

Stimulating innovation opportunities through shared and unique connections of intermediaries within advisory networks

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Abstract

Agricultural advisers are key intermediaries embedded within complex knowledge networks comprised of farmers and a range of private, industry and government stakeholders. Privatization of extension increases opportunities for market based extension services while changing the role of government and creating new challenges for knowledge sharing within networks. While privatization of extension has received considerable attention with respect to implications for public and private good, less consideration has been given to structural and relational implications for knowledge sharing. This study therefore considers the question 'how is knowledge sharing enabled in privatized extension networks?' To examine this question an empirically based case study was undertaken involving five industry extension advisers, referred to as Regional Extension Coordinators (RECs). This team was set up two years ago by Australia's dairy industry peak body, Dairy Australia to fill a gap in extension coordination and services left by the withdrawal of government extension services. Social network analysis in combination with qualitative data was used to identify the knowledge sharing relationships of RECs within their team as well as each REC's individual extension network. Findings show that the composition of each Regional Extension Coordinator's (REC's) network reflects differences in their professional backgrounds, for example whether their previous roles were in government or agribusiness. Knowledge sharing opportunities for the REC team include creating opportunities to access each other's unique contacts, identifying team strategies for working efficiently with contacts they have in common, and developing approaches for working more effectively with network contacts considered 'not very enabling'.

Keywords: Adviser networks, relationships, knowledge sharing, Australian dairy extension

Introduction

Agriculture extension provides critical support for farm productivity and knowledge sharing (Faure et al., 2012; Pragar et al, 2016). The public sector has traditionally being responsible for extension delivery due to assumed 'public good' value and benefit (Umali-Deininger 1997). While extension has and continues to play a vital role in supporting adoption of innovation and technology its economic and social value are difficult to measure in practice (ibid). Globally, neoliberal policy and a 'user pays' ideology have driven structural transformation of extension services in favour of pluralized, privatized, competitive market based options that reduce government investment (Klerkx et al., 2006; Hunt et al., 2012; Cristóvão et al., 2012; Knuth and Knierim, 2013, Pragar et a., 2016).

The process and pace of transition from public to privatized extension has varied globally and by sector. The Australian dairy sector supported a combination of public and private extension for longer than many other farming sectors however since 2014 Dairy Australia (DA) has taken greater responsibility for industry extension using a farmer levy funded delivery model referred to as the 'regional interface'. This is now the structure through which resources are invested in the leadership, planning, coordination and engagement activities to drive adoption of innovation on regional dairy farms (Dairy Australia P208 – Adoption and Innovation Strategy Information paper, July 2013). The 'regional interface' includes both public and private sector providers delivering extension services

to ensure farmers have access to the information, tools, methods and capability needed to run successful dairy farm businesses and ensure the industry continues to be vibrant and successful (ibid). While economic concepts of public good, private good and market failure continue to be debated with respect to extension, there is limited attention given to implications of structural and relational reorganization of extension services driven by business principles and specific terms of exchange. Attention to structural and relational opportunities and constraints in increasingly pluralized extension networks is important for addressing rising challenges of collaboration and coordination between extension actors representing multiple institutional contexts (Klerkx and Nettle, 2013). The coordination of privatized extension providers to serve the needs of a diverse range of farmers creates new facilitation and brokering challenges for advisers (Koutsouris, 2012) and the need to understand how individuals and organizations within their extension networks are connected. This study is an empirical examination of structural and relational opportunities and constraints within a recently established, industry funded extension team whose role is to foster coordination of dairy extension delivery across the State of New South Wales, Australia. Using a mixed methods approach combining social network analysis and qualitative data, the case study of five members of the of the Dairy Australia Regional Extension Coordinator team (New South Wales) and carried out in 2016 based on the research question “how is knowledge sharing enabled in privatized extension networks?”

1.2 Context: Location and People

Location

The study is focused on a team of five Regional Extension Coordinators working within dairy production regions of New South Wales (NSW) comprised of three coastal and two inland regions (see Fig 1). These dairy regions are geographically dispersed and situated in areas with fertile soils, flat to undulating land contour and good access to water.

