Universiteit Antwerpen

This item is the archived peer-reviewed author-version of:

Network learning : episodes of interorganizational learning towards a collective performance goal

Reference:

NETWORK LEARNING: EPISODES OF INTERORGANIZATIONAL

LEARNING TOWARDS A COLLECTIVE PERFORMANCE GOAL

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Abstract

Little is known about learning processes in horizontal networks. This study focuses on networks as learning entities, i.e. learning by multiple organizations as a group, and the mechanisms involved in developing and addressing a network level performance goal. Using a narrative approach we gather in-depth primary data from network members to examine: How do firms engage in network learning? And, how is network learning coordinated towards a performance goal in a horizontal interfirm network? Our findings comprise two learning episodes: "learning how to compete" and "learning how to perform". These episodes enable us to contribute to understanding on: network learning processes; the relationship between network learning and organizational learning; and the regulatory role a hub firm provides towards a collective performance goal.

NETWORK LEARNING: EPISODES OF INTERORGANIZATIONAL

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1. Introduction

Small and medium-sized firms, producer firms in particular, who enter an interfirm network often see this as a key way to compete (Tikkanen, 1998; Håkansson and Snehota, 2006). Often these firms, who are essentially part of a global value chain, (Bair and Palpacuer, 2015; Stringer, Hughes, Whittaker and Haworth, 2016) consider their own resources, in critical areas such as innovation, to not be entirely effective if they were to compete alone (Murto-Koivisto and Vesalainen, 1994; Tikkanen, 1998; Yli-Renko, Autio and Tontti, 2002). The various network forms used to compete in this setting are conceptualized by the knowledge-based theory of networks as venues for knowledge exchange (Maskell, 2001; Tallman et al., 2004; Weck and Blomqvist, 2005; Dyer and Hatch, 2006; van Wijk, Jansen and Lyles, 2008; Phelps, 2010), where resources, capabilities and knowledge are disseminated and circulated among members (Easterby-Smith, Lyles and Tsang, 2008). As such, the focus in these networks has primarily been on uncovering the benefits of knowledge transfer (Reagans and McEvily, 2003; Jensen and Szulanski, 2007), rather than on how the learning process takes place at the network level.

The process, involving the capacity of an organization (firm) to learn from others, is also referred to as *organizational learning within a network* (Knight, 2002; Easterby-Smith et al., 2008). Few studies have examined the collaborative processes firms engage in when *learning as a network:* a learning process where the network is the learner entity as a whole. Learning at network level goes beyond the multiple learning

processes that take place at the firm level in a network (Dyer and Nobeoka, 2000; Knight, 2002; Knight and Pye, 2004). How member firms engage in a network learning process and what coordination and regulatory mechanisms are required has received limited attention. In particular, little is known on the learning processes surrounding developing and addressing network level performance goals. (Kilduff and Tsai, 2003; Provan, Fish and Sydow, 2007; Mariotti, 2012) There is a call for in-depth qualitative research in this general area (Knight and Pye, 2004; Phelps, Heidl and Wadhwa, 2012; Mariotti, 2012).

This study attempts to advance understanding on network learning by examining: How do firms engage in network learning? And, how is network learning coordinated towards a performance goal in a horizontal interfirm network? To gain a granular level understanding of this process we confine our focus to the farm-to-process industry network in the New Zealand Dairy Industry. Network members play a vital role in producing 25% of the country's total export revenue. Using this unique context and the narrative approach we track the network learning path of a fragmented group of over 8,059 firms (i.e. farming units) that ultimately impacts on the quality of the milk they produce, where 95% is sold on the international market (LIC, 2015).

Our findings identify two learning episodes: "learning how to compete" and "learning how to perform". These episodes enable us to contribute to network learning in the following ways. First, we identify a network learning process and how it centres on developing a collective performance goal to compete globally. Second, we discuss the relationships between network learning and organizational learning that may increase the network firms' and the network's competitiveness. Third, we provide evidence on how a hub firm regulates network learning. By analysing these learning episodes, we are able to delineate the underlying stages and processes involved in

developing network learning that are coordinated via the regulatory role a hub firm provides, towards a performance outcome.

Next, we review the network learning literature. We then explain the rationale for using a single-case study methodology. This is followed by the findings section that identifies learning episodes and explains the regulatory role of a hub firm. Finally, we offer a theoretical discussion and practitioner implications.

2. The Process of Network Learning

Networks are considered important sources of knowledge for firms (Powell, Koput and Smith-Doerr, 1996; Maskell, 2001; Tallman et al., 2004). Some authors (e.g. Spender and Grant, 1996; Grant 1996) argue it is the knowledge within organizational structures that is a primary resource upon which competitive advantage is founded; while other authors assert the network is the locus of innovation, rather than the individual firm, due to the access it provides to knowledge and resources that would not otherwise be available (Powell et al., 1996). Networks have also been associated with limiting opportunism between firms by converting single transactions into long-term cooperation and fostering trust (Gulati and Sytch, 2008; Ring and van de Ven, 1992; Simonin, 1997; Teece, 1992). As such, interfirm networks, have been conceived as knowledge-sharing vehicles where member firms use the network to transfer knowledge, and thereby avoid many costs associated with knowledge transactions across markets (Reagans and McEvilly, 2003; Möller and Svahn, 2006).

The knowledge transfer literature (e.g. see reviews van Wijk et al., 2008; Easterby-Smith et al., 2008) regularly affirms the importance of interorganizational knowledge exchange on performance and innovativeness for those organizations involved. The network is viewed as the context in which knowledge transfer takes place rather than

being a learning entity itself. Yet, some empirical studies have noted that although the initial interest of firms in entering a network might be to explore external sources of specialized knowledge, by working together these firms might be able to create new shared knowledge and jointly improve their working practices, technical knowledge and skills (Arikan 2009; Mariotti, 2011; Coghlan and Coughlan, 2015). This process has been identified as network learning (Dyer and Nobeoka, 2000; Knight, 2002; Knight and Pye, 2004; Peters, Pressey and Johnston, 2016). The term network-level learning has been firstly defined by Dyer and Nobeoka (2000: 364) as "(a) knowledge development and acquisition that is useful in a specific network context, or (b) knowledge (e.g. a best practice) that is developed or resides within the network that is discovered and documented/codified by a network-level knowledge storage mechanism". As an example, Dyer and Nobeoka (2000: 364) cite: "Knowledge acquired, stored, and diffused by the supplier association quality committee (e.g. through its quality training program) would constitute network-level learning. This activity stores knowledge at the network level, and the knowledge is then made widely available for individual member firms to use in changing their individual firm practices. Thus, the changes (learning) that take place at the individual firm level are due to participation in network-level learning activities". Similarly, Knight (2002: 428) defines network learning as "learning by a group of organizations as a group. If, through their interaction, a group of firms changes the group's behaviour or cognitive structures, then it is the group of organizations that is the 'learner', not just the individual organizations within the group. In such a case, the network can be said to have learnt". In this conceptualization, network learning is more than the sum of the learning of individuals, groups and organizations that constitute the network; network learning processes would result in changes to attributes of the network, such as interaction processes and

structures, and shared narratives (Dunford and Jones, 2000; Knight, 2002). Then, evidence of shared cognitive structures (e.g. norms, shared understandings or narratives) and collective or coordinated practices across a network would support network learning.

