

## Encounters with knowledge entrepreneurs and 'sticky' knowledge transfer: Case Study Project 3030

BJ King<sup>1</sup>, MS Paine<sup>2</sup>, R Beilin<sup>1</sup>, and MP O'Kane<sup>1</sup>

<sup>1</sup>Melbourne School of Land and Environment, The University of Melbourne, Victoria 3010

<sup>2</sup>Dairy New Zealand, Hamilton, New Zealand

Email: b.king3@pgrad.unimelb.edu.au

**Abstract.** Resources of many kinds are shared within social networks, including knowledge of innovations. Knowledge transfer is 'sticky' when it requires significant effort to share and also when the knowledge itself and social processes relating to it are complex, such as when there are many stakeholders involved. The focus of this study is to create understanding about who plays key roles in the sharing and smoothing of 'sticky' home-grown forage knowledge produced by Project 3030. Social network analysis is used to create visual representations of network relationships within the project, and is interpreted using qualitative analysis based on data collected through interviews and participant observation. The interviews conducted with a range of network participants (researchers, extension professionals, service providers and farmers) seek to understand how and why they are sharing knowledge about home-grown forage being produced in Project 3030. The study's findings point to the significance of 'knowledge entrepreneurs' within the social network. Their relationship patterns and attitudes to sharing knowledge enable them to create spaces where knowledge of innovation moves relatively smoothly between those involved in its development and potential on-farm users. The three key learnings that have emerged from the research are that social network analysis can be instrumental for locating 'knowledge entrepreneurs' within the Project 3030 network and then how we can understand how such people manage knowledge 'stickiness' in order to help other network participants.

**Keywords:** Knowledge entrepreneurs, social network analysis, 'sticky' knowledge transfer

### Introduction

Non-irrigated dairy farmers in South Eastern Australia are facing significant uncertainties due to effects of climate and market uncertainty (Dairy 2009; Dairy Live 2009). Anticipating the challenges to the long term competitiveness and sustainability of the dairy industry, Project 3030 (Phase 1) was set up in 2005 to 'develop forage systems for non-irrigated dairy farms in Southern Australia capable of delivering a 30% improvement in return on assets (RoA) through a 30% increase in the consumption of home grown forage' (Chapman 2008: 1) It was intended that complementary use of home grown forage would increase productivity gains and profit for farmers whose management and consumption from perennial ryegrass was very high (Chapman 2008). Success of this project and others like it depends on there being effective linkages between research outcomes and on farm users. When complex innovations are developed, the challenge for all stakeholders, but particularly extension advisors, is to anticipate and manage the 'stickiness' of new knowledge and its transfer. Complex innovations may not be expected to flow smoothly between researchers, extension advisors and farmers. Adoption strategies and targets need to be planned and managed in ways that recognise this.

In 2008, Phase 2 of Project 3030 began with the inclusion of a further objective, to increase farm resilience as well as profitability measures (Chapman 2008).

The structure of Project 3030 is based on three themes, 'Grow and Harvest', 'Consume', and 'Profitable Farming'. The first two themes focus mainly on agricultural research activities involving the development of management approaches for growing and grazing forage crops to extend the availability of green feed as well as conserved feed. They are primarily research activities based at DemoDairy, Terang, Victoria. The objective of the 'Profitable Farming' theme is to develop extension principles and key messages emerging from the other two themes as well as from the commercially based activities of partner farms undertaking on-farm evaluation and adaptation of home grown forages. The current social research study is located within the 'Profitable Farming' theme and applies social network analysis to understand how information and knowledge about home grown forage is shared within Project 3030. Project 3030 participants include researchers (agriscience and social), steering group (governance) and project management members, extension providers, consultants, service providers and farmers.

Within the context of Project 3030, we are investigating how social relationships within social networks mediate the sharing of knowledge about the home-grown forage innovation being developed in this project. Who plays key roles in enabling the knowledge transfer process? What do we need to understand about the knowledge itself in order to facilitate it being shared and made accessible to its intended beneficiaries, non-irrigated dairy farmers? This paper will present social network graphs showing relationship links within Project 3030 as a whole and

within two partner farms. We will describe the concept of the 'knowledge entrepreneur' and the method being evaluated to locate such people within the networks. We will then discuss the concept of 'sticky' knowledge transfer and how this appears to be impacting on the project.

## **Background**

### ***Rural expertise***

The notion of rural expertise in the context of Project 3030 covers a range of roles and functions. Agricultural researchers contribute science based knowledge and practice which includes the ability to 'establish cause and effect relationships' (Flood 1999:80), and 'explanations of the whole which come from the cumulative properties of the parts' (1999: 80). In contrast, farmers have expertise in managing their complex businesses as systems even if, according to Leeuwis, 'they are not all-knowing' (2004: 86). Extension providers occupy a middle ground as knowledge enablers. They make available the expertise of others (e.g. researchers and farmers) through a range of professional competencies including technical communication expertise. Leeuwis (2004) suggests that this expertise is important for supporting farmers in what they are already doing and extending their opportunities for new learning. Extension officers do this by mediating technical and research-based knowledge.