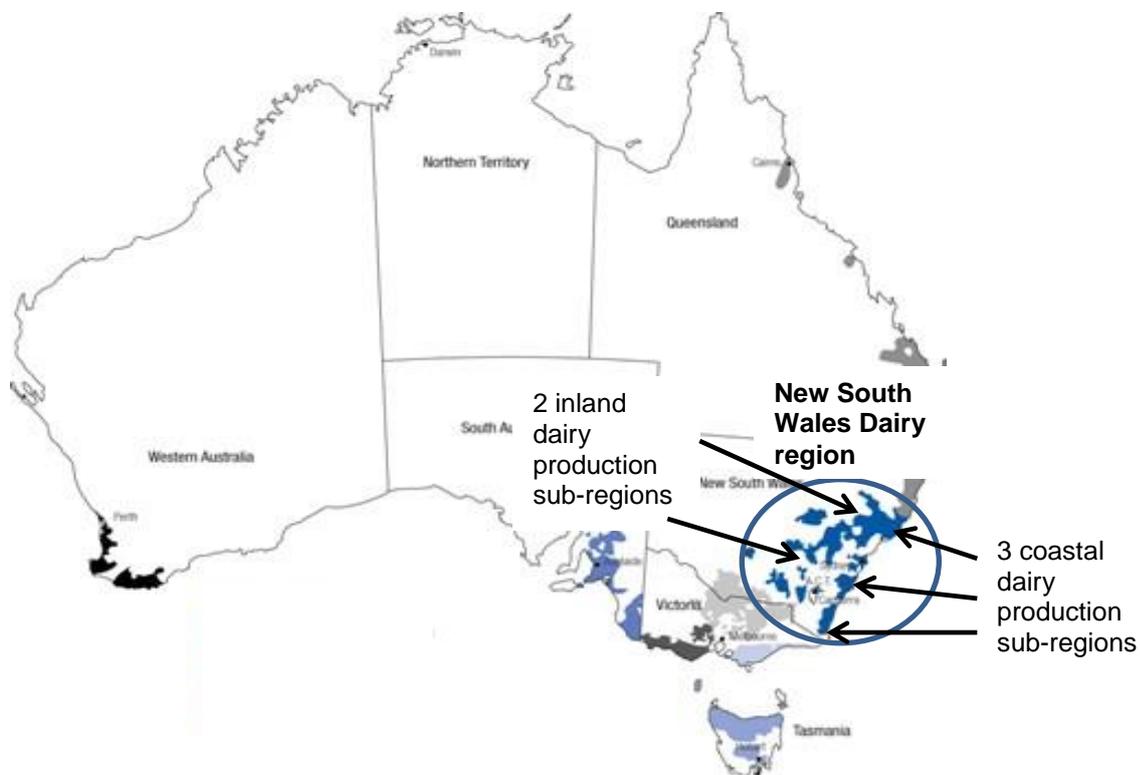


Figure 1: Location of the Australian New South Wales Dairy Region (Source <http://www.legendairy.com.au/dairy-farming/our-industry/our-regions>)

The NSW dairy industry is currently based on approximately 500 farms with an average herd size of 280 cows. Annual milk production is over one billion litres of which 70% is consumed domestically. NSW produces 8% of Australia's milk volume with a gross production value of almost \$500(A) million (Kempton, 2015).

Stakeholders in the New South Wales dairy extension network

Stakeholders involved in New South Wales dairy extension network include extension providers, farmers, industry, agribusiness, government agencies, research and education institutions. Within this mix of stakeholders the role of extension providers has traditionally been to facilitate farmers' access to knowledge, information and technologies that support more productive, efficient and sustainable farming practices (Faure et al., 2012; Koutsouris, 2012). In this intermediary role extension providers need to interact widely with clients and other professionals to maintain their own knowledge competency. They must also have well developed relationship skills that enable others to capture learning opportunities.

Dairy Australia (DA) is a national industry-owned Rural Research and Development Corporation (RDC) accountable to its farmer members and to the Australian government. DA invests a combination of farmers' levy and government funds across the dairy supply chain to ensure that the industry is profitable, sustainable and competitive. It operates regionally through eight Regional Development Programs (RDPs) across Australia, including Dairy NSW. Each RDP's is responsible for providing and coordinating regional extension, education and professional development services for dairy farmers and sub-regional Regional Development Groups RDGs. RDP's also provide funding for group projects which may involve discussion groups and local research trials. Each RDP has a Regional Manager and a team of extension field staff who collaborate with farmers, government agencies, milk processors and a broad range of rural professionals (agribusiness, consultants, and veterinarians).

Public sector interest in New South Wales extension policy and its delivery includes the Department of Primary Industries (DPI) (the government agency responsible for increasing the productivity and resilience of the agricultural sector through agricultural productivity research across livestock, plants and natural resource management areas) and Local Land Services (LLS) that operates in eleven sub regions of New South Wales (to provide farmers, land managers and communities with technical and advisory knowledge on a range of rural topics and issues). Public sector institutions with education and research interest in extension include vocational training institutes (Technical and Further Education (TAFE)), universities and the Commonwealth Scientific and Industrial Research Organization. (CSIRO).

Private sector interests in extension include agribusiness (suppliers of milking equipment, animal breeders, seed, fertilizer, general farm supplies, livestock agents, technicians), consultants (providers of general farm management advice as well as specialist in agronomy, nutrition, irrigation), financiers (banks and accountants), veterinarians, milk companies and milk supply field officers. Declining government investment in research, development, education and extension provided are currently shifting responsibility for these functions to the private sector (Kempton, 2015).

