

Facilitating the collaboration of practitioner and scientific knowledge: experiences from an Australian action research intervention

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Abstract: *This paper presents results from an action research intervention aimed at strengthening the role of private sector advisers in the Australian agricultural extension system. Private sector advisers participating in the research identified a number of barriers to their effective inclusion in this system. For example, in the traditionally science-centric Australian extension system, persisting industry-led funding structures and processes are perceived as having a 'gatekeeping function' when it comes to the setting of practice-based research priorities and therefore the further development and uptake of potential innovations from practice. Issues also arise around linking private sector advisers with current research and development and translating it into relevant on-farm extension practice (Nettle et al, IFSA 2018).*

In Australia, the privatisation of the Extension and Advisory system has been varied across industries, resulting in a complex system with different models of engagement between researchers, advisory practitioners and industry-based decision-makers. This has implications for the Australian agricultural knowledge and innovation system. Against this background, the paper focusses on the question of how integration of practitioner and scientific-based knowledge can be implemented towards innovative solutions for complex problems.

The paper describes the implementation of a shared knowledge management intervention. Based on principles of action research and collaborative design, participants jointly developed knowledge management processes aimed at breaking sectoral silos (public, private; research and practice) by bringing together a variety of actors in the agricultural knowledge system in two specific case study settings.

The findings from these interactions emphasise the importance of transparent communication and other trust building exercises, particularly the need to be inclusive of all actors and perspectives when collaboratively defining the 'problem' or 'knowledge gap' that is to be addressed. Historical tensions and expectations around roles and responsibilities between researchers, advisory practitioners and industry-based decision-makers can easily jeopardise any collaborative knowledge management efforts and therefore need to be made explicit. In this context, the findings indicate, first, that there is a role for agricultural industry bodies to strategically broker, support and enhance such cross-sector dialogue, and, second, that definition of this role will depend on the industry bodies' willingness to commit to and adequately resource their uptake of such a role in the system.

The research results make a contribution to theories of (inter)organisational collaboration and social learning in agricultural knowledge and innovation systems and have resulted in strategic and policy recommendations to participating industry bodies.

Keywords: *Action research; practice-science knowledge integration; systemic intermediaries; network building*

Introduction

Unfolding over the last thirty years, the privatisation of agricultural extension and advisory services in Australia has been varied across industries, creating a particularly complex and pluralistic extension and advisory system with public and private actors, and different models of engagement between researchers, advisory practitioners and industry-based decision-makers (Hunt et al., 2014). The Australian Commonwealth and State governments, and primary producers through their industry bodies, co-invest in research and development (R&D) through currently fifteen nationally based Rural Research and Development Corporations (five of which are Commonwealth funded statutory bodies and ten are industry-owned). Whereas historically the extension function in the Australian Research, Development and Extension (RD&E) system was linked to State and industry-led R&D, there has been a significant reduction of direct government involvement in extension services and there is now an expectation that the private advisory sector will increasingly fill the extension role. However, the system remains science-centric, and largely adheres to a knowledge transfer model, affecting the ability of private sector advisers to be effectively involved in co-innovation activities to strengthen the Australian Agricultural Knowledge and Innovation System (AKIS) (Röling and Engel 1991). Issues particularly arise around private advisers' access to current and new research and development, capacity development for the private advisory sector (Murphy et al. 2014), and translating research into to outputs relevant to on-farm extension practices and adoption (Klerkx and Nettle, 2013; Klerkx and Proctor, 2013; Nettle et al., IFSA 2018). While the Australian RD&E system is a nationally specific configuration of an AKIS, it presents an interesting and internationally relevant case study of how privatisation and related changes in the generation and translation of agricultural knowledge affect Agricultural Knowledge and Innovation Systems more generally (Hermans, Klerkx, Roep, 2015; Klerkx and Proctor, 2013; Labarthe and Laurent, 2013; Prager et al., 2016).

In 2015, the Australian Commonwealth Government established the Rural Research and Development for Profit Program to fund a number of national projects aimed at establishing and improving collaborations between industry, research and private advisory sector as a basis for the 'ongoing innovation and growth of Australian agriculture' (Commonwealth Government, Rural RnD for Profit Program 2015, 93). This paper presents results from an action research intervention conducted as part of 'Stimulating private sector extension in Australian agriculture to increase returns from R&D', one of the national projects funded by the Commonwealth Rural R&D for Profit Program from 2015 to mid-2018. The intervention, termed the 'Knowledge Trial', was a collaboration between private sector extension professionals, two agricultural industry Research and Development Corporations (Meat and Livestock Australia (MLA) and Sugar Research Australia (SRA)) and two Australian state governments (the Victorian Department of Development, Jobs, Transport and Resources and the Department of Primary Industries in New South Wales). Its goal was to strengthen the role of private sector advisers in agricultural extension and the agricultural knowledge and innovation system by collaboratively developing a model of engagement that would allow for the integration of practitioner and scientific-based knowledge towards the development of agricultural innovation solutions.

