitating the emergence of contemporary skills, know-how, competencies and strategic educational requirements to meet the needs of industries both now and into the future.

Lack of system coherence

One of the challenges confronting decision makers regarding agriculture research, development and extension is that each of the support systems underpinning these types of networks are designed and deployed with different objectives in mind. Examples of some symptoms that emerge from this type of system fragmentation include:

- For farmers – they experience an information overload with-out a sense of where they can source "trusted advice and relevant information" other than from their neighbours or trusted advisers;
- For service providers – they grapple with how best to support open innovation in ways that also delivers commercial returns to themselves;

- For equipment vendors – they grapple with the governance, data ownership and capability development challenges associated with sharing data required to deliver real benefits associated with precision agriculture;
- For researchers – they run the risk of losing touch with those that rely on their research to derive innovation benefits;
- For institutional managers – they have difficulty in being able to continuously monitor the impact of multiple projects and the interactions between projects, programs, strategies and policy objectives;
- For policy makers – they find it difficult to bridge the gap between policy, research, practice and impact and thus practice evidence-informed policy development;
- For educational institutions – they grapple with the challenges of supplying a pipeline of graduates with appropriate capabilities based on contemporary needs;
- For taxpayers, it is very difficult to find out who is doing what types of research and why and what is the value in terms of contribution to industry development objectives.

The challenge for program and project managers and knowledge management specialists

In conclusion, one of the overarching challenges for program and project managers is that current on-line collaboration platforms used to implement government funded programs that involve multiple institutions do not efficiently create the conditions for social learning across a diverse range of project stakeholders described above.

A Knowledge Management framework (i.e. via input from Service Innovation and Dairy KM) can help foster collaboration from both a technology platforms and knowledge brokering (linking/enabling/governance) perspective. Dairy KM will be using "digital" best practice technologies as route to market for the Dairy Nitrogen (or Manure) project via the use of collaboration platforms and digital learning networks (i.e. LifeRay portal) as a means of gathering, analysing, sharing (Synthesising & Adapting) information for use in Dairy Farming Community whilst providing a knowledge brokering governance framework to ensure that the right information is delivered to the appropriate first user (farmer/service provider/researcher) at the right time to enable informed science based decision making, Projects such as "*Manure Technologies To Drive Resource Efficiencies*" will have a learning network platform (LifeRay) with spatial capability for researchers, farmers and those interested in following the progress of this paddock scale project.

A second major challenge is that many different types of evidence, in the form of data or information collated and created either as a result of seasonal disruptions (like droughts or floods) or past and current research, development and extension programs and projects that span many years are not collected, aggregated and stored over both short and long periods of time in ways that are machine readable. This constrains the extent to which data and information can be efficiently released, accessed, re-used and re-purposed to support on-line collaboration communities like the ones that could develop through the life of the *manure technologies to drive resource efficiencies project.* The rationale for storing such data and information is to make a body of evidence available to those making decisions in any particular decision context. Thus in any decision support system, it is desirable to be able to develop support systems that aim to optimise different type of evidence and make such evidence available in easily consumed products and services at different levels of context. Different types of evidence referenced in Figure 1 include:

- Anecdotal types of evidence often referred to as experiential knowledge are used in **making sense** of any particular context(s) ;
- Sporadic types of evidence that are built up on an **annual or seasonal basis** through learnings that emerge in response to disruptions such as disease outbreaks or floods. The problem at the moment is that such evidence is not easily remembered and made accessible over long periods of time when a need arises;
- Science-based / objective types of evidence that are created through specific government funded **programs** that can run for periods of **up to (and beyond) five years**
- Other types of evidence (i.e. longitudinal data) that can be derived from data sets and information assets that might be preserved over **long periods of time**.

Method

Towards new institutional and network configurations in the form of public knowledge space(s)

To address these complex challenges, knowledge management specialists within Agriculture Victoria propose a new type of cross institutional knowledge space called a web-based public knowledge space. This is defined a networked and on-line institutional framework that aims to sustain and leverage the role of public knowledge, including regulatory knowledge, in order to generate innovation and productivity benefits where no one institution can develop such benefits on their own. The stakeholders of a public knowledge space can be broken up into two broad categories. Communities of interest (CoIs) are groups of people with common interests, issues or needs- in the case of the *manure technologies to drive resource efficiencies project*. CoI representatives might include farmers, service providers, equipment vendors and the like. Communities of practice (CoIs) are groups of people with related expertise that can serve the interests and needs of any CoI. In the case of the *manure technologies to drive resource efficiencies project* CoP representatives may include researchers farm economists, catchment management personnel, industry development, digital application and knowledge brokering specialists that all work together to engage their audiences and to delivery impact.

Guiding principles of a public knowledge space

A number of guiding principles have been proposed to support the on-going development of any public knowledge space. These are summarised as follows:

- Challenges can only be overcome through collaboration – sharing and evaluating experiences, insights and expertise from a diversity of agencies, sectors and geographic locations.
- All knowledge needs context to be useful. It must be delivered in a sustainable and persistent way to make the connections that solve problems and feed innovations.
- Everyone is a respected contributor. Participation is voluntary and, in principle, everyone benefits from the shared wisdom along the way. But in the end, knowledge sharing cannot be conscripted or mandated.
- The characteristics of different knowledge networks can vary significantly depending upon whether the context is shaped by research, development, extension or other priorities.