2. Conceptual framework

2.1 Extension background in Australian

Up until the 1990's public sector provision of agriculture extension developed alongside research capacity and together made a critical contribution to Australian agriculture. Extension services were considered to be 'of major importance to (farms achieving) higher production and lower costs' (Williams, 1968: quoted in Hunt, 2012: 14). Prior to the 1990's extension was regarded as a credible and valued profession supported by academic training and research (ibid). Provision of more

pluralized forms of extension was also encouraged such as public/private partnerships and fully privatized consultancy (ibid). After 1990 rapid structural changes implemented by government devolved research responsibility to industry based Rural Development Corporations. This coincided with the 'retreat' of government from provision of public sector extension, capacity and skills development of extension professionals resulting in 'weakened extension capability' and 'disconnection in the RD&E feedback loop' (ibid:16).

Structural changes in favor of privatized extension services have major implications for extension professionals and access to knowledge support by the agriculture sector. Traditionally, free publically offered extension was provided outside the constraints of user-pays market driven principles and largely involved one to one relationships between advisers and farmers. Privatization now means that advisory relationships are based on business and market principles of exchange. Employees in hierarchical government structures are increasingly at 'arm-length' from farmers and undertake development and research rather than extension roles. To make sense of such changes for the knowledge creation and sharing functions of extension, Adler et al.'s (2008) framework (see Table 1 below) distinguishes between implications of community, hierarchy and markets principles according to social mechanisms, control imposed, goal alignment, exchange of resources, terms of exchange, and extent to which terms of exchange or explicit, or not. The framework highlights that hierarchical principles, which traditionally applied to public provision of extension, are underpinned by control embedded in authority and are effective for sharing codified knowledge but weak for sharing new or tacit knowledge (typical of adoption challenges involving complex agricultural innovation). Market principles are underpinned by user-pays, price competition and opportunities to appropriate value. Incentives to create new knowledge are dependent on its commercial value as well as demand generated by consumers willing and able to pay for it. Community principles are underpinned by mutual trust that fosters knowledge sharing and facilitates learning in situations involving risk and uncertainty (and therefore of increasing importance within agriculture decision making).

Table 1: Framework of community, hierarchy and market principles (Adler et al., 2008)

	Community	Hierarchy	Market
Social mechanism is:	Trust	Authority	Price competition
Control exercised over:	Inputs	Process/behaviour	Outputs
Fits tasks that are:	Interdependent	Dependent	Independent
Best supports goals of:	Innovation	Control	Flexibility
What is exchanged?	Know-how	Obedience to authority	Money or barter
Terms of exchange specific or diffuse:	Diffuse ¹	Diffuse/specific	Specific ²
Terms of exchange made explicit:	Tacit	Explicit	Explicit

Source: Adler et al. (2008)

For extension providers the increasing influence of market and hierarchical principles impacts on the structures and institutions they are now working in in ways that not only impact on their relationships with farmers but also on the maintenance of informal collegial interactions. Coordination across new business structures introduces new challenges relating to consistency and quality of knowledge

¹ Generalized reciprocity refers to unspecified exchange but an expectation of future exchange or return of favours.

² Specific reciprocity refers to exchange of agreed resources.

products and services and increases opportunities for conflict of interest as advisers compete for a limited pool of clients.

While structural change due to privatization of extension is a 'given' under prevailing economic and political contexts it brings structural and relational consequences that are difficult to measure using standard empirical tools. Understanding how advisers are experiencing privatization within their professional networks is an opportunity for both policy makers and industry strategists to consider some of the critical consequences.

2.2 Social capital

For the purposes of this paper Lin's (1999, 2001) structural perspective on social capital is used to understand how location, position and the effects of both weak (open) and strong (close/closed) relational ties affect social network relationships. Lin suggests that 'social capital refers to resources embedded in a social structure that are accessed and/or mobilized in purposive actions' (2001:29). This definition highlights three critical elements – firstly resources may potentially be shared that have either material or symbolic value (including for example physical farm inputs, information, knowledge, and money³). Secondly these resources are embedded within and must be accessed through social structures⁴ (for example farm management expertise is available from advisers who may be self-employed or employed within organisations, have been highly trained in universities and have acquired practice based experience through social interactions with farmers and other professionals). Thirdly, social capital is mobilized for a purpose (for example farmers seek advice to ensure their farm businesses are profitable). Mobilization of social capital may be instrumentally motivated (to gain social capital) or expressively motivated (to maintain social capital) (Lin, 2001). Structural constraints and agency of actors determine whether opportunities for mobilizing social capital can be realized (ibid). This view of social capital focuses on how resources are valued, accessed and mobilised in social networks including what resources are deemed relevant and where they can be found. For example strongly connected network members who trust each other and interact frequently are well positioned to give and receive resources. Conversely weakly connected network members with limited access to resources are at risk of missing opportunities to develop the potential of their livelihoods and wellbeing. The gradation of strong to weak ties aligns with concepts of bonding, bridging and linking (High et al., 2005; Fisher, 2013) used to differentiate opportunities for sharing resources horizontally and vertically in a given social context. Bridging social capital is associated with brokers, or intermediaries such as extension providers, whose role is to connect otherwise unconnected individuals or groups in order to access valuable resources such as information and knowledge (Howells, 2006).