Effective agricultural innovation systems have been defined as the 'successful combination of 'hardware' (i.e. new technical devices and practices), 'software' (i.e. new knowledge and modes of thinking) and 'orgware' (i.e. new social institutions and forms of organisation) [...]' (Klerkx, Hall and Leeuwis, 2009, 6). They require the collaboration of many actors from scientific, extension, and agricultural practice domains (Hall et al., 2001; 2006; Hermans, Klerkx, Roep, 2015; Röling, 1992; Röling and Engel, 1991). Agricultural innovation systems scholars further emphasise the importance of local and boundary spanning networks, and the integration of different kinds of technical knowledge and practical expertise for a well-functioning innovation system (Ingram et al., 2018; Klerkx, Hall and Leeuwis, 2009; Lubell et

al., 2014). This increasingly includes awareness of extension practitioners' and farmer knowledge as additional innovation resources (Girard, 2015). However, policies and institutional structures providing for collaborative translation of research into practically useful knowledge responsive to end-user needs, remain fledgling in many countries, including Australia (Ingram et al., 2018; Klerkx, Hall and Leeuwis, 2009). In particular, there is a remaining focus on scientific research and technological innovation in international policies. *Vis á vis* this focus, the need for an 'institutional shift from the 'pipeline approach' of [...] agricultural research delivering new technology' (Lubell et al., 2014, 1099), and towards more networked, collaborative arrangements is emphasised in the literature (Estensoro, 2015; Ingram et al., 2018). In this context, agricultural knowledge and innovation systems approaches have been advancing the concept of multi-stakeholder coalitions to drive desired institutional change through communication, collaborative problem definition and interactive learning cycles (Klerkx et al., 2013; Röling, 2002; Röling and Wagemakers, 1998; Turner et al., 2016; Wellbrock and Knierim, 2014). However, implementing such collaborations in practice is not without challenges (Botha et al., 2014; Ison et al., 2014; Schut et al., 2016). For instance, beyond revealing structural/institutional gaps, the Australian research presented in this paper also points towards a range of socially and historically embedded challenges that can easily jeopardise collaborative knowledge integration efforts. Yet, there is a persisting empirical and analytical gap around these less tangible elements of social practice, implicit understandings and meanings, and social relationships, which may help or hinder the processes of collaboration, co-development and learning in practice (Schut et al., 2016).

This paper addresses this gap by describing the implementation of a collaborative knowledge integration intervention in two Australian case studies based on the principles of action research. Participants in the intervention jointly developed processes aimed at improving information flow in the agricultural knowledge system, and making research more relevant to extension professionals and on-farm decision-making by integrating different types of knowledge. Private sector advisers participating in the research identified a number of barriers to their effective inclusion in the agricultural knowledge system, including, but not limited to, issues around knowledge access and their limited participation in research-to-practice translation processes as described in the literature (i.e. Ingram et al., 2018; Lubell et al., 2014; Nettle et al., IFSA 2018; Turner et al., 2016; Valdivia et al., 2014). Additionally, the findings from the action research point to the importance of social practice elements and relationships for the success or failure of collaborations directed at achieving knowledge integration. Aiming to answer the question of how integration of practitioner and scientific-based knowledge can be facilitated, we highlight the established and emergent social practices that were revealed by the action research process, and present recommendations for practice change with a model process for knowledge integration that was co-developed with research participants. By drawing on elements of a practice-orientated analytical framework adapted from Reckwitz (2002) and Shove, Pantzar and Watson (2012), the focus on the actors and constitutive elements of social practices in the case studies allows us to unpack and analyse in detail the enablers and impediments to effective collaboration leading to knowledge integration. A better understanding of these practice elements and their interaction expands the reach of the hardware-software-orgware approach to agricultural innovation by a social practice perspective.

We begin this paper by locating the present study within the conceptual background of Agricultural Knowledge and Innovation System thinking and briefly outline the practice-orientated analytical framework chosen for the analysis of the action research intervention. The methodology section introduces the two case studies for the 'Knowledge Trial' intervention, the Best Wool Best Lamb network in the state of Victoria, and Project Catalyst working in the sugar cane industry, and outlines the collaborative principles that guided the design of the intervention. The findings and discussion present two layers of key results pertaining to existing structural/institutional and social practice barriers to knowledge integration and how these can potentially be addressed. Using the example of Sugar

Research Australia (SRA), we conclude the paper with an outlook on how agricultural industry bodies can define their role to strategically broker, support and enhance cross-sector dialogue as begun by this action research intervention.