Another vital role within farming networks is undertaken by rural professionals such as farm consultants and service providers who contribute a combination of both specific technical and general farm systems expertise. These network participants may not have direct relationships with agricultural researchers but they are in daily contact with farmers and develop considerable local knowledge as well as credibility. Connecting all of these roles and expertise is necessary in order to effectively support the flow of knowledge within the network.

### ***Social ties, social capital***

Social capital is defined by Putnam (1995:664-5) as being the 'feature of social life, networks, norms and trust that enables participants to act together more effectively to pursue shared objectives'. Social capital is crucial for the functioning of social networks. High et al. (2005) refer to three types of social capital – bonding, bridging and linking capital. How each of these forms of social capital is balanced will determine the level of connectivity and cohesion or alternatively, the fragmentation within a social network.

The existence of a relational tie between network participants is a potential link for sharing knowledge. Collectively, social ties are indicators of the social capital contained within a given network. Further, patterns of ties can be used to identify how participants are interacting and are useful in diagnosing constraints and opportunities within social networks.

Granovetter (1973) contributed to our understanding of the significance of relational ties by making a distinction between 'strong' and 'weak ties'. Strong ties are built over relationship longevity, a common sense of identity, emotional intensity, similarity of interests, willingness to reciprocate support and relational closure (High et al. 2005). As such, strong ties are an indication of strong social capital and sites where the introduction of new information and knowledge will allow participants to share and learn from trusted others. In contrast 'weak' ties are a bridge between otherwise separate parts of a network. 'Weak' ties provide potential links to new information and resources (Granovetter 1973) and as such connect otherwise closed networks to new knowledge opportunities. 'Weak' ties may be broken off when their usefulness has been exhausted. High et al.'s (2005) reference to bridging capital describes an intermediary form of social capital which enables collaboration through loose network tie connections and is significant because 'bridging capital acts as a network for the communication of a participants reputation, creating an incentive for trustworthiness and reciprocity' (High 2005:10). For those in extension and other mediating roles this form of capital is important for enabling learning opportunities for their clients.

### ***Sticky knowledge transfer***

Episodes of 'sticky' knowledge transfer become apparent when things don't go smoothly or more notably, become 'eventful' (Szulanski and Cappetta 2003). There is growing awareness (ibid) that 'sticky' knowledge transfer is likely to be the rule rather than the exception i.e. it is not an anomaly. von Hippel (2005) however suggests that knowledge 'stickiness' is a consequence rather than a process.

In the context of providing extension services for farming communities, knowledge transfer is inherently 'sticky' due to the number of stakeholders involved, the complexity of farming practices and uncertainty relating to seasonal patterns and market signals. These conditions pose significant challenges to extension providers. Reducing the difficulty and frustration that

such conditions impose requires understanding what predisposes knowledge transfer to become 'sticky'. Those involved in knowledge transfer processes require a highly competent understanding of not only the technical issues, but also the social processes involving multiple network stakeholders.

If 'stickiness' is understood as impacting on both the status of information/knowledge as well as knowledge transfer process this can be used in anticipating and preparing to manage the route to market challenges within and beyond Research and Development (R&D) projects. It is also relevant for RD&E projects such as Project 3030. Further, the resource demands of extending 'sticky' knowledge and undertaking 'sticky' knowledge transfer need to be fully considered by those with governance and project management responsibilities particularly in the delivery of project activities and monitoring of impacts and outcomes.

This implies that complex knowledge should be anticipated to be 'sticky' and potentially problematic within any given project setting, from the development of research findings to the adoption and commercial application of practices and products. The knowledge transfer process will take time and require planning and communication strategies to be developed by project stakeholders. The 'sticky' knowledge transfer approach contrasts with the concept of diffusion of innovations (Rogers 2003). Extension provision has been strongly influenced by Rogers (2003) model of diffusion in which linear (top-down) knowledge transfer undertaken by extension advisors is used to promote adoption of new on farm technologies in order to increase productivity (Black 2000). While likely to explain adoption of relatively simple technologies such as improved seed, tractors etc, diffusion does not adequately explain the process of knowledge transfer involving complex farm practice innovations under conditions of uncertainty and rapid contextual change. The sticky knowledge approach addresses questions of what, why and how new knowledge will impact on existing farm systems practices; who should, can and will influence adoption processes and what timeframes will an innovation require to be evaluated, adopted and adapted. This is not a standard top-down, bottom up, information exchange or structured training approach. It is an approach focused on understanding the knowledge resources available and how these will fit with the needs of practioners and their practices in contexts characterised by change and uncertainty.