2.2 Access and mobilization of information and knowledge sharing through collaboration

Adler and Heckscher (2005) argue that the prevailing ascendancy of market principles in economics and policy gives rise to individualism that is contrary to the maintenance of communal norms of interdependence and trust that underpin collaboration. Within an extension network, farmers, advisers, service professionals, among others, regularly exchange technical, economic, environmental and social information and knowledge that directly impacts on the efficiency, profitability and sustainability of farming. While provided by the public sector the sharing of knowledge by extension advisers was typically an open process. Advisers working across different farms freely shared their knowledge of what new practices worked or not. This provided opportunities to influence rates of adoption as well as learn from others' mistakes. Privatization of extension knowledge reduces opportunities for open sharing of both knowledge and experience as this becomes a private asset and a source of competitive advantage (Hunt, 2012).

³ Lin (1982, 1999) refers to resources as including wealth, power and status.

⁴ Social structure is determined by positions, authority, rules and agents (ibid).

3. Methodology

Social network analysis (SNA) is a method for describing the structure of relationships within groups, communities and organisations (Cross and Parker, 2004; King and Nettle, 2013). Formal and informal relationships are represented visually in social network models (sociograms) using lines (edges) to show a relationship between nodes (vertices or graph points) according to a specific relationship of interest (between individuals and/or organisations). A relational connection provides the potential for resources, both tangible and intangible, to be shared (Wasserman and Faust, 1994; de Nooy et al., 2005). Social networks are formed for many reasons (Wasserman and Faust, 1994; Scott 2013) and are based on an explicit relational question relevant for a specific purpose. Findings cannot be generalized beyond the implications relative to this question. SNA data is presented in sociograms (network maps) in which each connection (node) is situated as a graph coordinate in two dimensional space.

For this study the boundary of the empirical case was formed by relationships of five members of the Dairy NSW REC team and who they regard as their 'top 30' contacts.

The relational questions used to identify network ties were

'In your extension capacity, who are the most important 30 people you talk to in the dairy industry (not including people who work in your same organization)? Followed by

'What organization do they belong to?

The contacts named by each REC were combined to create a network model for this extension team. To assure confidentiality each contact's name and relationship was ascribed a numerical value. The data was processed with SNA software, Pajek. Data was also collected about frequency of interaction with each contact and perceptions of whether each contact is 'enabling' or 'not very enabling' of collaboration. The social network of all five REC's resulted in a network of 98 nodes and formed a core-periphery structure (see Fig 1 below). The network model includes 17 core nodes representing contacts shared by at least three REC's. Before finalizing the network models, feedback was sought from each REC as to whether the draft SNA models 'made sense' to ensure that the data was of sufficient quality for the next stage of analysis.

4. Findings

4.1 The Dairy NSW Regional Extension Coordinators' network

A social network model based on extension relationships of five members of the Dairy NSW REC team is shown in Figure 1 below. It forms a core/periphery structure based on 98 nodes. The five respondents are marked with letters (nodes within the small circles) and their contact nodes (alters) are indicated with numbers. Nodes shared by at least three REC's are located in the network core while nodes that are unique for each REC are located in the network periphery. Nodes shared by only two REC's are located between the core and the periphery. Eleven role groups were identified in the network and are indicated by colour (see Key for Fig 1 roles below).

The network 'core'

The core⁵ contains 17 nodes who represent critical extension knowledge capability and influence within this network. The core includes seven farmers, four milk company field officers, three government employees, two consultants and one educator. Of these the most highly connected are nodes 41, 26, 60, 10, 19 and 34 who include three government employees, one farmer, one consultant and one milk company field officer. The connectivity patterns of these network members

⁵ Nodes : 41,26,60,10,19,34 (Core star nodes); S,G,J,M,R (REC's); 83,55,62,30,86,84,20,80,69,16,50 (Core nodes potential stars and/or brokers)

suggest they are network ‘stars’ (Cross and Parker, 2004). Network ‘stars’, or central connectors, are people highly sought out by other network members for their expertise, experience and skills. Their presence provides credibility and status for the wider network and they are critical for enabling information and knowledge to flow efficiently and effectively to other network members (ibid). Most network ‘stars’, although not all, are well known and highly visible to other network members.