Background

The conceptual framing of the Australian extension (RD&E) system in this project was adapted from agricultural innovation systems (AIS) and agricultural knowledge and innovation systems (AKIS) scholarship (EU SCAR 2012; Röling and Engel, 1991; World Bank 2011). Röling and Engel (1991) define the AKIS as ‘a set of agricultural organizations and/or persons, and the links and interactions between them, engaged in the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilization of knowledge and information, with the purpose of working synergistically to support decision making, problem solving and innovation in agriculture’ (Röling and Engel, 1991 in: EU SCAR 2012, p. 23). In their later definition of the AIS, Leeuwis and van den Ban (2004, in: EU SCAR 2012, p. 25) add an explicit focus on the economic use of knowledge and ‘new products, new processes, and new forms of organization’ as well as ‘the institutions and policies that affect the way different agents interact, share, access, exchange and use knowledge’.

The academic literature points to a number of additional differences, but also commonalities between the two systemic perspectives (Labarthe et al., 2012). For example, both consider innovation as a collaborative process and therefore a phenomenon of social interaction involving multiple social actors and sources of knowledge. Although strict conceptual boundaries between the two approaches remain contested, we note that the commercially focussed project, *Stimulating private sector extension in Australian agriculture*, adopted an AIS approach. In the context of this paper, on the other hand, we consider the AKIS framework, with its attention to wider social networks, and formal and informal processes between actors, more relevant to the intervention discussed. Lubell et al (2014) emphasise the networked structure of agricultural knowledge systems and suggest that there is scope for strategic systems management by integrating social, technical, and experiential learning pathways (Leuci, 2012). They explicitly include social networks, belief systems, and practice adoption as elements defining agricultural knowledge systems (Lubell et al., 2014, p. 1092).

As Engel and Salomon (2003) observe, the interactional understanding of the AKIS is the result of a comparatively recent evolution in knowledge systems thinking. Whereas knowledge used to be seen as an object or commodity, the influence of soft systems methodology since the 1990s (Checkland and Scholes, 1990; Röling and Engel, 1991) has led to an action and process oriented conceptualisation of knowledge. ‘[K]nowledge’, as Ison (2008, p. 151) says, ‘is not something we have but arises in social relations such that all knowing is doing’. In both AKIS/AIS scholarship and practice, this shift has resulted in a focus on collaborative action research and social learning approaches (Blackmore, 2010; Cerf et al., 2000; Ison et al., 2014; Leeuwis and Pyburn, 2003; Moschitz et al., 2015; Reason and Bradbury, 2008) that understand learning as a process where knowledge is (collectively) developed in social (inter)action (Ayre and Nettle, 2015).

Hence our interest and analytical focus in this paper is on the ‘doing’ of collaborative knowledge integration and knowledge governance, loosely defined here as the collective practices and inter-organisational/cross-sectoral structures and actors involved in generating, managing, disseminating, and translating agricultural knowledge. That is, we focus on the agricultural knowledge system as (generated by) social practices. Social practices, as Blue et al. (2016) drawing on Schatzki (2002) emphasise, are embedded within social, cultural and political contexts. Never occurring in isolation, they dynamically interact with a range of other social practices and contexts. Theorists of practice emphasise the dual nature of social practices: they are both reinforced and re-enacted by people over time, but are also modified and changed in this continuous performance and in relation to changes in other, linked practices.

Reckwitz (2002, p. 149) defines 'practice' as consisting of several interconnected elements, including bodily and mental activities, objects and their use, types of existing knowledge, practical, technical or professional know-how, and emotions. Building on Reckwitz, Shove et al. (2012) summarise three key categories of practice elements: materials, infrastructures and competence. Social and institutional infrastructures, and competence, encompassing the types of existing knowledge, implicit and shared understandings organised around symbolic meanings, belief systems and epistemologies as well as conventions and procedures, are particularly relevant to our inquiry in this paper. Additionally we are interested in social relationships as both resulting from these practices and contexts (i.e. (inter)organisational relationships) and as a practice themselves (and therefore open to change). In this way, the social practice lens offers a particular angle on understanding organisations – and therefore the social barriers and enablers of inter-organisational and cross-sectoral collaborations – as both anchored in and emergent from social practices and discourses (Fairhurst and Putnam, 2006; Pitsis, Kornberger and Clegg, 2004).