Network learning is frequently associated with interorganizational learning. Interorganizational learning refers to learning at the level of pairs or groups of organizations that are proactively cooperating (Levinson and Asahi, 1995; Larsson, Bengtsson, Henriksson and Sparks, 1998; Holmqvist, 2003; Crossan, Maurer and White, 2011). Although network learning involves interorganizational learning, we intentionally use "network learning" to refer to a "group of organizations learning as a group" and differentiate it from other types of interorganizational learning like dyadic learning between two organizations in an alliance or organizational learning arising through interaction between organizations but without affecting them as a group.

Despite the growing interest on the knowledge-based view of networks, little research has been developed on the knowledge outcomes at the whole network level (Knight, 2002; Phelps et al., 2012; Coghlan and Coughlan, 2015). Our interest is to fill this gap in the literature and focus on networks as learning entities. We aim to contribute to the understanding of the network learning process and the coordination mechanisms involved.

3. Coordinating network learning towards a performance goal

Given the scarcity of research on network learning, the outcomes of the learning process can be controversial with regard to firms' or a network's performance. As such, network learning and the mechanisms associated with this concept undoubtedly play an important, but not well understood, role in regulating the learning process towards a

performance goal for the whole network (Kilduff and Tsai, 2003). While some authors argue that network learning is not associated with performance improvements (Knight and Pye, 2004) other authors argue that network learning is a potential source of competitiveness for participant firms (Dyer and Hatch, 2006; Mariotti, 2011; Coghlan and Coughlan, 2015). On one side of the argument Knight and Pye (2004) found no clear relationships between network learning and strategic change or network performance improvements when investigating the prosthetics supply network. Although the firms in the network had learned as a group, there was no clearly defined agenda for change and no unitary authority with a mandate to plan and control the network (Knight and Pye, 2004: 483). On the other side of the argument Dyer and Hatch (2006) found networks are a critical unit of analysis in explaining knowledge-related outcomes associated to relational competitive advantage in a suppliers' network. In addition, Dyer and Hatch (2016) demonstrated network-level barriers preserved the competitive advantages that could be achieved through interfirm knowledge transfer routines, so that networks might be an important structure where firms might leverage the knowledge assets to create sustainable advantage.

Capaldo (2014) argues that networks can provide firms with knowledge resources that can enhance firms' ability to compete, but the process of network governance needs to be carefully managed. Similarly, Kogut (2000) states that if a network is to be effective at knowledge management, it must create "coordinating principles" that "support coordination among specialized firm". In vertical supply chains, the prominent position of a dominant purchaser can set and manage the coordination mechanisms of network level learning towards performance goals (Dyer and Hatch, 2006; Knight and Pye, 2004). However, developing coordination mechanisms and collective goals in horizontal networks (e.g. industry networks) is more complex due to the potentially

conflicting interests of the member firms and the lack of a dominant firm (Kilduff and Tsai, 2003). Some studies have identified the existence of firms that take central roles of network coordination, whose main function is to orchestrate network resources often without hierarchical authority (Dhanaraj and Parkhe, 2006; Provan and Kenis, 2008; Albers, Wohlgezogen and Zajac, 2016). These firms have been commonly referred to as hub firms (Burt, 1992; Gardet and Mothe, 2011; Gardet and Fraiha, 2012). Hub firms can facilitate collective action in the pursuit of multi-organizational goals, such as improved practices, and making recommendations or creating industry recipes. Their roles can involve assessing and transferring relevant knowledge held at different points in the network (Gardet and Mothe, 2011).

A considerable gap in the literature remains on how network learning may be coordinated and regulated towards performance goals (Knight and Pye, 2004; Provan, Fish and Sydow, 2007; Mariotti, 2012). This research attempts to address this situation by examining two research questions: How do firms engage in network learning? And, how is network learning coordinated towards a performance goal in a horizontal interfirm network?

4. Method

We used a case study design as it is suited to asking "how" questions (Pratt, 2009) with regard to network learning. A case study also provides the opportunity for in-depth investigation into contemporary problems occurring in a real life context (Scholz and Tietje, 2002), in this instance in a primary producer, industry network setting. Case studies provide a particularly powerful mechanism for providing empirical data on specific phenomena, from which viable inferences and generalizations can be developed (Siggelkow, 2007; Sinkovics, Penz and Ghauri, 2008). Furthermore, the case study

method is appropriate when researchers want to gain knowledge on the order of events as they occur, or to identify the relationships among constructs (Zikmund, Babin, Carr and Griffin, 2012).

We selected a horizontal interfirm network where member firms are involved in learning at a network level to collectively identify and address the key problems confronting the sector. In doing so, we examined processes of network learning and the role of the hub firm as a regulating agent. We use a learning episode framework with a focus on network learning as our unit of analysis. The episode structure as an analytic framework provides an important means to manage the ambiguity, complexity and dynamics of interorganizational interaction (Huxham and Vangen, 2000). Network learning episodes are narratives of learning events in a particular network that occur in a specific period of time. The episodes of network learning may include the drivers for learning, the learner network, the learning processes and outcomes, the performance implications and the associated organizational, group and individual learning (Knight, 2002; 2004). Our purpose of using learning episodes is to bracket network experiences to create structural boundaries around significant sets of strategic processes in our empirical case.

We focus on the farm-to-process sector of the New Zealand dairy industry. This sector is positioned within one of New Zealand's largest industries that produces approximately 25% (NZ$13.7 billion, 2015) of the country's total export revenue. With approximately 8,059 farm owners and 5.02 million dairy cows (2015) (LIC, 2015), this industry sector produces milk products, where only 5% are consumed locally, with the remaining 95% sold on the world market. As such this network setting provides a unique context for our study due to its ownership and co-operative structure. The farmers own their cows and the land they farm on and have voting rights over

organizations such as DairyNZ and the milk producer company that sells the product on their behalf in a global competitive milk market.