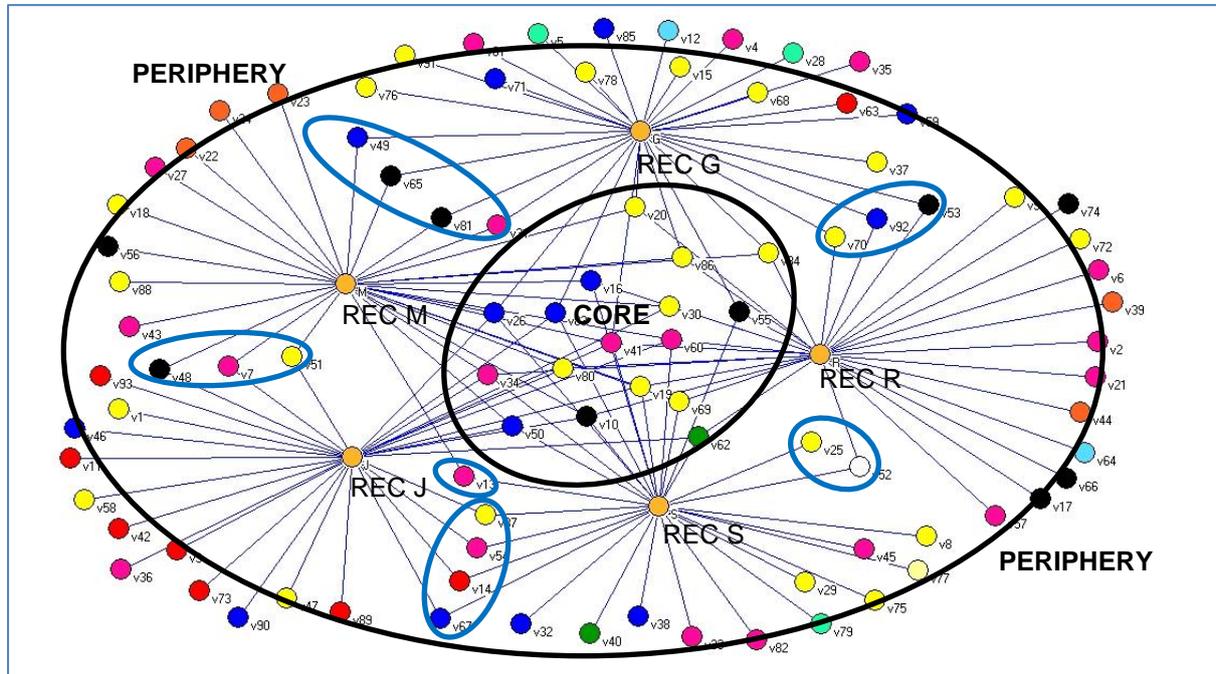


Figure 1: Core/periphery network model of ‘top 30 extension’ contacts for the NSW REC team (December 2015). Core nodes within the central back circle are shared by at least three REC’s. Blue circles between the core and the periphery indicate nodes shared by only 2 REC’s. Unique connections for each REC are shown on the black outer periphery circle.

Key for role groups in Figure 1 (numbers refer to how many of each role group are present in the network)

DA REC (5)		Researchers (5)	
Farmers (26)		Veterinarians (3)	
Government DPI, LLS (21)		Educators, TAFE (2)	
Milk Company representatives (14)		Technicians (2)	
Consultants (10)		Industry Advocacy (1)	
Agribusiness (8)		Other (1)	

The other eleven core members include six farmers, three milk company filed officers, one consultant and one educator. While not as highly connected as the ‘stars’ they are centrally positioned and provide network connectivity and intermediation opportunities for the network. Their location in the network enables them to coordinate and control the flow of information and knowledge with individuals or groups that may otherwise not have access to the network’s resources.

4.2 Shared contacts between the core and the periphery

Between the network core and periphery connections shared by only two REC’s are shown in blue circles (see Fig 1 above). Not all REC’s share nodes with other REC’s but this appears more likely

between those whose work regions are in closest physical proximity (e.g. REC R and G; REC J and S). REC M, who has the greatest number of ties (8) shared with other REC's, is a State-wide specialist available to advise on land, water and carbon and is therefore working across all dairy regions. The highest number of shared nodes between REC's outside the core is four. Shared contacts are mainly consultants, farmers, government employees and milk company representatives who are sources of information and advice for the REC's.

Unique network contacts.

The dairy industry of NSW is geographically wide spread which means that REC's are working long distances from each other. Unique connections for each REC are shown on the peripheral circle in Fig 1. RECs' unique ties represent 40% of all network contacts and based on contacts within their work regions. Their unique contacts are highest with farmers (30%), then local government employees (24%), milk company representatives (15%) and consultants (11%). REC's connections with these four role groups comprise 80% of all network connections. The role distribution of unique connections for each REC is shown in Table 2 below. The similar contact patterns of REC J, G and S is because they each hold dairy extension coordinator roles but in different locations. REC R is the overall team leader with responsibility for strategic issues and team oversight rather than on farm extension delivery. Both REC R and M both work across all regions and their leadership roles require connections to researchers which are reflected in their 'top 30' contacts. The significant proportion of REC J's unique contacts with agribusiness reflects his previous employment in this sector. Sharing unique network contacts between team members provides opportunities to develop expertise and knowledge.