Methodology

In accordance with the conceptual frameworks outlined, the Knowledge Trial was conceptualised as an action research intervention aiming to facilitate improved and active engagement of the private advisory sector with the agricultural knowledge system. The intervention aimed to address disconnections within the system, for example the direction of knowledge flows and the translation of research to practice and practice to research. These key issues informing the intervention had been identified in a review of the international literature, and in four regional discussion forums with the private sector extension providers and primary producers.

The intervention was devised according to the principles of collaborative inquiry and co-design (Heron and Reason 2008; Ison 2008; Reason and Bradbury 2008). It purposefully involved a range of stakeholders in collectively defining the 'problem' as well as finding possible 'solutions', and with the aim to facilitate social learning and social innovation by activating the transformational potential of participatory action research (Berthet et al., 2016; Brinton Lykes and Mallona, 2008; Estensoro, 2015;).

Intervention set up and case studies

The team: The core intervention team consisted of a social researcher from the project research team, a Project Officer, who was a professional from the private advisory sector, and representatives from industry research partners (two industry bodies and two state governments). This core team developed the general intervention objectives based on the findings from the regional forums and, in the effort to produce results relevant to cross-industry contexts, chose two case study settings in the meat and wool industry in Victoria and the sugar cane industry in Queensland.

Participant selection: The Project Officer was an adviser from a large consulting firm in Victoria working in the meat and wool sector. He was appointed in a brokering role that was pivotal to the collaborative effort because it utilised his knowledge of professional networks and advisory and farming practice in this sector. The role included selecting and engaging with potential participants based on his knowledge of people and their roles in the industry, contributing to the design of the topic area and learning activities of the intervention, facilitating face-to-face or web-based interactions and maintaining connections throughout the duration of the intervention.

The Project Officer, in consultation with the core intervention team, selected two industry programs based on their activities around the knowledge system and therefore the assumption that the intervention would be relevant and of interest to them. Additionally, both programs satisfied a set of selection criteria for establishing the intervention, being well-

established networks of farmers and advisers that showed potential to improve and expand their interactions with other actors. Importantly, in keeping with the collaborative approach, participants were asked who else should be engaged with as part of the intervention at the first workshop.

The Victorian Best Wool Best Lamb network (BWBL) is an established network of extension professionals and primary producers with a high level of external government and industry support. BWBL facilitates information exchange and learning activities via a network of extension providers who function as group coordinators within a large network of lamb (red meat) and wool producers. Regular meetings of local discussion groups are central to the program, making use of the diverse skills and similar interests of group members. Facilitated by the coordinators, members identify key issues for their businesses and learning approaches best suited to their needs, and have the opportunity to participate in yearly planning sessions on the topics to be addressed. Group coordinators organise learning activities, communicate new research and development information, and challenge producers to trial new technologies.

Project Catalyst (PC) in the sugar industry is a group of about 70 sugar cane growers, natural resource management groups, local government, the World Wildlife Fund and The Coca-Cola Foundation. Sugar Research Australia (SRA), the principal Research and Development Corporation for the sugar cane industry, engages with PC as an interested partner. The project aims to harness diverse interests and expertise in an effort to improve water quality by reducing fertiliser run-off from sugarcane farms affecting the iconic Great Barrier Reef on the North-Eastern coast of Australia. In contrast to BWBL's established structures, however, PC brings together an unconventional range of stakeholders with very different, sometimes conflicting interests and operates in an environment with little existing institutional infrastructures to facilitate the co-generation and dissemination of knowledge. Coordinated by PC, participating sugar cane growers from across Queensland's sugar cane growing regions run trials and case studies on their farms, for example, 'Using Bio-fertiliser to reduce reliance on fertiliser'. The aim for these grower-led trials is to verify existing research and to capitalise on the growers' applied knowledge, observation or innovations to add to existing knowledge. The processes of integration are multi-directional (adoption/trialling of new research on farm; on-farm knowledge informing research) and there is an expectation that knowledge generated in this way may be taken up into the industry's Best Management Practice. Dissemination activities include the annual PC forum, shed meetings on technical topics (soil health, nutrients), local networks and innovative growers communicating their findings to other growers, private advisers, the industry's productivity services and to researchers.