To understand the overall structure, key participants and general strategic direction of the New Zealand dairy industry, we began by collecting secondary contextual data from an online search for DairyNZ and a milk production company on their respective websites[1]. These information sources provided initial understanding on the processes this industry engaged in to compete on a global market. We began to identify the key participants and divisions in the industry. The industry divisions included the farmers to the milk production companies (farm-to-process) and the milk production companies to the market (process-to-market). Due to the enormity and complexity of the industry we confined our focus to the farm-to-process sector, where we identified a fragmented network of small firms and a central organization: DairyNZ. We performed a pilot interview with two senior managers in DairyNZ, who had five or more years' experience within the organization. The purpose of these pilot interviews was to build knowledge on this particular sector of the industry that included DairyNZ's goals, programmes and general operations.

This combined information enabled us to begin to understand the magnitude of the challenges this sector was facing and to identify its key participants. These participants included DairyNZ, a farmer representative organization, a milk production company, farmers and animal specialists. We then developed a set of open questionnaires and scheduled interviews (see Appendix 1 for an interview schedule example). We began by interviewing a third DairyNZ management member, followed by representatives from the milk production company and the farmer organization to further understand the industry sector's overall issues and requirements and how the

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[1]www.dairynz.co.nz; www.fonterra.com;

various targets and goals were developed and addressed. There have been over 60 solution programmes developed that include pasture supplements, offering feed, effluent, nutrient, fertility and seasonal management programmes. Since these solutions are designed to meet a variety of goals they require many different skill types that can include: veterinarians, farm advisors, regional councils, training providers, effluent management companies, milk processing organizations, and farming advocacy groups. Next, we refined our focus to one learning solution, the Healthy Hoof Programme. We interviewed the programme manager and an external specialist to examine how the choice was made to develop the programme. Next, we interviewed one veterinarian and two scientists who were developing the programme. From here we began interviewing two veterinarians involved in the adoption of the programme and two farmers who had implemented it. Care was taken to closely examine the specific goals of the programme, and the steps taken to develop, implement and receive feedback on the programme. We also asked participants to describe the expected and unexpected outcomes. In all, we conducted 27 interviews, where each typically lasted one hour (see Table 1 for a complete list of participant categories). To protect participant anonymity, participants within each category have not been further identified.

Interviews were conducted in two stages over a 26-month period in 2012 with two follow up interviews in 2016 to examine for consistencies in the learning process for the network. All interviews were recorded and transcribed verbatim. Our aim was to understand the participants' role in the interfirm network; the nature of the problems each group experienced including their knowledge gaps; and how solutions were developed to address these problems at both the individual and network level. Since the overall analysis of our data began early in this period we were also able to use this understanding to further refine the interview narratives. Collis and Hussey (2009)

suggest this approach where irrelevant data is discarded and data relationships are identified. We attempted to reduce potential biases from participant accounts by comparing responses between members from the various firms (Yin, 2011). A seminar was also conducted with six management staff at DairyNZ on their request at the completion of the first round of interviews. Data gathered from this group was used to further verify and adjust, where necessary, the information that we had collated. In addition we also gained access to annual farmer surveys where we were able to obtain data on the learnings and effectiveness of the Healthy Hoof Programme. It should be noted that while this programme had already been developed we cross checked our data sources in relation to its formation and the problems confronting the industry at the time.

Due to the overall complexity of the industry, the analysis of our data began by identifying the industry sector's key issues and targets that led us to examine more closely two events relevant to network actors. These events emerged as two discrete episodes that we analyse separately. The first event began with the formation of DairyNZ and triggered Episode 1 "learning how to compete". This led to the setting of a network level performance goal. We bounded our second episode "learning how to perform" on the development of one specific solution programme, the Healthy Hoof Programme, and its implementation towards the network's performance goal. We identify this episode as "learning how to perform". Having identified these two core learning episodes we used thematic analysis to develop our narrative for each. For example, in episode two, some central themes and categories (in brackets) identified include: causes of cow lameness (driver for learning); farmer knowledge gaps on cow lameness (driver for learning); developing a learning programme (network learning process); improving a learning programme (network learning process); adopting a

learning programme by farmer (organizational learning process); opinion about a learning programme (learning outcome); benefit of a learning programme (learning outcome); hub firm plus action e.g. promoting, transferring, monitoring (hub firm roles), etc. These codes and categories helped us in the search process in developing each episode from our multi-sourced textual database. This data was fed into ATLAS ti7 qualitative research software to help enhance the trustworthiness of our analytical process of coding and analysing (Sinkovics et al., 2008).

Insert table 1 about here

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5. Network learning episodes

From our empirical findings we now present the two network learning episodes we identify in this farm-to-process interfirm network: 1. Learning how to compete; and, 2. Learning how to perform. We also examine DairyNZ's role in these episodes as the hub firm. We later discuss these findings in relation to network learning theory and provide theoretical and practitioner implications.

5.1 Episode 1: Learning how to compete

Prior to 2008 and the establishment of DairyNZ it was commonly acknowledged in the dairy sector that the 11,300 dairy farmers at this time were a large, fragmented group of business owners with herd sizes ranging from less than 250 to over 700 cows per farm. These farmers had a range of complex problems between them that extended from general farm management to cow fertility and soil drainage. It was reported, "dairy

farmers were [regularly] sitting around in groups not agreeing" (farmer organization representative). These farmers "realized they needed to consolidate their voice" (DairyNZ management participant). The farmers were aware of the vital role they play in the New Zealand economy, and the challenges that their geographically dispersed nature brought about. "We capture about 65% (2012) of the total profit in terms of the export market and we wanted to improve on that" (farmer organization representative). A farmer participant reports, "We want to produce quality milk and keep improving our production". Another farmer participant said, "We are open to learn new skills". While another farmer said, "At the time we knew we needed a voice, we couldn't do it alone". It was agreed by representatives from the milk processing company, farmer associations and individual farmers that the industry had identified and articulated a broad problem. As a DairyNZ management participant said, "We need to figure out how to compete on the international market".

