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University of Alberta

2009

RURAL ECONOMY

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Staff Paper 09-04

Staff Paper

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Acknowledgements:

Steiner gratefully acknowledges support from the Alberta Food Processors Association for conducting the 2009 survey. Thanks to Jolene Ali especially for conducting the 2005 survey. Excellent research assistance was provided by Richard Quinn, Lynne Draganiuk and Mark Graham.

1. Introduction

Following the pioneering work of Michael Porter (1990; 1998), a significant literature has emerged on location-based clusters. These clusters have been considered as geographic concentrations of interconnected companies and institutions in a particular field, such that locally defined entities and indigenous industries can be a source of competitive advantage (Porter 1998). Location-based clusters evolve when a concentration of a number of key business elements emerge in one geographical area. Such key elements include transportation infrastructure, investors, educational institutions, logistical resources, suppliers and human resources (Porter 1998). When successful firms engage in such clusters, they can create a demand-pull effect and draw a variety of high quality resources into the area. As a result, participation in a cluster enables firms to operate more productively in sourcing inputs and accessing information, technology and needed institutions (Porter 1998). Resulting knowledge-spillovers and agglomeration economies can have further desirable labour market and growth implications, further increasing the propensity to cluster spatially (Henderson, Kuncoro and Turner 1995; Audretsch and Feldman 1996; Blien and Maier 2008).

The traditional Porter-view of a production cluster has been expanded to include virtual cluster configurations (Preissl 2003; Preissl and Solimene 2003; Earl and Gault 2006; Pitelis, Sugden and Wilson 2006; Graf 2007). Since firm strategy is often embedded in global markets, Preissl (2003) suggests that knowledge creation in an increasingly global and complex economy requires us to focus on *interaction* rather than location as the constitutive element of clusters. Therefore, Preissl (2003) puts forward the notion of innovation clusters as consisting of virtual and physical cluster configurations. Such innovation clusters could be characterized by the systemic character of the relationships between firms (e.g. individual and organizational learning) and non-firm actors (research institutions, agents promoting technology transfer, policy actors), and therefore by the increasing interdependency and integration of non-firm actors (Preissl and Solimene 2003). It seems intuitively appealing to think of such virtual cluster configurations as part of innovation clusters in high-tech industries (Henderson et al. 1995), but how relevant are these virtual elements and related

non-firm actors for food clusters, and for the evolution of the food processing sector in those clusters in particular?

Perhaps the best documented examples of clustering activity in the food sector include wine clusters (Porter 1998; Holbrook and Wolfe 2004; Hickton 2004; Porter, Ketels, Miller, Bryden 2004; Aylward and Glynn 2006; Giuliani 2007), the agro-food biotechnology clusters (Cooke 2005) and in particular the Öresund food cluster, which expands across the borders of Denmark and Sweden (Lagnevik, Sjoholm, Lareke and Ostberg 2003). Lagnevik et al.'s (2003) study of the highly successful food cluster in the Öresund region puts forward the notion of dynamic food innovation clusters, where non-firm actors play a key role in the evolution and success of such clusters. As for the Canadian food industry, research has focused on the speciality foods cluster in Toronto (Wolfe 2006), on the wine clusters of southern Ontario and the Okanagan (Wolfe 2006), and on the agricultural and food biotechnology cluster in Saskatchewan (Phillips 2002; Lagnevik *et al.* 2003). However, other evidence on clustering activity in Canada's food industry is scarce.

Considering the above issues and evidence, this paper has multiple objectives. It aims to identify some of the key features that characterize successful food industry clusters, while focusing on the role of non-firm actors, and particularly on government support for networking and cluster growth. In order to achieve these objectives, section 2 first presents a short overview of innovation and food clustering support in Alberta. This section is followed by a review of some of the key literature on location-based clusters and virtual cluster configurations, and the role of government support for clustering activity in this context (section 3). Section 3 also presents empirical evidence on clustering in the food industries of several developed countries, so as to identify some of the common features of successful food clusters, and to provide empirical evidence on various levels of government support. Section 4 focuses on empirical evidence of networking, clustering and government support from the food sector of one of Canada's Prairie Provinces, Alberta. In an attempt to answer to what extent this support has reached firm and non-firm actors, section 4 presents the results from two exploratory industry surveys that were conducted in Alberta in 2005 and 2009, and discusses policy implications from these results. Section 5 concludes the paper.

2. Innovation and clustering support in Canada and in the Canadian agri-food sector

There is arguably little published empirical evidence on clustering activities in the food sector of one of Canada's three Prairie Provinces, Alberta, despite the fact that the Canadian government attributes an "*Alberta life sciences cluster*" to the province (WEDC 2008). Before presenting such empirical evidence from the Alberta food processing sector, it is however first desirable to identify some of the characteristics, opportunities and challenges of the Canadian food processing industry.

Food processing is the largest manufacturing sector in seven provinces and accounts for 10 per cent of the share of total manufacturing shipments in Canada (Krakar and Longtin 2005). It was also the largest employer of manufacturing labour, accounting for 14% of the manufacturing workforce, in 2004 (Krakar and Longtin 2005). Further, the Canadian food industry is characterized by a significant presence of large multinational firms, which account for about 50% of the industry's output (Krakar and Longtin 2005).