Method: The intervention was conceptualised as action research with an analytical focus on the elements of social practice emerging from this action. As such, all project interactions were treated as sources of data and therefore a mixed methods approach to data collection was appropriate. The lead researcher kept participant notes of team meetings and telephone conferences to document the emergence of the collaboration. The team-led design of workshops and learning activities provided opportunity to reflect on how the understanding of the complexity of the topic evolved with the action research. Two focus group meetings/workshops in each of the case study areas and one final symposium occurring over a few months, provided participants with the opportunity to collaborate, network and learn from each other in the pursuit of a shared goal (improving the knowledge system). Further data collection occurred on the basis of discussion notes as well as interview and questionnaires that were used to evaluate the experience of research interactions.

In the first workshop meetings, the intervention team presented the draft intervention concept and invited participants to refine the 'problem' to be addressed from their perspective, and suggest additional stakeholders they saw as important to its success. The

workshop discussions used the ORID facilitated conversation structure. The ORID method takes discussants through several stages of reporting on their ‘objective’ (O) knowledge of the situation at hand, ‘reflecting’ (R) on the problems and opportunities characterising the situation, through to ‘interpreting’ (I) what this means and making ‘decisions’ (D) about what needs to happen next. The data recorded from these meetings consisted of written notes participants had prepared in response to the questions asked as part of the ORID process, and combined notes from the discussions as prepared by the lead researcher and one other team member. The workshop notes were summarised using a thematic analysis approach to synthesise a shared idea of problems and opportunities from the meetings as well as a draft plan of action that had emerged from the discussions. Following this thematic analysis, the intervention team liaised with key intervention contacts to co-develop a model process for improved knowledge integration. The first iteration of the suggested model process represented the tasks involved in the knowledge system as they had been described by the participants: from identifying topics for research or field trials through to the validation of findings and their translation into development and extension packages or the conception of new research. Each task was paired with suggested ‘communities of practice’ that included researchers, advisers and farmers. Having been presented to intervention participants during a second set of workshops in December 2017, the draft underwent a series of iterations following participant feedback and discussion. Figure 1 shows the final model following this feedback process. In contrast to earlier versions, this final version positions advisers, producers, researchers, industry bodies and other actors in the knowledge system as a ‘community of practice’ (Wenger 2000) in a location central to the tasks of (elements of) the knowledge system as described by the participants and emphasises provisions for feedbacks between the knowledge tasks.

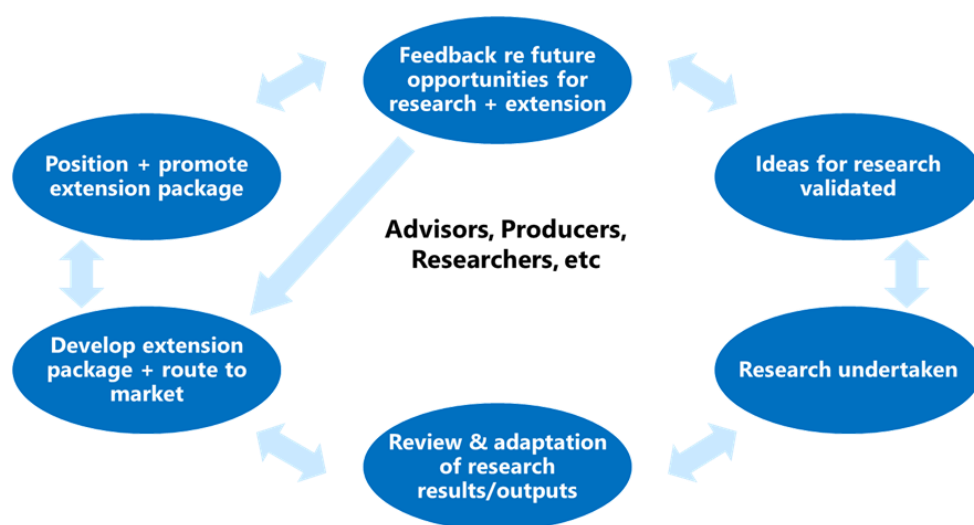


Figure 1: a model for knowledge integration

Participants at the Victorian workshop included: BWBL coordinators who had participated in the first workshop, private extension providers not affiliated with the network, representatives of the NSW and Victorian governments, and a representative from the Southern Australian Meat Research Council. The PC workshop in Queensland brought together the program coordinator, two sugar cane growers, three industry representatives, and representatives from the Queensland Department of Agriculture and Fisheries (DAF), and two regional productivity services. Anchoring the discussion in two technical topics, the participants were asked to pinpoint gaps they perceived in their knowledge relating to these topics, explore the nature of these gaps and to identify related issues and opportunities arising from this multi-perspective discussion. They were further invited to provide feedback on the suggested

model process, and to nominate strategies for practice change that would help to address the gaps identified and that they themselves and the industry bodies could implement. The data discussed here result from these workshop discussions, extended intervention team discussions, and the social researcher's participant observation notes of the meetings and more informal interactions with participants and partners.