Recognizing the size, complexity and long-term nature of this broad industry problem, a decision was made by two farmer representative organizations and selected farmers to divide the industry into two sectors. One is the supply-to-process end of the industry and the other is the process-to-market sector. At this point the farmers rallied together to form discussion groups across the regions to discuss how their problems could be addressed in a coordinated manner. This discussion led to the formation of DairyNZ, which got ". . . unreserved support from industry members. Farmers and the farmer associations agreed . . . we needed a neutral voice between us . . . there are a lot of different interests" (milk production company participant). It was ". . . critical that we are seen as a neutral body" (DairyNZ management participant) where the organization provides a skill set of over 30 scientists and an experienced management team. DairyNZ offers strategic and innovative guidance to the farmers. This organization is referred to

by members as an "industry good" organization. DairyNZ collectively worked with key dairy farmer representatives and a milk production company to develop a learner network. This included forming a strategic goal setting partnership where each organization, while aware of their knowledge gaps brought with it specialized know how and complementary values and aims that represent the interests of this large, fragmented group of farmers.

Members from the strategic goal setting partnership met with the collective intent of pursuing a learning process that involved discussing how they could start to consolidate the many sub-goals underpinning the broad problem of "how to compete globally". "We took a blank sheet of paper and said, what do we want to become by 2020?" (DairyNZ management participant). Guided by DairyNZ, the group was to identify a manageable problem set to be addressed in the more distant future. Recognizing the complex nature of the industry sector the strategic goal setting partnership came up with three key industry aims, including: to be competitive, to be profitable (perform) and to be sustainable. DairyNZ took a lead role in coordinating and refining the implementation of these aims.

At this level key industry sector members, such as DairyNZ representatives, reported feeling overwhelmed with the task of attempting to learn how to manage the range of problems involved in how to align and address the three industry growth aims. The farmer representative organization participant reported, "We need to constantly be on top of figuring out ways to keep our cows in peak health". A DairyNZ management participant said, "We want to ensure that we are always coming up with ways to improve the quality of the milk that we produce". Another DairyNZ management participant reported, "We also have an on-going responsibility to New Zealand in terms

of reducing pollution . . . we needed to sort out how to keep cattle away from streams and rivers and lakes". Having identified the sheer magnitude and multi-faceted nature of these problems, the next challenge for this industry sector was to learn how to categorize and decide on ". . . what is the mix of programmes which will pull together to support these aims" in order to develop a comprehensive list (farmer organization representative). The industry sector was confronted with the problem of how to align its strategic aims with manageable targets.

A farmer organization representative said, "We knew we couldn't do it alone . . . we needed expertise from others. The challenge was figuring out a way to tackle this problem by taking bite-sized chunks". With this in mind DairyNZ set about to form collaborative partnerships with a range of industry participants with specialist skills that included veterinarians, farm advisors, regional councils, training providers, effluent management companies, milk processing organizations and farmers. The purpose of these partnerships was to coordinate expertise and to develop projects that will jointly work towards achieving one of DairyNZ's identified strategic targets, with a goal to increase farm performance by 15% by 2016 (DairyNZ management participant).

DairyNZ began a multi-stakeholder consultation process to address the knowledge required to address 27 strategic targets that aligned with the three areas of competitiveness, profitability and sustainability (see Table 2). This target setting process required each of the partnering organizations to seek the opinion and knowledge of several hundred large and small organizations including farm advisory groups, researchers, policy makers, veterinarians, rural bankers and associated farming groups. These targets range from Farm Production and Resource Use Targets, to Farm People and Management Targets to Off-Farm Drivers Targets. Once developed, these targets

then needed to be approved by the farmers, via a further consultative process coordinated by DairyNZ.

Insert table 2 about here

5.2 Episode 2: Learning how to perform (The Healthy Hoof Programme)

This episode follows the path of implementing a process to where the network learned how to increase animal health and milk quality to address a key target and the performance goal already set (see Table 2, target 6). A common health problem on New Zealand farms was cow lameness[2]. An industry specialist reported that "lameness is one of NZ dairy farms' three main health issues and is a major animal welfare concern. There are financial impacts from lost production and treatment costs and non-financial costs, such as time and staff morale". This participant also said, "Interestingly, the cost of lame cows is not the top concern for farmers. It is usually around time, effort and the dislike of seeing lame cows plus production loss and reproduction effects".

DairyNZ's management recognized farmers had a problem, where they had insufficient knowledge on cow lameness. This understanding was sought by coordinating informal feedback from farmers from sources such as annual farmer field days and farmer regional meetings, as well as data received from annual surveys sent out to farmers. DairyNZ quickly recognized that they also needed more knowledge if

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[2] Cow lameness is a condition that impacts on the mobility of a cow to self-feed, which ultimately if left untreated can have detrimental effects to individual farmers' competitiveness.

they were to develop world class specialized understanding in cow lameness and its management. A DairyNZ management spokesperson said, "We had some ideas but we needed external comment on what we were proposing". Even though DairyNZ had in-house scientists engaged others with specialized animal health knowledge, including veterinarians and those with specific skills in cow lameness.

A large number of farmers understood the direct physical factors causing cow lameness, but they lacked understanding on the range of other underlying practices that contributed to the condition. A range of causes that were identified in contributing towards cow lameness needed to be considered in the development of a solution for farmers. For example, the farmer organization representative reported, "Cows do no good when the ground is too wet, it messes with their hooves". An industry consultant discussing the poor farm management practices sometimes engaged in said, "Some farmers make their cows walk too quickly and sometimes too far to get to the milking shed". Other causes of lameness can include slow pasture rotation and generally poor stockmanship. Another farmer representative said, "There was no doubt that some farmers needed a bit of help". A strategic solution management partnership was developed with a world renowned dairy cattle lameness expert, three DairyNZ scientists, two veterinarians and two farmer representatives. Their task was to coordinate what would become the Healthy Hoof Programme. Having developed a solution programme to address cow lameness problems, the next challenge was how to transfer and "sell" this knowledge to farmers via a standard solution programme (the Healthy Hoof Programme). DairyNZ developed a series of adoption partners to "take the programme to the farmers" (DairyNZ scientist). The adoption partners selected included industry members such as veterinarians and farm consultants located throughout New Zealand. Key members in the strategic solution management

partnership worked with the 85 adoption partner members to train them on the requirements of the programme, so they in turn could train and guide local participating farmers. Initially various one-to-many promotions such as "Through Inside Dairy, farm discussion groups, and events that promote the Healthy Hoof Programme were used. Vets often run farmer seminars where they may promote the service" (veterinarian participant). A DairyNZ management participant pointed out, "You can't just put a product on the website and hope to interact with farmers . . . so there has to be an element of interaction with the farmer" and "We do that using a group-based approach . . . throughout the country" (veterinarian participant).