Szulanski and Cappetta (2003) identify four stages in which potential episodes of knowledge transfer need to be anticipated and managed. These include project initiation, early implementation, 'ramp-up' and evaluation. Table 3 presents an overview of this approach using examples of 'sticky' knowledge transfer episodes in Project 3030.

### ***Knowledge entrepreneurs***

Dealing effectively with an increasingly overwhelming amount of information available is a significant challenge. According to Coulson-Thomas (2003) information availability is no longer the main constraint to change or creating new opportunities, but rather it is the ability to 'penetrate the sheer volume of information'.

The balance between having access to knowledge and having access to others who can help make that knowledge applicable and relevant has shifted in favour of the latter. Coulson-Thomas (2003) suggests that relational and other interpersonal skills are (now) regarded as more important than knowledge. He also suggests that while knowledge is a combination of information and experience, expertise is a combination of knowledge as well as the skills and tools to use it.

It is important to be able to identify people in networks who possess the qualities of 'knowledge entrepreneur' because these are people who, according to Coulson-Thomas have the ability to realize the energy and imagination of information. They may be thought of as having a 'calling' to acquire, develop, and extend information and knowledge into understanding and then help others use it effectively. The knowledge entrepreneur is skilled in the ability to communicate complex knowledge, can identify 'best practice' uses of new knowledge as well as collaborative ways of working and learning that create and enhance value for others. They tend to be practical people who ask the 'so what' questions in the process of filtering information and knowledge for relevance, significance and viability (Coulson-Thomas 2003: 20). A 'knowledge entrepreneur' recognises the value of knowledge and actively makes learning opportunities available in contrast to the 'trader' who more simply makes products or services available (Kingston, 1977).

According to Coulson-Thomas (2003), knowledge entrepreneurs also have a critical understanding of when is the 'right' time for an innovation, and conversely when is the 'wrong' time. The ability to apply initiative and recognize conditions for success for a given knowledge opportunity requires a broad understanding of the context in which they are working with

others. 'Knowing when to act or react is a key entrepreneurial competence' and involves 'a balance between initiative and response' (Coulson-Thomas, 2003: 37). A summary of the attributes of a knowledge entrepreneur suggested by Coulson-Thomas are presented in Table 1 below.

**Table 1. Summary: Attributes of a 'knowledge entrepreneur' (Coulson-Thomas 2003)**

- |    |  |
|----|--|
| 1. | Ability to question, challenge, explore, discover  |
| 2. | Use the know-how of their 'superstars' and creative spirits to craft distinctive offerings to provide their clients with genuine choice.                               |
| 3. | Regard their knowledge and ways of working as a source of competitive advantage  |
| 4. | Ability to challenge the relative importance of action/reaction; complexity/simplicity; activity/reflection; change/continuity in order to create genuine alternatives |
| 5. | Ensure that they maintain their skills and update their knowledge with training and learning opportunities   |
| 6. | Recognise commercial opportunities and add value for clients   |
| 7. | Participate in flexible, active networks   |
| 8. | Engender the trust of others, credible and reliable  |
| 9. | Understand the systems they work in and are technically competent  |

How can we distinguish the qualities of a 'knowledge entrepreneur' that make differentiate them from others in the network? Coulson-Thomas (2003:13-14) characterises the knowledge entrepreneur as understanding how to 'acquire, develop, share, and exploit information knowledge and understanding' as well as how to 'help and enable others to use and apply them effectively'. Further he suggests that such people can 'communicate and share... complex knowledge in ways that assist comprehension and understanding'. This ability is important in the management of 'sticky knowledge'. If we believe that 'knowledge entrepreneurs' play a significant role in knowledge sharing, locating them in social networks may allow us to enhance the effectiveness and uptake of innovations by working with them more closely.

### Methodology

This study uses a mixed methods concurrent design which is intended to create opportunities for both explanation and exploration of the research question (Creswell et al. 2007). Qualitative and quantitative data were collected at the same time during one-to-one interviews with 40 participants of Project 3030. The social researchers of this study as participant observers have regularly attended meetings of the partner farms, Project 3030 field days and other project meetings.

Partner farms are an integral activity within the research undertaken by Project 3030. They are located in the main non-irrigated dairy regions of South Australia (O'Kane 2008:188). Each is a commercial dairy farm where the farmer(s) have been contracted to as O'Kane describes 'trial new management generated by the (3030) research team within their own farm systems and to help co-develop successful practices concerning complementary forage utilisation (2008:188)'. A selected group of local farmers (Regional Development Group) support this activity by taking part in regular discussion group meetings facilitated by a Department of Primary Industries dairy extension officer and a private farm consultant. The group discuss home-grown forage options and opportunities in this commercial farm setting and collectively learn and share knowledge about forages, which contributes to the findings of the overall project.