Findings and Discussion

As observed in the description of the two case study settings, BWBL and PC both operate within different institutional structures. BWBL is itself already a network of extension professionals and producers supported by public and private research and development providers that engage with producer needs. PC, in contrast, operates in an environment that lacks formal structures for knowledge exchange or where existing organisational boundaries or commercial pressures inhibit the sharing of knowledge. The findings indicate 'structural holes' (Lubell et al 2014, p. 1094) in both case study knowledge networks, however, on closer inspection the influence of social practice factors in creating or maintaining these structural holes can be observed as well. The discussion of findings from the intervention is structured around key issues that arose from the interactions in both case study settings. It concludes by summarising the main commonalities and suggests strategies to address the impediments to effective collaboration and knowledge integration as identified by the participants.

Challenges around sources of knowledge and barriers to knowledge exchange

Issues around accessing new and current agricultural research and development knowledge were identified by participants in both case study settings (workshop notes Mackay and Attwood December 2017). Scientific journal subscriptions often come at a significant financial cost and extension providers not affiliated with a network or industry body providing them with access to these journals, are often unable to access scientific publications. Participants in PC additionally emphasised the issues that come with operating in a commercial environment where the sharing of knowledge, and particularly applied contextual knowledge, is seen as giving up individual (or organisational) competitive advantage (Mackay 2017). This commercialisation of knowledge further inhibits the communication of practice relevant knowledge or needs for new research between advisers and the industry body. As one SRA representative observed:

*There are too many players competing for reduced funding – if I sit down with [private sector] advisers, why would they share their info with me?
(SRA, Mackay December 2017)*

When asked for their preferred or most utilised sources of knowledge, advisers and producers in both case studies emphasised the peer-to-peer connection with trusted colleagues and fellow producers to access knowledge they recognised as practically useful, in addition to commercial providers and, to a lesser extent, industry publications. Organisational, or 'knowledge domain boundaries' emerged as one of the main inhibitors to knowledge exchange and became particularly obvious in regards to the integration of scientific and on-farm practitioner (extension and producer) knowledge. For example, while participants pointed out that the sugar cane industry best management practice (BMP) could be a potential vehicle for knowledge sharing, BMP depends on the endorsement by the industry body. Research undertaken by the Department of Agriculture and Fisheries (DAF) is not automatically considered for inclusion in BMP if it has not been duplicated or verified by industry body researchers. Similarly, innovative grower knowledge generated through on-farm trials may not become available to the wider industry if it cannot be verified by scientific research, but as the findings reveal, research funding is contingent on whether the research topic is perceived to be of value by the industry body. The participants in both case studies consequently perceived that existing industry funding structures had a 'gate-keeping'

function when it came to generating new knowledge, a structural element that was exacerbated by social practice elements, such as a tendency that ‘fad topics’ appeared to receive funding over other, ‘less interesting’ research topics (workshop notes Mackay December 2017). These and other funding realities, it was felt, stifled the innovation system by limiting creativity and inquisitiveness. Additionally, in the sugar industry, the average funding cycles are misaligned with sugar cane growing cycles. With three-year project funding cycles too short to see any impact or conclusive results, the ability to contribute practice-based knowledge is limited (workshop notes Mackay December 2017). The dominance of mainstream information networks driven by the industry and the lack of structures to share more ‘alternative’ knowledge was also commented on when PC participants discussed the case of a grower trialling inter-row cropping techniques to restore nitrogen and suppress weeds in his plantations. As he was advocating his practice independently of the established industry networks, i.e. the industry affiliated productivity boards, which are driven by the sugar mills, his knowledge was not readily available to other growers or the wider system.

Knowledge translation

There was a range of factors that seemed to be contributing to difficulties of knowledge translation and integration. Most participating sugar industry advisers perceived their links with researchers and universities as non-existent or weak at best. BWBL participants similarly perceived researchers as ‘disconnected’ from farm and extension practice and observed a lack of communication with researchers regarding on-farm relevance of knowledge. While the AIS and AKIS literatures acknowledge the importance of knowledge integration (Ingram et al 2018), the perception that science and practice belong to different ‘knowledge domains’ appeared to persist in the practice experience of the participants, who continued to encounter a linear knowledge transfer model. For example, PC participants observed that:

All you get at the end of a project is the final report– all you get is data – we don’t get taken along on the journey of a project, don’t get any stories about the project, its context and [what happens on] farms (PC workshop participant, Mackay December 2017)