But often that was not enough "either because one-to-many never really works in terms of really thinking of how that model might fit on particular farm systems . . . We realised we have to have the one-to-one support as well" (veterinarian participant). DairyNZ management reported, "Demand needs to be stimulated by registered consultants". Upon receiving a farmer request to investigate the programme, an adoption partner member, such as a veterinarian, visits the farm to provide an initial assessment of the farmer's situation and to develop an action plan that is followed up by on-going support. "The Healthy Hoof Programme is free to levy-paying dairy farmers i.e. the resources and support are free but farmers pay an hourly fee that can range anywhere from 5-12 hours per annum for vet fees. For the farmer, paying for the service puts a value on the programme and so gets a management-led enthusiasm for the programme that filters down to the farm team" (Healthy Hoof Programme manager). "Usually the value is sold to farmers quite easily. We have developed a lameness cost calculator which estimates the monetary value in reducing lameness specific to that farm and then translates this to how many lame cows do you need to prevent to pay for the programme" (veterinarian participant). When vets are on a farm offering the Healthy

Hoof service, this may lead them to secure other business opportunities with the farmer for example where there are cow fertility problems. These visits can then provide indirect benefits back to the overall mission to increase animal health. The vet's visit with the programme may also prompt a farmer to tell his or her neighbouring farmer about the benefits of taking part in Healthy Hoof Programme that leads to a request by this other farmer to participate in the programme. Evidence of the value that the programme brings to farmers is indicated in part by the annual Dairy Farmer perception survey that DairyNZ uses to get "Solid evidence in monitoring the programme" (DairyNZ member). In 2015, 70% of farmers reported being aware of the programme. A total of 55 farmers had registered for the programme, up from 32 in 2014 and 49 in 2013. Several farmers reported they believed the programme has made their employees more satisfied in working with the animals. One farmer reports, "I think in my case it can lead to my farm hands staying longer, so there's fewer turnovers; well that's a big part of it". In 2015 nine veterinarians had attended provider training. A veterinarian reports, "The programme help[s] with staff training, team morale, financial productivity, and using time that's no longer spent fixing problems on the farm". Another veterinarian suggests improvements are made where learnings' "Definitely to staff morale and team attitude . . . improved pride . . . improved relationships between farmer owners and managers/sharemilkers. Owner/operators and sharemilkers with more than one staff member are possibly the easiest to convince. This leads to more spending on other facets of business and less cow wastage so production can be increased". These sentiments are echoed by a farmer who said, "It was great to have a rural professional who is so passionate about the programme helping you through your lameness problems". One DairyNZ management participant made a summary comment: "The prevention of lame cows sits largely with improved farm management".

The learnings from the Healthy Hoof Programme spilled over to improve other areas of animal health including milk production that ultimately impact on the overall competitiveness of the industry. Many of the management solutions involved in preventing lame cows also improve cow management and milking efficiency ". . . that directly improves milk production" (DairyNZ management participant). For example, some of its content ". . . has been taken up in to the Milksmart programme which has been developed since Healthy Hoof. Milksmart is around improving milking efficiency in the profitability area . . . it was thought of during development of Healthy Hoof but now it's in a more official programme" (DairyNZ management participant). A farmer representative organization member suggested, "Rural professionals can identify problems and implement policies, procedures and give training in to other areas such as mastitis. Often getting a win with Healthy Hoof can lead to a relationship that leads to the Healthy Hoof provider working with this farmer in other areas". Improvements to this programme are also being considered such as where "Some versions of documents have been updated. There is the possibility in the future that we will add more detail around lameness in off-paddock situations, e.g. to incorporate more nutritional effects of lameness" (veterinarian participant). However, most of the participant groups acknowledged the on-going challenge to make more use of ". . . farmer network partners such as Young Farmers" (Healthy Hoof Programme manager) to get feedback on their needs and ideas for the future.

A DairyNZ management participant shared that solution partner members, for example scientists and other industry professionals, develop a learning process that works towards developing a solution ". . . always have their antennae out for how some parts of a solution could be transported over to be used or adapted for another solution". Or some parts of a solution might be better suited to another: "We might say, well this

won't work for us, or yes this system will be likely to succeed, but why don't you link with another team over here" (veterinarian participant). It is the 27 targets that provide the "Magnet that pulls you to what you're after, the ideas and new understandings come out of the professionals and the scientists and the teams here and as I said that the ideas also come from the farmers feeding back through" (veterinarian participant). This way of working enables the sector to take ". . . a more proactive position based off the strategy and the 27 targets" where the feedback and any subsequent adjustments are managed by DairyNZ (DairyNZ management participant).

6. Discussion

The two learning episodes described above "learning how to compete" and "learning how to perform" provide empirical evidence of network learning. We identify a network learning process where the two learning episodes combine to form a network strategic learning process that centres on a collective performance goal. We also extend understanding on the relationship between network learning and organizational learning in attempting to increase member firms' and network's competitiveness. Finally, we provide specific insights on the role of the hub firm in regulating network learning. We discuss each of these contributions in more detail below.

6.1 Understanding network learning

Episode 1 "learning how to compete" demonstrates a network learning process where it shows how thousands of small firms (farmers) in an industry learned as a group to address their common problems, which led to the development of a performance goal. At the beginning of Episode 1, prior to 2008, firms and associations in the New Zealand dairy industry regularly debated their problems but could not agree on how to address them. The large number of geographically diverse firms typically had a wide range of

often complex issues and various levels of understanding that when combined intensified the ineffectiveness of these firms in solving these problems. To address this situation, firms agreed to create a neutral body (DairyNZ) that became the central hub firm to consolidate their voice and to guide the process of consultation. At this point a network structure was born. This episode describes how firms (farmers) nominated representatives in the network to engage in a learning process that led to setting a strategic performance goal. We interpret the various steps in this episode as a network learning process, because it provides empirical evidence of collective cognitive and behavioural change. Firms' cognitive structures evolved towards the collective broad problem of "how to compete globally" where they defined this broad problem in three major areas. Having set a performance goal, representative groups in the network agreed to define a set of strategic targets to guide their efforts towards. This set of structured targets had embedded within it the network's shared interpretation of the problems to be addressed and shaped by their collective interests and priorities. Episode 1 also shows behavioural change across firms as they interacted and coordinated with each other as a group. The creation of strategic goal and target setting partnerships that included a central organization (DairyNZ) who led and guided these strategic processes and regularly consulted with and sought feedback from all member firms.