The interviews included the key social network question "who do you talk to about issues relating to Project 3030". The interviews also included open questions to find out what participants considered to be the important issues in relation to their experiences within the project. The qualitative data generated by the structured question was quantified into a format for social network analysis. Pajek software (de Nooy et al. 2005) was used to create social network models of the project as a whole network system (Figure 1), and the partner farms (Figures 2 and 3) as subsystems within the project network.

The boundaries of the three social network graphs presented as part of this study are formed by the relationships between network participants interviewed (ego) and their directly named contacts (alter).

To validate the social network models (Figures 1 and 3), the graphs were presented at group meetings, to the participants who provided the data. The notation of the graphs was explained although the identities of the participants were kept confidential. The participants were asked "does this visual display of the social network you are part of make sense to you?" The feedback

process provoked further discussion and enabled the participants to reflect on the relationships within the network. It was also an opportunity to raise further questions and reduce uncertainty as well as to enhance understanding about the network structure for ongoing analysis and interpretation. The visual presentation of data allowed participants to engage quickly with the complex information contained in the graphs.

Qualitative data was coded using NVivo8 which informed thematic development. The two phases (structural SNA and qualitative theme analysis) of the research were then connected. Subsequent interpretation of data from the combined methods has led to asking new questions. Specifically for this paper, the question of ‘what can the patterns of ties held by network participants explain about how they are sharing knowledge about home-grown forage?’ (in relation to Project 3030). To address this question regular equivalence block model analysis was undertaken.

Regular block model analysis is useful for the identification and definition of ‘roles’ (Hanneman 2009). Hanneman explains that “regular equivalence is important because it provides a method for identifying ‘roles’ from patterns of ties present in a network... whether or not the occupants of the roles have names for their positions” (2009: 2). UCINET software was used to undertake the block model analysis of partner farm social network data (using Regular Block models via Tabu Search) which created matrices in which the clustering of similar tie patterns was able to be analysed. Qualitative data, collected from interviews as well as from participant observation, then informed interpretation of tie pattern clusters.

Mixed methods research approaches have been criticised for ‘flattening’ interpretive possibilities. According to Freshwater this means that “there is no space for undecidability in either the text or the method” (2007: 141) which results in reduced opportunities for broad and creative interpretation. It was found in this study however that the feedback sessions with network participants ‘opened space’ in which they were able to consider the significance of network relationships as well as how opportunities within the network may be enabled or constrained and this subsequently informed ongoing interpretation.

The rationale for the use of mixed methods approach is that the SNA method provides a structural explanation for the relationships within Project 3030 and the qualitative method provides the rich data to address the question of how knowledge sharing in relation to the Project 3030 forage practice innovation is occurring. The combination of explanatory and exploratory power of the two methods is intended, as Creswell explains, to provide a “better understanding of the problem than if either dataset had been used alone” (2007: 7).

## Case study findings and discussion

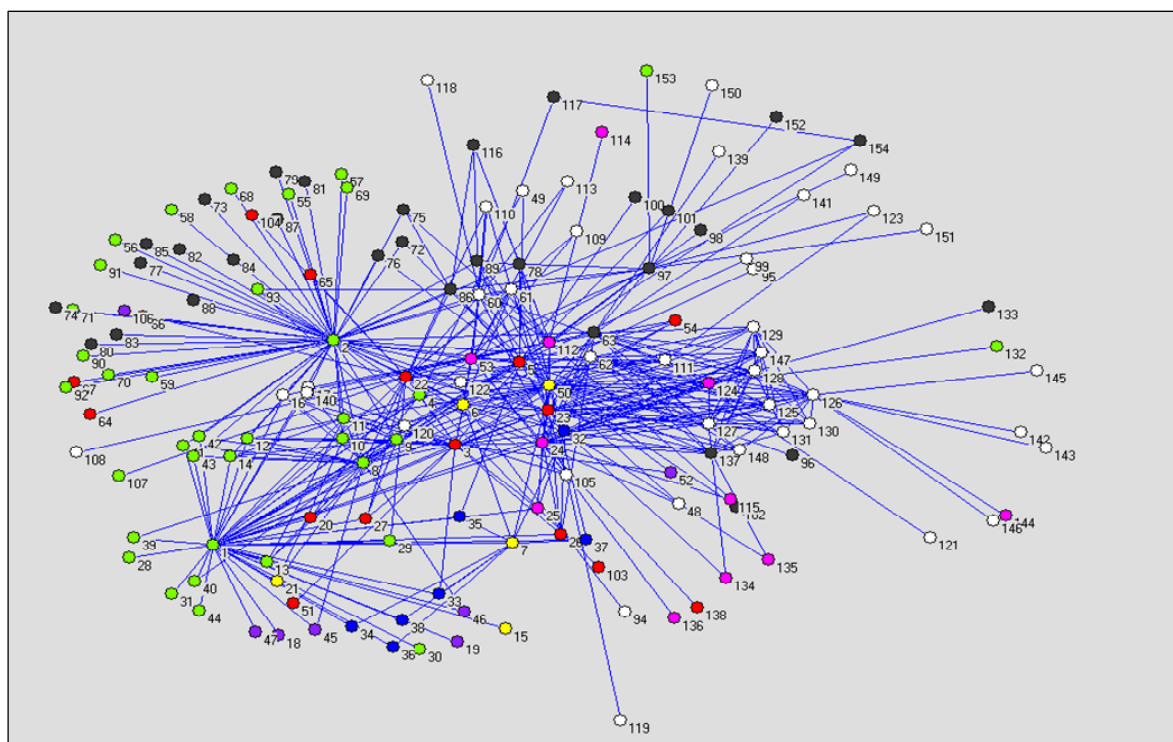
### 1. Social Network Analysis Project 3030