Despite the availability of numerous learning opportunities, including sector specific conferences, meetings and workshops etc., BWBL and PC participants observed that knowledge continues to be delivered ‘top-down’, and described a lack of opportunity for contextualised ‘sense-making’ in discussion with peers beyond the more informal avenues and networks. In particular, they identified a need for deliberative discussion of data and research conclusions between researchers and advisers and producers to ensure the practice relevance and validity of results and build confidence in the research. However, a number of knowledge carriers from the private extension sector and primary producers, are effectively excluded from such or similar forums in practice. For example, the Southern Australian Research Council have been unable to sufficiently engage private sector advisers as part of their regional committees, which aim to consult with end-users on the setting of research and development needs, as funds to pay private sector consultants to attend and make up for the loss of income are limited. Similarly, farmers can only be offered a small sitting fee, limiting the knowledge input from practice.

Building on the idea of a forum to facilitate this kind of interaction, PC participants saw additional opportunities arising at the back of on-farm research implementation, suggesting that on-farm trials and producer feedback could further the generation of more questions and ideas for additional or future research and extension. Involving end-users (extension providers and producers) in the processes of setting research priorities and interpreting research in their respective contexts has been described as ‘essential to achieving translation and boosting innovation’ (Ingram et al 2018; Valdivia et al. 2014). However, we

would like to note a number of additional practice impediments to successful collaborations aimed at integration of knowledge as they were revealed by the discussions.

Communication and trust

Participants in both case studies agreed that lack of communication created significant barriers between the actors in the knowledge system. Perceived agendas and suspected vested interests were described as ‘probably the worst’ impediment to effective knowledge sharing and collaboration (workshop notes Mackay December 2017). Historical tensions between organisations tended to have an influence on how individuals representing these organisations interacted: for example, two of our partners agreed that without the intervention creating the impetus for their collaboration, they would not have actively sought any collaborative interaction. However, the same partners worked together productively as part of the intervention, and the workshop meetings in both case studies likewise initiated or strengthened collaborative links between people and therefore, their organisations.

Importantly, the need to understand and then mediate political dynamics between the players was recognised as key to bringing together a range of stakeholders and initiating productive collaboration. For instance, in the sugar case, ‘soil health’ instead of ‘water quality’ was judged to be a ‘non-provocative topic’ more conducive to discussion and that would not be perceived as ‘too politically fraught’ or ‘hostile’. ‘Water quality’, our partners in PC suggested, ran the risk of alienating particular actors as it could be interpreted as raising issues around the negative environmental impacts of sugar cane farming, and therefore as reinforcing a public narrative of cane growers not caring for their environment. In order to avoid defensive reactions, therefore, the team chose ‘soil health’ as a technical topic that provided a common denominator and shared benefit for a range of interests, including cane growers and conservationists.

The discussions in the sugar case study revealed that cane growers and conservationists were perceived as two opposite poles in the knowledge system relating to sugar country. There was clear resistance against sourcing knowledge from either the conservation foundation or other NRM bodies. On the other hand, a grower who had been affiliated with PC for a number of years observed that in his experience, growers and conservationists could learn from each other and gain mutual understanding of their driving motivations. Project Catalyst, it can be argued, by providing the opportunity for networking and interaction between traditionally opposed players, had created a platform on which participants could learn about and negotiate different ‘agendas’. ‘In the case of conflict’, as Lubell et al. note (2014, 1094), ‘network theory suggests the importance of building “bridging” social capital among members of different groups [...] in order to facilitate better understanding of diverse viewpoints and empathy.’

While it is fair to say that perceived agendas were amongst the factors influencing interactions in both case studies, this factor was strongest in the sugar case and a lot less pronounced in the existing Victorian network, due perhaps to the fact that people interacting in BWBL shared in stronger ‘bridging capital’ and interests were more aligned. In sugar, by contrast, ‘agri politics’, and the range of different bodies in the sugar industry, as one cane grower observed, led to an ‘us and them’ mentality:

‘There’s certain things you work on together and others you won’t – often it’s just a perception thing [but there is a] suspicion of agendas that puts up barriers to getting the information’ (workshop notes Mackay December 2017).

In this context, the importance of openness and transparency in communication, and balancing the representation of organisations in industry discussions was emphasised as a trust building exercise (workshop notes Mackay December 2017). Trust was particularly

pertinent for both BWBL and PC participants when it came to sources of knowledge and a lack of confidence in the validity of certain knowledge due to hidden agendas and commercial interests.