The cognitive and behavioural changes that network members underwent in this period can be interpreted as collective learning by a group of firms (Dogson, 1993; Crossan et al., 1995) that aligns with Knight's (2002) definition of network learning as "a group of organizations learning *as a group"*, where it is learning *by* networks in contrast to learning *within* networks. Through their interaction, member firms changed the group's cognitive structures and behaviour, hence learning occurs as a group of firms rather than just the individual organizations within the network. Our work supports Dunford and

Jones (2000) and Knight (2002) where network learning has led to a change in the interaction processes, structures and the shared stories between member firms.

Episode 2 "learning how to perform" describes a network level learning process that, while different from Episode 1 in terms of learning, works to address the collective performance goal set in this earlier episode. In Episode 2 we show how a learning process develops interorganizational mechanisms for knowledge creation, knowledge transfer and knowledge adoption as a group (i.e. addressing the specific problem of animal health, creating or searching specific knowledge on cow lameness, developing a standardized programme to encapsulate this knowledge, establishing a partnership with veterinarians, promoting this programme, transferring practices to prevent lameness to farms, etc.). Episode 2 also shows network learning at cognitive and behavioural dimensions. We interpret cognitive learning at the network level when DairyNZ became aware of their limited knowledge on cow lameness after this problem has been identified and targeted. DairyNZ developed an expert solution partnership and launched a research project with several Australasian leaders in this field to gain a deeper understanding on the causes of lameness. The research project created new understanding on the underlying causes of this condition. The solution partnership then aimed to share this specific knowledge with farms throughout the network.

From a behavioural perspective, the solution partnership created a network structural mechanism for efficient knowledge creation with a standardized solution programme (the Healthy Hoof Programme). This partnership also established the rules and conditions for farmers to access to this programme. The transfer of this knowledge to farmers was carried out by adoption partnerships. The adoption partners were trained to provide support to disseminate this knowledge as well as to adapt the standardized programme to meet the requirements of individual farmers. We interpret the

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development of structural mechanisms and coordination rules for knowledge sourcing and knowledge transfer at the network level that did not exist prior to Episode 2, as evidence of network learning. Behavioural network learning in this episode includes the coordination of practices across the network to facilitate adoption of the Healthy Hoof Programme to recipient firms. It is important to note we distinguish between these network level practices from changes at organizational level when a firm implements the Healthy Hoof Programme. We interpret the latter as organizational learning because it involves changes of the organizational routines, practices and systems. Organizational learning triggered by network learning will be discussed later.

We believe our episodes on the farm-to-process network provide empirical evidence of network learning, which has been defined as "learning by a group of organizations as a group" (Knight, 2002; Knight and Pye, 2004). It should be noted that, while Episode 2 has focused on the Healthy Hoof Programme, this network spawned multiple (around 60) standard programmes that are not discussed. This strengthens the notion that the network learning process described here is not serendipitous; on the contrary, it emerges from a deliberate intention of solving network firms' collective problems. Similarly, the development of network mechanisms to create and transfer knowledge shows intentionality and coordination at the network level. As such, these findings may serve to counter the view that interfirm relationships are often unable to enforce the rules and directives required to integrate knowledge (Grant and Baden-Fuller, 2004).

This empirical evidence on network learning also extends existing understanding on the knowledge-based view of networks. It aligns with the previous studies on network learning (Dyer & Nobeoka 2000; Knight 2002; Knight and Pye, 2004; Coghlan and Coughlan, 2015; Peters, Pressey and Johnston, 2016). It also shows that network

learning is different from learning by organizations (organizational learning) within a network, in a process frequently identified as interorganizational learning (Crossan et al., 1995; Levinson and Asahi, 1995; Larsson et al., 1998). Network learning takes place when it results in changes to attributes of the network.

6.2 Network learning and organizational learning relationships

Some authors have considered network learning and organizational learning might be closely interlinked (Dyer and Nobeoka, 2000; Knight and Pye, 2004; Dyer and Hatch, 2006). Yet, the relationships between network learning and organizational learning have been scarcely explored. When network learning takes place we may also find evidence of organizational learning, although organizational learning is a process of learning individual organizations engage in. Episode 2 describes how network learning (i.e. the creation of the Healthy Hoof Programme and the coordination mechanisms at the network level used to implement this programme) triggers multiple processes of organizational learning by recipient firms (farms) when they select this programme. Adopting the Healthy Hoof Programme involves changes in understanding the factors influencing cow lameness across individual farmers and their employees and the implementation of better practices of animal health and farm management to prevent this condition.

The transfer of knowledge to an extended number of firms in a network requires addressing the problem of how to overcome any knowledge transfer barriers between firms (van Wijk et al., 2008). Our study shows that although knowledge is available to firms, farmers in this instance, organizational learning does not develop naturally in the network. When the Healthy Hoof Programme was made available it was not directly adopted, on the contrary, further effort was required by the network to transfer this

knowledge to individual farmers. Episode 2 describes how the solution management partnership used adoption partners to implement this solution programme in a one-to-one relationship after noticing that one-to-many promotions didn't work. Adoption partners are key agents during implementation to reduce knowledge ambiguity (Levin and Cross, 2004; Szulanski and Jensen, 2004) and increase adoption effectiveness. In addition, this process limits knowledge transfer outside the network's boundaries due to its solution specificity. Hence, firms in a network may benefit the network learning outcomes critical for building their competitive advantage (Coff, Coff and Eastvold, 2006), but in our case study this only happens when a subsequent process of learning at the organizational level takes place to adopt the network learning outcomes from developing the programme. We believe these findings extend prior research (e.g. Knight and Pye, 2004; Dyer and Hatch, 2006) on the relationships between network and organizational learning, showing that it is organizational learning that can potentially increase member firms' competitive advantage, but it is the network's rules, coordination mechanisms and specific knowledge sourced by network learning that triggers and facilitates organizational learning.

We have also identified another relationship where learning from an organization involves change at the network level. Episode 2 describes the replication of the same solution programme that is targeted towards thousands of firms throughout the network. For example, the Healthy Hoof Programme had an adoption rate of 23%, with an uptake by over 2500 firms who benefited from the programme. After several iterations of the programme, the solution management partnership gets feedback from adoption partners. This feedback is used to increase efficiency and accuracy in future offering of the programme. Additionally, adoption partners of the Healthy Hoof Programme such as veterinarians can identify other farm needs that provide

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opportunities to develop other related solution programmes (e.g. Milksmart programme or mastitis prevention). In both situations, it is organizational learning that influences network learning. Thus it might be the interaction among organizational and network learning which might leverage firms' competitive advantage and strengthen network ties.