Table 2: Roles of unique contacts

Network Role	REC R	REC M	REC J	REC G	REC S 8	Total and %
Consultant	6	5	1	3	2	17 (11%)
Milk Officer	2	5	6	7	7	22 (15%)
Farmer	10	9	8	10	7	44 (30%)
Educator			1		2	3 (2%)
Government	8	8	6	5	9	36 (24%)
Industry	1					6 (4%)
Researcher	2	3				5 (3%)
Agribusiness			8	1		9 (6%)
Bankers/Accountants						
Vets				2	1	3 (2%)
Agronomist					1	1
Nutritionist				1		1
Knowledge developer						
Technician	1			1		2
Other					1	1
TOTAL Contacts	30	30	30	30	30	150

4.1 Network access and mobilization of resources

The success of extension work is dependent on access to information and knowledge resources. Perceptions and experience of others' willingness to collaborate is an indication of their confidence

that interactions within those relationships will facilitate access to knowledge and information that allows them to achieve extension goals and tasks.

Perceptions of collaboration

REC's were asked to indicate whether they perceived each of their top '30' contacts to be 'enabling' or 'not very enabling' of collaboration based on their perceptions of approachability, willingness to share information and confidence in their working relationship. The results for the combined 98 contacts named in the NSW REC network model are shown in Table 3 below. The majority of extension contacts (86%) were perceived to be 'enabling' with respect to sharing information and knowledge. Eighteen individuals in the network were identified as 'not very enabling' including nine government employees, four consultants, three milk company field officers, one agribusiness representative and one farmer. Notably, three of the 'star' nodes (one each from government, a milk company and a consultant) were perceived as 'not very enabling'. Three other core nodes were also perceived as being 'not very enabling' (one farmer, one milk company field officer one consultant). A perception of 'not very enabling' may indicate that workload and time constraints limit ability to be responsive or that conflict of interest or commitment exists. Importantly, a total of 6 of the 17 core nodes were perceived as 'not very enabling' (35%) which is a concern for this network as the significance of connectivity with REC's suggests that they are influential and have gatekeeping roles with respect to enabling access to critical knowledge resources.

Table 3: REC's perceptions of collaboration with their network contacts

Perception of collaboration	REC R	REC M	REC J	REC G	REC S	Total number of ties
Enabling	27	23	29	23	28	130 (86%)
Not very enabling	3	7	1	7	2	20 (14%)
Ties per REC	30	30	30	30	30	150

Differences in perceptions vary between each REC (REC J only perceives one 'top 30' contact not to be enabling whereas REC M and G each perceive 7 of their 'top 30 contacts' to be not very enabling and in combination account for 14 of the 20 'not very enabling' perceptions). Differences in perception may be due to a range of professional and personal factors including personality, relationship history and duration, institutional, epistemological and other differences. Further examination of why particular individuals were perceived to be 'not very enabling' was outside the scope of this study however all but one individual perceived in this way was identified as belonging to organizational structures based on hierarchical or market principles (i.e. government, processors and consultancies).

Frequency of interactions

Frequency of interaction provides opportunities to develop relationships, trust and rapport. REC's were asked whether they interact with each of their top 30 contacts weekly, monthly or six monthly. Interaction frequency is summarized in Table 4 below. The average across all REC's indicates that 60% of their extension contacts occurs monthly however this varies for each REC. Interaction patterns for REC R, J and G are similar however REC M has the highest weekly interaction (10) and REC 5 has the lowest weekly interact (1). It is likely that each REC develops their contact frequency pattern in relation to their own knowledge needs related to their role and location. The analysis is not intended to imply that there is an 'ideal' pattern of interaction common to all REC's but to highlight similarities and differences within the team.

Table 4: Frequency of interaction

Frequency of interaction	REC R	REC M	REC J	REC G	REC S	Total number of ties	Average for the REC team

Weekly	4	10	6	7	1	28	5.6 (20%)
Monthly	21	19	16	19	15	90	18 (60%)
6 monthly	5	1	8	4	14	32	6.4 (10%)
Ties per REC	30	30	30	30	30	150	

Despite implications of social capital theory that more frequent interaction is likely to strengthen relationships (and social capital is created) the REC's reported 27 'enabling' relationships involving 6 monthly interactions. This suggests that some collaborative relationships are likely to be based on linking social capital and do not require highly frequent interactions based on bonding social capital.

5. Discussion

The study's findings provide insights about structural and relational opportunities and constraint's for the five REC team members and their 'top 30' professional contacts with respect to knowledge sharing. Firstly the REC's shared and unique connections identify 98 different individuals and organisations with whom the team share knowledge. Opportunities to develop the relational resources of the team and each individual member can be enabled by explicitly understanding why members access shared connections as well as why each REC maintains relationships with their unique 'top 30' connections. For example the SNA model identifies 17 'core' contacts shared by at least three RECs, seven of whom are highly connected 'stars' (Cross and Parker, 2004) however some were perceived as being 'not very enabling' of collaboration, particularly from government or consultancies. Whether perceived as 'enabling' or 'not very enabling' of collaboration, network 'stars' are typically in high demand and time-poor and their capacity to maintain relationships is affected accordingly. For the REC team it may be possible to connect more effectively with such people through scheduling regular group meetings with them or nominate a team member to act as an intermediary on behalf of the team. Another opportunity to tap into the collective relational resources of the team could be for each REC to share their unique contacts with each other particularly those who may bring specialized knowledge to the team. For example, RECJ has unique contacts with agribusiness contacts that may provide access to specialized knowledge held by the commercial sector. In addition only two REC's named researchers and no REC named financial contacts in their 'top 30' contacts despite both role groups representing critical knowledge resources for extension networks. The knowledge capacity of the REC team and each member could be developed by exploring how to better connect with both these groups. The team can use the SNA as a tool to identify other relational opportunities and constraints based on their knowledge of each other and their sector not necessarily apparent to anyone outside the team. REC's are aware that there are some people within their networks who create relational barriers (gatekeepers) that require time and effort to manage and a solution is sometimes to work around them. They are also aware that developing new relationships as well as maintaining existing relationships is time consuming and it is easier to focus on people they are comfortable with.