The SNA was based on a key question addressed to 40 interviewed social network participants who were asked “who do you talk to about Project 3030?”. The purpose of this question was to identify interactions that are specifically about Project 3030 rather than general farming, personal or other relationships which many network participants are also likely to share. The Project 3030 relationships are presented in the graph shown in Figure 1.

Network density and connectivity – implications for knowledge sharing Figure 1 shows the relationships within the social network of Project 3030 based on data collected from 40 interviewees (ego) and those they mentioned (alters) as talking to about Project 3030. The total network shown in Figure 1 contains 154 participants who are represented by the coloured dots (nodes). The colours of the nodes indicate different roles of the participants within the network. The relationships between each person are indicated by a line (tie). The data shown is undirected i.e. the direction in which knowledge exchange is occurring is assumed to be mutual.

The network in Figure 1 is comprised of agriscience researchers, social researchers, extension providers, steering group members, farm consultants, farmers and service providers. The overall structure of this network is a core-periphery configuration with the highest density of interaction occurring within the central (core) area of the graph. The participants in the core are predominantly researchers, consultants and extension providers. The relationship patterns show multiple ties (relationship connections) and many participants have ties in common. This indicates that there is a lot of communication occurring about Project 3030 between these participants. Clearly however, it does not show how and why this is happening. The periphery of the graph shows sparser tie patterns and is populated mostly by farmers and service providers who are not involved in research activities directly.

**Figure 1. Social Network Graph of Project 3030 Participants (December 2008)**



KEY	Roles within the network
● (Yellow)	Researcher - Agriscience
● (Green)	Researcher - Social
● (Red)	Extension provider
● (Blue)	Steering group/Project Governance
● (Pink)	Farm consultant
○ (White)	Farmer
● (Orange)	Service Provider
● (Dark Blue)	Other

This distribution of relationships may be explained by the relatively early development stage of the project. It does however raise questions about what communication strategies are needed to better include farmers and service providers. Diagnostic analysis is called for to address opportunities and constraints in relation to the reach of the key principles and messages being developed by the research teams. The structural overview of the network raises further questions such as- How does knowledge about home grown forage change as it is shared within this network. Why? Is there mutual exchange of knowledge between research teams and farmers adopting commercial use of forages? Who are the network participants who enable knowledge sharing about home grown forage and how are they able to do this successfully? These last two questions are specifically considered in this paper through the concepts of ‘knowledge entrepreneur’ and managing ‘sticky’ knowledge transfer.

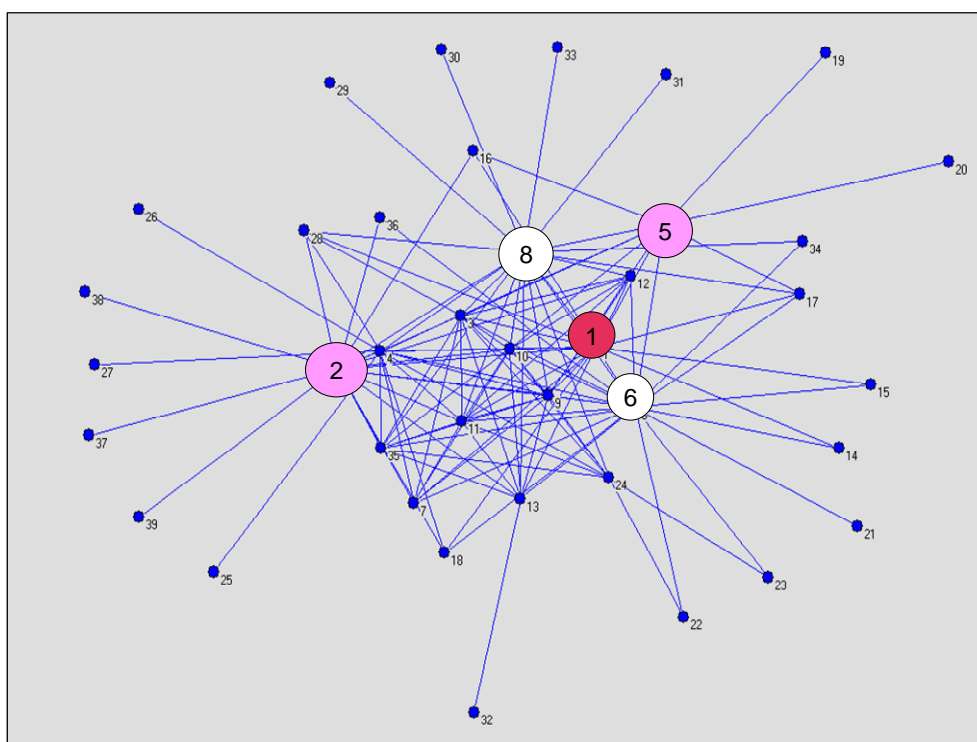
*Tie patterns* Tie patterns of network participants can be analysed from the network structure based on relational position and density of ties. In this study we are particularly interested in identifying participants who share a high number of ties. More specifically we are interested in those who are closely connected to where new knowledge from R&D is developing and who are also closely connected with farmers. These people are well placed to capture the value of the