6.3 The role of the hub firm in network learning

Our findings highlight the role the hub firm plays in regulating network learning processes. In this instance the hub firm occupies a key and central position within and between the episodes "learning how to compete" and "learning how to perform". Episode 1 describes how a fragmented large group of small firms needed to consolidate their interests and to act in a coordinated manner to address their collective problems. As a result these firms agreed to create DairyNZ, a neutral organization to lead and implement a strategic process to increase network firms' competitiveness. This episode leads to developing a collective network performance goal. Episode 2 describes the creation of a solution programme when a significant animal health problem was collectively identified and targeted. In Episode 2 DairyNZ guides the process of knowledge creation and sets the rules and mechanisms for efficient knowledge transfer to network member firms in an attempt to increase collective performance and to achieve the performance goal set in Episode 1. DairyNZ was purposefully created to develop an agency role at network level. Member firms refer to DairyNZ as an "industry good" organization. We identify this firm as a hub firm, as it works to bring together the dispersed resources and capabilities of network members (Dhanaraj and Parkhe, 2006) and to govern most of the network's coordination mechanisms (Gardet and Mothe, 2011). We believe our findings fill a gap in existing literature on the role of the hub firm in network learning where in this instance DairyNZ was not an existing

firm in the original network but rather was purposefully created as a neutral organization, since other member firms (farmers) were aware they could not develop these network level agency functions.

This study identifies three key roles the hub firm performs in a horizontal fragmented interfirm network: First, is a collective strategic consultation role by drawing together the collective interests of member firms and valuable external opportunities to improve the future of the NZ dairy industry. Episode 1 shows how fragmented farmer problems are collated into one broad problem "how to compete globally" and then 27 strategic targets (see Table 2) are developed, debated and agreed as a network strategy development process. Second, is coordinating the network knowledge flows: appointing members to solution management partnerships, advising the development of standard solution programmes or setting the procedures for programmes implementation and adoption to recipient firms. Episode 2 shows how the hub firm plays a central role in setting the mechanisms for knowledge transfer and arranging knowledge adoption via solution programmes to thousands of farms. These findings support Capaldo (2014) and Kogut (2000) by recognizing the importance of an effective coordination mechanism in network knowledge management. And third, is centralizing the collation and the dissemination of feedback. The hub firm collates feedback from network members to create new opportunities for knowledge spill-overs. This firm promotes debate among member firms participating in solution programmes to improve the programmes' implementation and explore new cooperation opportunities. The hub firm also disseminates knowledge to firms (farmers) for example on new industry requirements. Together these three mechanisms provide a means and support to address the inherent complexities and often conflicting interests of network

members in the absence of a dominant firm (Kilduff and Tsai, 2003; Knight and Pye, 2004).

The findings show how numerous problems experienced by network members can be collated, particularly through the positioning of, and responsibility taken by, the hub firm to systematically engage in collective action. Its central positioning between the two learning episodes we identify contributes to the existing gap in the literature with regard to how network learning can be coordinated and regulated in setting and striving to achieved performance goals (Knight and Pye, 2004; Provan, Fish and Sydow, 2007; Mariotti, 2012). By striving to systematically address the inherent complexities embedded across the multiple problems that are present in a horizontal interfirm network, this research also extends the work of, for example, Ebers and Jarillo (1998) and Arikan (2009). We believe this study contributes to extend existing literature on the roles hub firms play in network learning by identifying how a hub firm aligns collective interests, promotes knowledge mobility and sets an appropriability regime within the network (Dhanaraj and Parkhe, 2006; Fang, Yang and Hsu, 2013; Batterink, Wubben, Klerkx and Omta, 2010;).

7. Practitioner implications and conclusions

We identify a range of practitioner implications from our study. Our findings demonstrate important learning benefits where routines have been put in place for single firms as well as the whole network. In the "learning how to perform" episode producer firms, i.e. farmers and their employees in this instance, can use learnings from a generated approach (here, the Healthy Hoof Programme) to regularly self-diagnose and develop their own preventative strategies for future problems by, for example, monitoring and improving soil drainage. Veterinarians, as adoption partners, can also

use learnings gained from farm visits to pass onto others farmers. Also, when visiting farmers, veterinarians regularly identify and monitor other animal health problems, e.g. mastitis (cow milking infection) where they can introduce customized treatment plans farmers will learn from. The learnings in this episode also have implications for the whole network coordinated by the hub firm. For example, the hub firm learns how to balance promoting nitrogen fertiliser for pastures to improve grass growth with draining pastures to improve cow hoof problems that can also potentially pollute streams.

Similarly, in Episode 1 "learning how to complete" the hub firm is regularly reminded of the importance of developing a neutral trusting relationship between farmers and their representative firms. Without practising this type of learning as well as recognizing the need to bring in external expertise when required, especially with multi-stakeholder negotiations; it is unlikely the range of target areas required to meet the overall performance of the industry sector would be identified.

The nature of the learnings in these two episodes and the performance goal that is central to both also has implications for other inter-firm network types and their members, particularly for primary producers operating in horizontal inter-firm networks, who may lack sufficient expertise to compete alone, whether it is a lack of innovative expertise or knowledge on market requirements. When various network level performance goals are introduced that depend on learning episodes which overlap, this highlights the important role the hub firm plays in regulating learning not only within each episode but also between them in the network (Provan et al., 2007).

The limitations associated with our study, we believe, provide numerous fruitful opportunities for further research. First, the identification of the network learning process in an interfirm network is confined to a single case study in one industry sector.

Further studies could look to replicate this study in other industry settings. In the future, researchers could also examine for the presence of other learning processes and how they might link to the development of performance or other goals, for example, ones that combine sustainability and performance in the primary producer sector. Second, while our study focused on the learning process in a horizontal primary producer network, future studies might investigate the nature of network learning when this network form combines with a vertical network, i.e. when taking a global value chain perspective (Dicken 2015). Third, the findings showed economies of scale and economies of learning of firms participating in network learning process; however, our data did not provide detailed evidence of economies of scope or of reduced transaction costs. And fourth, the study highlights the orchestration and regulatory role of a hub firm. Future studies could examine how this hub firm performs a regulatory role in the goal process either in more conflictual settings or across other (e.g. non-industry interfirm) structures.