There are core contacts who are gatekeepers. They are necessary but challenging people in which bridges are continually in need of repair and strategies are needed to work around them. Also RECs are limited in the time they have available to seek new contacts especially for those who work part-time, and each REC's network is flavored by the 'comfortable' relationships – people easy to work with and in areas of familiarity'.(REC)

As well as the relational insights discussed above, SNA offers a way of understanding the structural effects of a pluralized extension network. The framework presented in Table 1 above (based on Adler et al., 2008 and Lin, 2001) uses notions of community, hierarchy and market to categorize institutional differences between network actors. Each network member identified by the REC team was allocated to a community, hierarchy or market category according to the dominant structural principle of their activity (see Table 5 below and using the 14 different roles groups identified for the SNA). Although farmers operate commercial businesses in Table 5 they are identified as representing community structures based on the willingness to share knowledge with each other (between farmers

and in discussion groups) as well as their interdependence for economies of scale in milk production and processing.

The top two rows of Table 5 indicate types of extension resources represented by each actor such as knowledge and information, strategic leadership, databases, practice based knowledge and experience. The lower three rows draw on the REC's perceptions of collaboration and frequency of interaction with their contacts to consider how the different actors may influence access and mobilization of resources.

Table 5: Summary of knowledge resources and availability in the NSW REC network (numbers in brackets indicate how many organisations and individuals were identified in the network)

Extension network resources	Network actor	Structural principle 1 Community	Structural principle 1 Hierarchy	Structural principle 1 Market
Knowledge and information Strategic leadership Research Databases	Organisations	Farmers advocacy groups (2) Farmer discussion groups (7)	Government – DPI LLS (4) Dairy Australia TAFE (3) University (2)	Consultancy – sole practice, group practice (10) Vet practice (3) Milk companies (6) Agribusiness (9)
Knowledge and information Practice knowledge and experience	Individuals	Farmers (26) Industry advocate (1)	Researchers (5) Government employees (21) DA RECs (5) Educators (2)	Vets (3) Technicians (2) Milk company field officers (15) Agribusiness reps (8)
Access and mobilization of extension resources				
Perceived collaboration	Not very enabling		Government employees 38%	Consultants 45% Milk company field officers 20%
Perceived collaboration (opportunity to mobilize information and knowledge resources)	Enabling	Farmers 96%	Government employees 62% Researchers 100% Farmers (4%)	Consultants 55% Milk company field officers 80% Agribusiness reps 90%
Frequency of access	Frequency of interaction	3/5 REC's in weekly contact with farmers All REC's in monthly contact with farmers	All REC's in weekly contact with government employees; 2 REC's in weekly contact with researchers	3/5 in weekly contact with consultants; 2/5 in weekly contact with consultants; 1/5 in weekly contact with Agribusiness

REC's perceptions of whether their network contacts are 'enabling' or 'not every enabling' of collaboration (as a proxy for knowledge sharing) are based in structures of both hierarchical and market institutions. In contrast 96% of REC's interactions from farmers aligned with community based principles are perceived to be 'enabling' of collaboration. Structures based on community principles draw on trust and unspecified terms of resource exchange (Lin 2001) in contrast to those based on market principles and specific exchange of resources (Adler et al. 2008). The distribution of network members of the REC network in Table 5 shows that community structures are represented by 9 farmer groups and 27 farmers; hierarchal structures are represented by 27 organizations and 37 individuals; and market structures are represented by 11 entities and 33 individuals. The implications of this mix and distribution of institutional structures require further longitudinal study to assess changes over time and the impacts on managing and coordinating relationships to facilitate and maintain effective and efficient knowledge sharing. Tracking such changes is important for policy

makers as well as extension providers for supporting decisions relating to distribution of resources in the public interest as well as industry goals.

6. Conclusions

The purpose of this study was to understand the structural and relational implications for knowledge sharing in a recently privatized extension network and what this means for coordination across a wider, pluralized network. Findings show that the composition of each Regional Extension Coordinator's (REC's) network reflects differences in their professional backgrounds, for example whether their previous roles were in government or agribusiness. Knowledge sharing opportunities for the REC team include creating opportunities to access each other's unique contacts, identifying team strategies for working efficiently with contacts they have in common, and developing approaches for working more effectively with network contacts considered 'not very enabling'. Community, hierarchy and market based institutions are all represented in the REC team knowledge sharing contacts however contacts from government (hierarchy) and consulting (market) sectors most likely to be perceived as 'not very enabling' of collaboration. Further work is needed to understand the basis of these perceptions and what bridging strategies may ensure that these institutions remain open to ongoing shared innovation opportunities.