3030 Project home-grown forage innovation and make this available to the intended farming community. In particular for Project 3030 the intermediary relationships involving service providers and farmers are potentially valuable for extending the reach of project communication.

Participants with high numbers of ties in Project 3030 are found to be those who hold brokering (pass on information within the network) and boundary spanning (pass on information/knowledge beyond the boundaries of the network) roles as well as those who act as 'gatekeepers' (those with access to knowledge however they either intentionally or unintentionally restrict others from this access). To determine the characteristics of brokers, boundary spanners and gatekeepers analysis of qualitative information provided by network participants is required.

*Partner farms social networks* The social network graph of Partner Farm 1 is shown in Figure 2. It is made up of the 12-15 participants (farmers, consultants, service providers and researchers) who regularly take part in Partner Farm 1 activities. The network displays a core/periphery structure with multiple mutual relationships shared between the partner farm participants as indicated by the dense ties at the network core. There are also less densely connected participants located at the periphery who are mainly the supporting service providers and farmers interested in Project 3030 but not direct participants in the Partner Farm's Regional Development Group (RDG). This is a strong, established social network that has been active since 2005. The participants have long standing relationships many of which predate the partner farm activities. Most of the farmers also participate together in a separate farm discussion group and many have well established friendship ties.

**Figure 2. Project 3030 Partner Farm 1 Social Network (December 2008)**

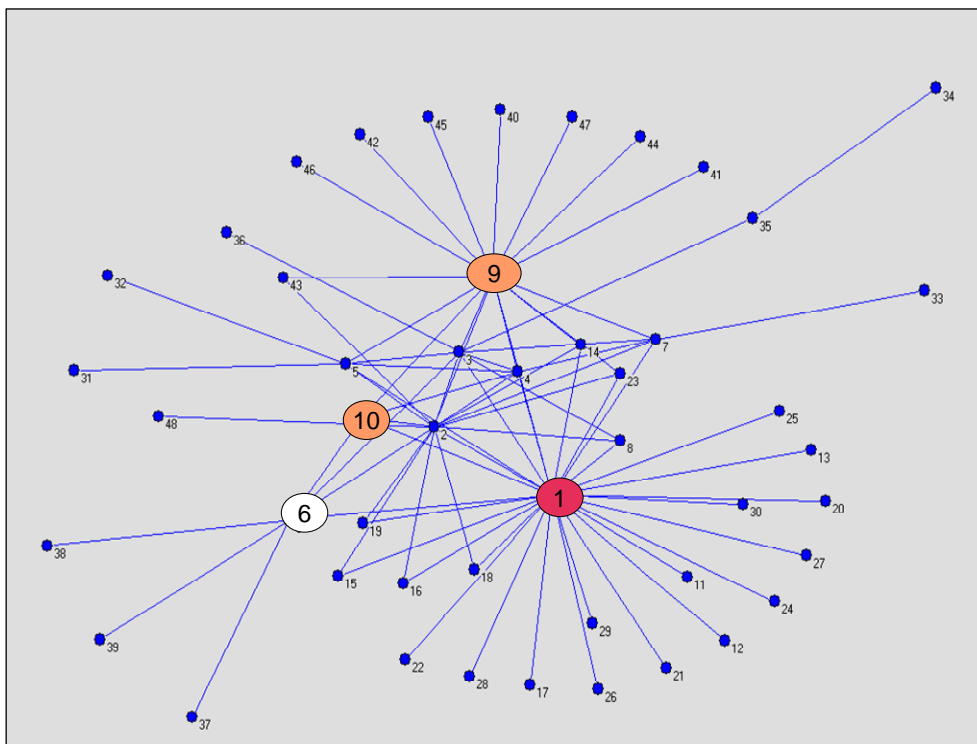


The relationship tie patterns of the Partner Farm 1 social network have been analysed using regular block model analysis as described in the methodology section above. Five network participants display similar tie patterns i.e. a high level of strong ties to most other Partner Farm members (clustered in the centre of the graph) as well as several ties to others beyond the membership of Partner Farm 1. Based on the common structural features of their tie patterns, these five individuals are all in positions that potentially enable information to be shared with others. These five network members represent three different roles, extension provider (1), consultant (2 and 5) and farmer (6 and 8).