As Pitsis, Kornberger and Clegg (2004, p58) emphasise, building trust is building ‘the non-rational conditions for rational negotiation’ and is therefore integral to any form of collaboration between individuals as much as between organisations and groups as it can determine the decision to begin and continue with a collaborative partnership. Trust, however, can only be established through experience. We argue here that the intervention, having initiated new networks in both case study areas provided the opportunity for this experience of trust building by bringing together a range of players that would not have normally chosen to interact or collaborate. It must be noted, however, that the success of the intervention very much depended on the presence of individual systemic intermediaries, the project officer and key industry group partners, whose social networks span different kind of boundaries and who played key roles in brokering the relationships established as part of the intervention. It was these individuals and the trust they enjoyed in their networks that helped to bring together the intervention teams in the first instance.

Facilitating the collaboration of practitioner and scientific knowledge

In addition to the model process for knowledge integration (see Figure 1) co-designed by the intervention team and partners, the participants agreed on a number of tangible strategies for an improved knowledge system. This included, first, the insight that effective collaboration for the agricultural innovation system needs to enable and sustain a diversity of perspectives. This in turn requires investment in the private and commercial sector to enable their stronger engagement in research design, development and extension, as well as the strengthening of advisory roles and networks, and improving transparency of communication in order to encourage and sustain process of trust-building. Other strategies included supporting issues of access and opportunity within the RD&E system amongst key groups to influence processes by improving access to databases, publications and RD&E processes. Participants acknowledged, however, that implementing some of these strategies, and achieving and building on the intended outcomes are a mid-to-long term goal, as they require a re-ordering of social structures and expectations as well as sustained efforts and collective commitment to change towards a strengthened agricultural innovation system in Australia.

Conclusion

The findings underline a need for contextualised ‘sense-making’, involving actors from research, industry, extension, and on-farm practice. In contrast to traditional knowledge transfer settings, such a deliberative space allows for integration scientific and practice knowledge, beginning with the ways in which research is conceptualised and validated in practice. In addition to providing a potential platform for knowledge exchange and integration, the configuration of participants in the intervention generated new networks and new modes of relating among the actors that revealed the role played by both structural and practice factors for the success or failure of knowledge collaborations. While the importance of collaboration and the conceptualisation of knowledge as dynamic and cumulative learning processes involving a range of knowledge carriers is widely acknowledged in current theory and policy, the action research exposed a gap between this theory and social practice. For example, at first glance BWBL seems to be well connected structurally, with good existing network structures aimed at knowledge exchange between different players. However, the participants’ experience showed that a number of barriers continue to exist in practice, including persisting linear knowledge transfer processes and time and financial pressures that effectively prevent private sector engagement in the knowledge system.

Based on our analysis, we argue here that structural and social practice gaps may co-produce each other. From this perspective, we suggest that addressing structural gaps may

also be able to address social practice factors that inhibit knowledge integration and vice versa, creating the opportunity for open communication between a variety of stakeholders may serve to reveal structural issues that were hitherto undetected or not communicated. Building trust, practicing open communication, identifying shared interests can only happen if given the opportunity and will in the long-term benefit collaborative and knowledge integration efforts by fostering improved opportunities for networking, communication and collaboration.

In other words, we hypothesise that the systemic (practitioner, science, decision makers) co-development of integrated innovations requires social innovation: the transformation of cross-sectoral social (and institutional) relations based on dialogue and the creation and maintenance of spaces for collaboration and social learning (Estensoro 2015; Lubell et al 2014). However, the question of who could drive this engagement remains. The findings indicate, first, that strong inside knowledge and networking capacity is needed to instigate the kind of collaboration described. Further, it requires boundary-spanning partnerships and actors that enjoy trust amongst a range of players, understand the important issues facing these players and are able to influence many other actors in the system (Lubell et al. 2014). The intervention confirmed the benefit of using participatory methods that capitalise on and integrate technical and experiential knowledge to make research more relevant to practical decisions. However, while there is a role for agricultural industry bodies to strategically broker, support and enhance such cross-sector dialogue, (Klerkx, Hall, & Leeuwis, 2009), the definition of this role will depend on the industry bodies' willingness to commit to and adequately resource their uptake of such a role in the system. Additionally, the transition to a more co-ordinated and collaborative advisory and extension system is complex and organisational and sectoral drivers and needs are likely to be dynamic with time. In particular, breaking traditional expectations around knowledge flow from science to practice will require continuous reflection on the theory and practice of learning and knowledge generation in the AKIS. In the case of the sugar industry, SRA has begun to consider its potential role for stimulating innovation system interaction by brokering relationships and networks, by integrating the interactive model developed by intervention participants in their engagement strategy, which was launched in early 2018.

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