Addressing system fragmentation

Addressing system fragmentation requires a focus on transforming existing work practices and support systems in ways that allows for evolutionary change and capability development. It is reliant upon building capabilities to support engagement and reach activities and to create the conditions for the co-design of solutions to problems in partnership with specific audiences. To achieve this end, it is perceived to be necessary to reduce the siloed nature of and fragmentation between the four types of networks described in to the introduction to this paper.

Enabling whole system innovation

The World Bank (2006) states that an innovation system can be defined as:

"A network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance. The innovation systems concept embraces not only the science suppliers but the totality and interaction of actors involved in innovation".

By implication, any innovation systems approach entails a more complex view than the narrower focus on a linear continuum of research, development and extension activities. An innovation systems perspective implies that for an innovation to take hold, new types of technical, social and institutional configurations need to emerge (Klerkx et al 2012).

Digital application development to create the conditions for innovation systems thinking

Agricultural Victoria knowledge management specialists are developing a number of digital applications and governance frameworks that would create the conditions for the emergence of innovation systems thinking . A new collaboration application that has recently developed by Agricultural Victoria in partnership with the Rural Industries Research and Development Corporation using the LifeRay platform has the potential to create an effective collaboration environment to draw in the diversity of project stakeholders. As part of this approach to work, institutional contributor agreements (for example to be signed by partners such as Agriculture Victoria and Dairy Australia) are being used to create a license to facilitate effective intellectual property sharing between the government, private, community and educational sectors. This includes the ability of project stakeholders to use social media tools as part of the tool kit to reach and engage targeted communities of interest. This represents a new way of working that has the potential to link those with decision rights relevant to matters of nitrogen use at the farm, community, regional, state, national or even at international levels.

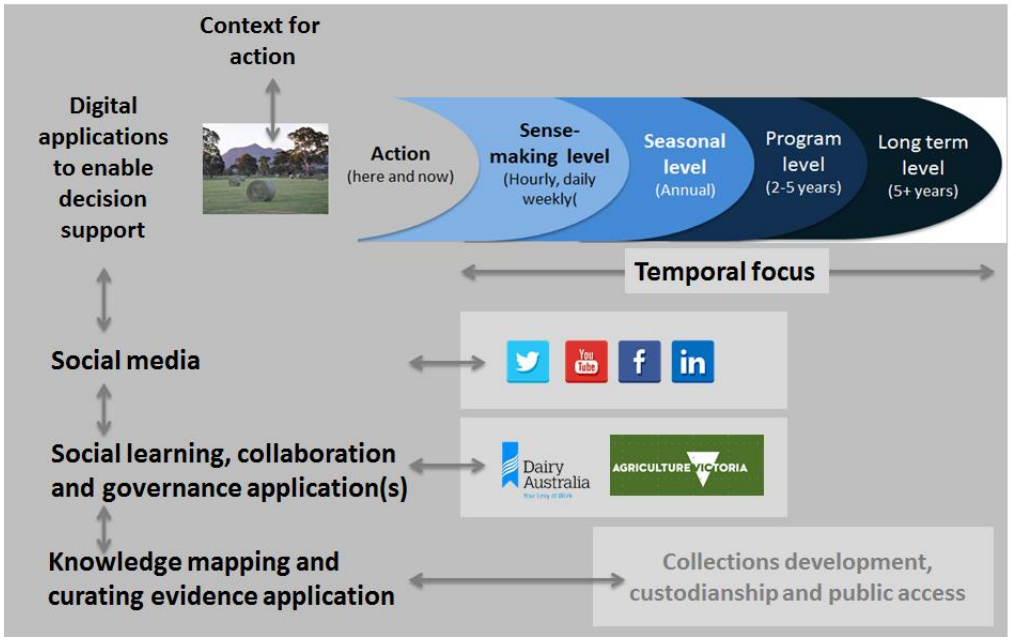

Figure 1 Digital application development to enable collaboration and evidence informed decision making

By a customised collaboration environment this means that representatives of CoPs and CoIs no longer need to be reliant exclusively upon face to face contact; or to be co-located in order to work effectively together. Famer centric nitrogen focused high value content can be drafted, reviewed and published in a shared environment, and can continue to evolve in response to emerging issues and new ideas. Scientific peer review by community of practice members (including international members) can ensure this Dairy Nitrogen content (or any published content) is authoritative and reliable. Moreover, well-structured and maintained systems ensure all centric content is discoverable, publicly accessible and preservable over time for the benefit of farmers, and their near network of stakeholders.

On top of this, these new applications can be used to create an on-line register and network of organisations, people, programs and projects and related data and information resources in ways that allows for appropriate levels of public (or private) discoverability and access. In this way, representatives of both CoIs and CoPs can work collaboratively on their projects with a greater diversity of subject matter experts or ask questions directly using an online 'discussions forum' module. This is all about realising the benefits for solving problems drawing upon the principles of co-design.

Results

The intent of contemporary online collaborations environments (such as the LifeRay platform discussed in this paper) is not to replace existing commitments to face to face extension practices associated with the use of nitrogen. Instead, working online across existing boundaries means those involved have an opportunity to transform the way they work by supporting collaboration across institutional and jurisdictional and international boundaries. This leads to opportunities to enhance innovation systems thinking, to share access

to expertise and to make available authoritative content and decision support tools where by evidence is being used to make better decisions more often. 'End users' also have enhanced access to reliable Dairy Nitrogen focused material and expertise in real time, and can utilise existing content or ask questions directly using an online 'discussions forum' module. Therefore, online collaborative RD&E helps to reach new audiences, better supports existing end users, improves access to information and expertise across the sector.

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