The relationship tie patterns of the Partner Farm 2 social network (Figure 3) have also been analysed with regular block model analysis. Four network participants present similar tie patterns i.e. a high level of strong ties to most other Partner Farm members (clustered in the

centre of the graph) as well as several ties to others beyond the membership of Partner Farm 2. Based on their tie patterns, these four individuals are all structurally located in social network positions that enable knowledge sharing. The four people represent three different roles, extension provider (1), service provider (9 and 10) and farmer (6).

**Figure 3. Project 3030 Partner Farm 2 Social Network (July 2009)**



This social network of Partner Farm 2 (Figure 3) is more open than that shown in Figure 2. This group has also been meeting since 2005 but many participants did not know each other before it was established. There is a more significant presence of service providers and less dense clustering of relationships at the centre of the graph.

The role of the extension facilitator (number 1 in both models) is significant for the connectivity of both social networks however in Partner Farm 2, the extension facilitator is the only connection to 14 others and therefore holds a vital communication-enabling role for sharing and extending the learning from this group to other farmers and rural professionals.

We suggest that based on analysis of tie patterns and qualitative analysis collected in the social networks of Project 3030 and the two Partner Farms described above, that it may be possible to locate, knowledge entrepreneurs in these networks. To do this requires understanding their structural position as well as professional and personal attributes that characterise their attitudes to knowledge sharing, and relationships. The qualitative analysis undertaken to address this question is discussed next.

## **2. Knowledge sharing**

In order to characterise the knowledge sharing attributes of social network actors identified through the structural patterns of the network and the block modelling analysis, semi-structured interviews were undertaken with representatives from each of the eight role groups identified in the network (see Figure 1). The interviews were coded based on themes emerging from interviews and data collected from participation of the researchers in a range of Project 3030 activities since 2007. This provided insight about what qualities participants in the network bring to knowledge sharing. Particularly attention was given to those who hold a combination of 'strong' and 'weak' ties.

*Who are the 'knowledge entrepreneurs' in Project 3030?* The knowledge challenge for farmers in Project 3030 is significantly greater than having access to information. It is about knowing how to use knowledge effectively within farming systems that are already complex and contingent on uncertain weather and market conditions. The 'knowledge entrepreneur' plays a key role in such social networks as they gather, make sense of and then filter information and knowledge. They



then make these understandings available to others to use according to their needs and terms, thereby acting as a kind of knowledge enabling conduit.

Structural and qualitative analysis have both been used to locate participants in the Project 3030 network who appear to bring the characteristics of 'knowledge entrepreneur' within the partner farm networks. The regular block models distinguish several participants who have a high number of relationship ties both within the core of the partner farm networks and with others towards the periphery. Such people are active participants in the network but not necessarily in ways that enable knowledge sharing. Drawing on Coulson-Thomas's attributes of a knowledge entrepreneur (2003) we can further distinguish these participants from brokers and gatekeepers by qualitatively analysing the content and themes that have been collected in interviews with potential 'knowledge entrepreneurs' as well as from the comments made about them by others. These people are not distinguishable by their formal roles ie, extension providers, farmer, service provider, or by their prominence in the groups as observed through participant observation. They do however hold attitudes towards knowledge sharing and relationships that distinguish them as active learners as well as actively sharing/transferring knowledge with others. An example is given below of a service provider participant in a Partner Farm who explained:

*"Working with really good farmers and consultants you get to pick up something off them every time, especially when they start suggestion certain scenarios. Certain farmers are highly respected and when they tell me what they do I have then been able to go on and suggest that for other farmers I work with. And they try these things and found they were quite successful with what these good farmers are doing. I learn quite a bit in the meetings (of the Project 3030 Partner Farm)".*

A range of knowledge entrepreneurial qualities are expressed by the service provider above. He appreciates working with others and recognises and appreciates their farming strengths and approaches. He is both respectful and respected within the Project 3030 network. He listens actively to the farmer's ideas and how they interpret and create options. He picks up this information and offers this as opportunity for his clients but gives credit back to his source. In this way he himself becomes a conduit but in doing so, his skills and the trust others have in him are made invisible.

Table 2 presents a summary of the qualitative attributes of a 'knowledge entrepreneur' that have emerged from this study based on analysis of Project 3030 Partner Farms social networks.