In sum, by taking a network learning perspective, our study provides understanding on the mechanisms and structures both from a cognitive and a behavioural perspective across settings that can be used to understand the process of network learning, as well as the learning process that occurs between individual firms and the network. By separating out the learning processes in each episode we were able to delineate the activities involved at each stage and the regulatory role the hub firm provides in a horizontal network towards developing and addressing a collective network performance goal.

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Appendix A: Interview Questionnaire Sample

Semi-structured Questionnaire *(Version for Adoption Partner Interviews)*

1. How would you describe the Healthy Hoof Programme?
2. What are the various stages in the delivery of the programme?
3. What are the core learning stage in this programme for the farmer?
4. How do you work with your partners in offering this programme?
5. How do you "sell" this programme to farmers?
6. What kinds of problems in understanding cow lameness do farmers present with?
7. To what extent do you need to convince and explain the value of adopting the learnings from the programme rather than farmers making the first approach to you?
8. How valuable is word of mouth from other farmers in getting farmers to ask about the programme?
9. To what extent are mass marketing opportunities, e.g. annual farmer field days, valuable in getting uptake?
10. How dedicated are farmers generally to adopt and carry through with what has been suggested in the programme?
11. What opportunity do farmers get to provide feedback on the programme?
12. While you are on the farm, what other opportunities present where you can learn about other animal health problems farmers may have beyond this programme?
13. What changes have been made in sharing the knowledge this programme offers since you have been involved in it?
14. How common is it for a farmer who use the programme to ask about and want to learn how to adopt another service to improve animal health?
15. If a farmer adopts the Health Hoof Programme are there other indirect learnings and value gains for the farmer that you are aware of?
16. What role does DairyNZ play in coordinating your efforts and those of the programme more generally?
17. When a farmer adopts the programme are there other indirect benefits from these learnings' (prompt .e.g. happy farm workers who have healthy cows, so reduces staff turnover)?

Primary Data – Participant Source[3]	Number of Interviews
4 DairyNZ senior management *(goal setting, solution, adoption)*	6
2 DairyNZ scientists *(solution)*	2
1 Dairy NZ Healthy Hoof Programme manager *(solution, adoption)*	3
	1
1 Milk production company *(goal setting)*	2
2 Farmer representative organization *(goal setting, solution)*	1
1 external industry consultant *(solution)*	1
1 veterinarian *(solution)*	2
2 veterinarians *(adoption)*	4
3 Farmer representatives	4
4 Field day farmer interviews	
Seminar group (DairyNZ management 6 members)	1

Table 2: Dairy network strategic areas and targets at the end of Episode 1

Target Number	Target Description
	Competitiveness Area: Farm Production and Resource Use Targets
1.	Achieve 1750 kg MS/ha (milk solids per hectare) from home grown feed by June 2015 in a research farmlet/demonstration context.
2.	A forage evaluation system including a measure of Forage Value, will be established following consultation and operating as agreed with industry by June 2012.
3.	Regional and local demonstration networks established and supported in nine regions, meeting negotiated regional expectations by June 2012.
4.	Optimal rates of genetic gain in the national herd are achieved, underpinned by an independent, farmer-owned evaluation system delivering information on relative profitability of animals to farmers and breeding companies through to 2020.
5.	Industry and government database initiatives are linked together in a National Dairy Data Network established by 2011.
6.	Industry animal health and milk quality targets met by 2016.
	Profitability Area: Farm People and Management Targets
7.	As a result of WFA (whole farm assessment) 30% of farmers have changed management practices and increased farm profitability by 2013.
8.	Labour productivity increases by reducing staff turnover to the national average by 2015 (currently 50% above national average).
9.	Achieve 100,000 kg MS/50 hr week by June 2015 in a research farmlet/demonstration context.
10.	Contribution to PFP and other industry outcomes on-farm by the appropriate use of recommended farm management tools. An industry-approved farm management toolkit is being used by June 2011 and updated every two years.
11.	The average skill level of the dairy farm workforce is increased by 40%, as measured by the New Zealand Qualifications Authority qualification framework, by June 2016.
12.	Professional standards and availability of farm business management capability (advisers & farm managers) improving from June 2012.
13.	By June 2010 establish a measure to audit the skills status of the industry. By June 2013 the labour market satisfies industry workforce requirements such that 90% of the people working in the industry have the skills required to competently perform their roles.
14.	By end of 2011, 50% of dairy farms have, and are implementing through an auditable process, nutrient management plans that reduce their nutrient footprint either to established benchmarks of high resource use efficiency or agreed partnership targets; 90% of farms are doing so by end of 2012.
	Sustainability Area: Off-Farm Drivers Targets
15.	In 2014, 70% of dairy farms are modifying their farm system or using mitigation technologies to reduce greenhouse gas emissions; 100% of farms are doing so in 2015. *Subject to change in proposed ETS legislation

16.	By end of 2015, production of greenhouse gases from New Zealand dairy farms are reduced by 10% in CO2 equivalents/kg MS (relative to legislative baseline) and in so doing improve productivity. *Subject to change in proposed ETS legislation
17.	By the end of 2011, 70% of dairy farmers are compliant with the good practice animal welfare guidelines for dairy farming established in 2010; 100% of dairy farmers are compliant by end of 2012.
18.	Effluent non-compliance < 15% by June 2011; by June 2012 < 10%, with no serious offences.
19.	By June 2012, dairy cattle will be excluded from 90% of streams, rivers and lakes.
20.	Achieve 30% reduction in system footprint (one or more of irrigated water use, greenhouse gas emissions, and nutrient loss) with 0% production loss in a research farm-let/demonstration context by June 2016.
21.	No serious breaches of the minimum standards of the Codes (Dairy, Transport, Painful Husbandry Practices, and Commercial Slaughter) under the Animal Welfare Act and the requirements of the Agricultural Compounds and Veterinary Medicines Act (for induction).
22.	By June 2012, at least two proven technologies for reducing greenhouse gas emissions have been developed (highly dependent on Pastoral Greenhouse Gas Research Consortium).
23.	By end of 2010, begin implementation of a 15-year strategy that will test in some areas whether eradication of Tb is possible under New Zealand conditions, while containing and rolling back Tb in other areas and maintaining national incidence of Tb close to current levels (0.33% infected herds).
24.	By 2015 the public perception of dairying has improved.
25.	Achievement of Johne's-free status by 2015.
26.	Maintenance of EBL-free status.
27.	By end of 2010, complete design and begin implementation of a comprehensive animal identification and traceability scheme that includes all at-risk species and provides means to manage a biosecurity crisis efficiently and protect market access