The SNA offers a benchmark for ongoing longitudinal comparison of the changing balance of roles represented in the REC's 'top30' network contacts. While it is suggested here that the team's network is currently weak in research and financial knowledge, future changes in farming practice and the need for greater environmental accountability may require different forms of expertise to be available to the network. Further understanding is needed about how to manage and coordinate extension across a changing, pluralized, balance of community, hierarchical and market institutions. The geographically dispersed REC team will continue to face ongoing relational and structural challenges as well as coordination challenges. They can use their understanding of the strengths and weakness of knowledge sharing in both their team and individual networks to capture opportunities to access and mobilize knowledge as well as maintain and build social capital and capture opportunities for innovation.

References

- Adler, P. and C. Heckscher (Eds) (2005). *The firm as a collaborative community: reconstructing trust in the knowledge based economy*. Oxford, Oxford University Press
- Adler, P., Kwon, S., and C. Heckscher(2008). *Professional Work: The emergence of collaborative community*. *Organization* 19(2): 359-376.
- Cristóvão, A., Koutsouris, A., and M. Kuglar (2012). Extension systems and change facilitation for agricultural and rural development. In Darnhofer, D and B. Dedieu (eds.), *Farming Systems Research into the 21st Century: The new dynamic*. Dordrecht, Springer Science+ Business Media.
- Cross, R., and A. Parker (2004). *The Hidden Power of Social Networks: Understanding how work really gets done in organisations*. Boston, Harvard Business School Press.
- de Nooy, W., Mrvar, A., and V. Batageli (2005). *Exploratory Social Network Analysis with Pajek*. New York, Cambridge University Press.
- Faure, G., Desjeux, Y and P. Gasselin (2012). *New challenges in agricultural advisory services from a research perspective: A literature review, synthesis and research agenda*. *Journal of Agricultural Education and Extension*. 18(5): 461-492.
- Fisher, R. (2013). *A gentleman's handshake: The role of social capital and trust in transforming information into usable knowledge*. *Journal of Rural Studies*, 31: 13-22.
- Howells, J. (2006). *Intermediation and the role of intermediaries in innovation*. *Research Policy* 35: 715-728.

- High, C, Pelling, M and G. Nemes (2005). *Understanding informal institutions: Networks and communities in rural development*. In: Transition in Agriculture, Agricultural Economics in Transition II, Institute of Economics, Hungarian Academy of Sciences, 28-29 Oct 2005, Budapest, Hungary.
- Hunt, W., Birch, C., Vanclay, F. and J. Coutts (2014). *Recommendations arising from an analysis of changes to the Australian agricultural research, development and extension system*. *Food Policy* 44: 129-141.
- Kempton, K. (2015). *NSW dairy industry overview 2015: Intensive Livestock Production*. NSW Department of Primary Industries. Australia.
- King, B.J. and R. Nettle (2013). *Private-public advisory networks: An Australian dairy pasture seed case study*. *Extension Farming Systems Journal*, 9(1): 1-9.
- Klerkx, L., de Grip, K, and C. Leeuwis (2006). Hands off but strings attached: The contradictions of policy-induced demand-driven agriculture extension. *Agriculture and Human Values*, 23(2): 189-204
- Klerkx, L, and R. Nettle. (2013). *Achievements and challenges of innovation co-production support initiatives in the Australian and Dutch dairy sectors: A comparative study*. *Food Policy*, 40: 74-89.
- Knuth, U and A. Knierim (2013). *Characteristics of and challenges for advisers within a privatized extension system*. *Journal of Agriculture Education and Extension*, 19(3): 223-226.
- Koutsouris, A. (2012). *Facilitation and brokerage: New roles for extension*. *Journal of Extension Systems*, 28(1): 18-27.
- Lin, N. (1999). *Building a Network Theory of Social Capital*. *Connections*, 22(1): 28-51.
- Lin, N. (2001). *Social Capital: A theory of social structure and action*. New York: Cambridge University Press.
- Prager, K., Labarthe, P., Caggiano, M and A. Lorenzo-Arribas. (2016). *How does commercialization impact on the provision of farm advisory services? Evidence from Belgium, Italy, Ireland and the UK*. *Land Use Policy*, 52: 329-344.
- Scott, J. (2013). *Social Network Analysis*. London, SAGE Publications.
- Umali-Deininger, D. (1997). *Public and Private Agricultural Extension: Partners or Rivals? The World Bank Observer* 12(8): 203-24.
- Wasserman, S., and K. Faust (1994). *Social Network Analysis: Methods and Applications*. New York, Cambridge University Press.

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