**Table 2. Qualitative checklist for identifying 'knowledge entrepreneurs' in Project 3030 Partner Farm social networks**

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1.	Ability to identify the information, knowledge and understanding other people need to do their jobs competently
2.	Ability to manage 'sticky' knowledge transfer
3.	Technically competent in a given field
4.	Understand the practical implications within a given technical field
5.	Have a combination of 'know-how', experience, skills
6.	Locally embedded, well known and established in the network

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The attributes listed above compare closely with several of the attributes identified by Coulson-Thomas (2003) summarised in Table 1. Within the farming context of Project 3030 a significant feature of 'knowledge entrepreneurs' appears to be their embeddedness in the networks in which they work and live.

Locating episodes of 'sticky' knowledge transfer in Project 3030 As Project 3030 has progressed, the requirements and conditions for knowledge transfer have and will continue to change. In Table 3 below, examples of knowledge transfer issues that have impacted on Project 3030 to date.

**Table 3: Examples of ‘sticky’ knowledge transfer issues in Project 3030**

Project Stages	Who is involved	Context: The Ideal	Context: The Reality	Attributes of Knowledge	Impact on existing skills & practice	Project 3030 Experience
1. Initiation What’s the opportunity?	Steering group Project Leaders Investors	30% increase in profit (Return on Assets) & 30% increase in home grown forage production	Many farmers will increase their production through improved ryegrass management	What is the knowledge gap in farm practice?	How do farmers fit home grown forage production into existing systems?	Which farmers are ready to adopt home grown forages? Notion of ‘top 10% farmers’ who are already optimising ryegrass management
2. Early implementation	Research Extension Partner Farms Consultants	Rainfall in summer & winter that allow optimal production of summer & winter forage	Drought/low rainfall in summer limits summer forage	Technical expertise & timing  What are the risks of growing forage?	Farmers adapt forage practice to seasonal conditions & farm systems	Research results show ryegrass potential  Complementary forage more risky than ryegrass
3. Ramp up	Research Extension Partner Farms Consultants Service Providers Top 10% Farmer	Farmers ready & keen to adopt home grown forage practice	Farmers still unsure that benefits outweigh risks  Seasonal conditions limit options  Multiple stakeholders	What do farmers need to know in order to adopt home grown forage practice? i.e. fit of new practice into existing practice	Grow on milking platform or outblock?	Where does responsibility for extension sit in Project 3030?
4. Evaluation	Steering group Project Leaders Farmer Users Investors	Project 3030 is successful Financial & production goals achieved	To date 15% Return on Assets is a good result  Get ryegrass management right as a priority	Farmer’s experience with home grown forage shared with research	Requires several seasons experience with forage crops to understand how to manage them	Managing the dual message of ryegrass management optimisation & opportunities of home grown forage

The issues emerging in Project 3030 have complex implications for changes in farm practice that have and will create knowledge transfer challenges. There are implications for significant on-farm practice change that are or will potentially be ‘sticky’ in terms of managing information and sharing knowledge. Effort and resources are required to facilitate the sharing the key principles and messages effectively and there is considerable potential for misunderstandings as well as creative adaptation. Those in extension, consultancy and service provider roles as well as some key farmers are structurally positioned within the Project 3030 network, and many have the personal attributes, that enable them to share knowledge about farming innovations effectively. They do however need appropriate time and opportunity to learn what is required and how the home-grown forage innovation may complement and impact on other farming practices and the farm as a system.

Project 3030 is currently developing a set of principles based on research undertaken in farmlet and forage field trials at DemoDairy, modelling of production and financial data, and input from the learning’s of partner farm activities. A multi-disciplinary team comprised of researchers, extension advisors, consultants and farmers (the ‘Technical Coordinating Committee’) has been established and tasked with reviewing principles relating to home-grown forage. This has provided an opportunity to ensure the principles are fit-for-farm as agreed by key stakeholder groups and is a significant step forward in managing the ‘stickiness’ of the Project 3030 home grown forage innovation.

## Conclusion

In recent years climate variability and market volatility have impacted seriously on farming communities including non-irrigated dairy farmers of Victoria. The need to adopt farming practices that secure farm sustainability will continue to be crucial for farmers and the dairy industry in South Eastern Australia. The introduction of innovation is a key strategy for industry wellbeing, adaptation and survival but when this brings significant on-farm practice change, there is also a need for well planned and resourced knowledge transfer that taps the human capacity in social networks beyond traditional extension provision. Locating those people in rural networks who have knowledge entrepreneurial skills and capacity to manage the 'stickiness' of knowledge transfer is a means for enhancing the reach and effectiveness of innovation. For Project 3030, locating knowledge entrepreneurs and working closely with them to help them work better with others is a way to enhance the reach and value of the project for all stakeholders. Strengthening our understanding of social networks provides opportunities for better managing innovation and change processes.

## Acknowledgements

We wish to acknowledge Dairy Australia and the Geoffrey Gardiner Foundation for their support for this study.

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