Compared to other Canadian manufacturing industries, the Canadian food processing industry is characterized by a low technology adoption rate (Baldwin and Sabourin 1998), which is of concern, since empirical evidence suggests that network communications technologies are particularly important to productivity growth in the Canadian food manufacturing sector (Baldwin, Sabourin and Smith 2004). Innovation in Canadian food processing is driven by three main factors: firm size, business practices and R&D expenditure by production and engineering departments (Baldwin and Sabourin 2000).[1]

In Alberta, food manufacturing activity - as measured by the number of food manufacturing establishments - was ranked fourth among Canada's provinces: in 2005, 8.8% of Canada's food manufacturing establishments – about 300 plus firms - were located in Alberta (Statistics Canada 2005). In terms of Canadian food and beverage manufacturing sales, Alberta was the third largest contributor in 2007 (12.9%), behind Ontario (40.9%) and

[1] The key role of R&D expenditure on innovation has been established for the Canadian manufacturing sector as a whole (Baldwin and Hanel 2000).

Quebec (24.2%). Food and beverage industries represent Alberta's third largest manufacturing sector in 2007, after petroleum and coal products (22.4%) and chemicals manufacturing (20.8%). At $5.4 billion, meat processing (including poultry) remains Alberta's largest food segment (53.6%) (AAFRD 2008).

Alberta represented 18.9% of Canada's agri-food exports in 2005, second only to Ontario (in both 2005 and 2007) (AAFRD 2006; AAFRD 2008). However, these exports are largely low in value-added, as they are dominated by unprocessed beef, wheat, pork, Canola seed and live cattle - the top five Alberta export products in 2005, in declining order (AAFRD 2006). It is thus of no surprise that the provincial government identified agri-food as a "priority value-added sector", and has plans of doubling agri-food revenues from $9.8 to $20 billion by 2013 (Alberta Government 2006a).

Alberta's food manufacturing industry faces several key challenges. First, its location relative to the major consumer markets in the US and Eastern Canada implies high transportation costs (Alberta Government 2006a). We would expect that this is of particular concern to Alberta's food processors, since small scale companies dominate this sector. The average shipment per establishment was only $2.2 million in 2004, and 37% of Alberta's manufacturing establishments (agriculture, construction and mining machinery industries) had fewer than five employees (Conference Board of Canada 2005). Second, the labour shortage, particularly of skilled and educated people, was expected to continue over the next ten years, reaching a shortfall of up to 100,000 workers (Alberta Government 2006a; Alberta Government 2006c; Josty and Godin 2005). This labour constraint could possibly be the single most important constraint for a successful food cluster development in Alberta (Wolfe 2003; Munn-Venn et al. 2004). Third, a lack of business R&D spending has been predicted to affect innovation performance in Alberta (Josty and Godin 2005). Since empirical evidence from all of the Canadian manufacturing industries suggests that R&D investment, firm competencies and past innovation activities are the three main factors affecting innovation (Baldwin and Hanel 2004), we would expect that this lack of business R&D spending puts severe constraints on any cluster growth in Alberta's food industry.

To support the food industry in Alberta and to achieve the objective of increasing agri-food revenues, the provincial government has initialized several programs, policies and institutes. The Alberta government has initialized the Alberta Agriculture Research Institute (AARI), the Alberta Value Added Corporation (AVAC) and helped to form the Agriculture and Food Council Value Chain Initiative (AFCVCI). The AFCVCI, formed together with industry representatives, is an association incorporated under the Societies Act, with the goal of promoting the development of value chains and value-added processing activities in general (AFC 2008). Funding possibilities for food industry participants are available through AFCVCI, in the form of The Advancing Canadian Agriculture and Agri-Food (ACAAF) Program. This program is run by the federal government, as a five-year, $240 million program, succeeding the Canadian Adaptation and Rural Development (CARD) Fund since 2004 (AFC 2008). AARI is designed to fund, coordinate and promote strategic initiatives in research, development and technology transfer for the agriculture and agri-food sector (AARI 2006). AARI is an arms-length government agency governed by a board of directors, which gives money to innovative Alberta-based agri-food companies. AVAC Ltd. is an Alberta-based, not-for-profit, private company that invests in innovative ideas that support the economic viability of Alberta's agri-food sector. AVAC is structured like a traditional corporation, with a board of directors and an executive management team, and receives financial support from the government of Alberta (AVAC 2006).

The Alberta government also provides financial and human capital assistance to private firms and Universities, for example through the Food Processing Development Centre, the Agrivalue Processing Business Incubator ($5 Million), the Food Science and Technology Centre, the Sensory Evaluation Centre (AFRD 2006), and the Agri-Food Discovery Place (WEDC 2006).[2] At these centers, firms can collaborate with industry stakeholders, and individuals with start-up ideas as well as established food processors can get manufacturing and commercialization support at a subsidized rate.[3]

[2] There are two Alberta-based Universities with a strong research focus on the agri-food sector, the University of Alberta (Edmonton), and the University of Lethbridge (Lethbridge).
[3] Exact dollar figures for these supporting infrastructures were difficult to obtain.

Considering all of the above efforts, the Alberta government and the city of Edmonton aims to "*build an innovation-driven, value-added and automation-focused cluster of companies involved with agriculture and food products in Greater Edmonton*" through the Edmonton Economic Development Corporation (EEDC 2006). As another step into this direction, the EEDC has founded the Food Processors Logistics Research Council (FPLRC). The intent of this pilot is to test the concept of a shared distribution system for perishables, as well as to develop a business case for investment in a permanent operation (Alberta Government 2006a).

In conclusion, it appears that there are significant financial resources and supporting institutions and organizations available to the Alberta food-processing sector, aimed at promoting networks, innovation and food cluster growth. However, the question remains to what extent key stakeholders in the Alberta agri-food sector perceive that such resources have actually promoted networks, innovation and cluster growth. Before we present survey results from Alberta in an attempt to answer this question, and to discuss the policy implications that arise from these results, it is desirable to (i) discuss the potential roles that governments may have in cluster development, and (ii) review empirical evidence on clustering from food industries of other developed countries.

3. Cluster development and opportunities for government support: insights from previous food cluster analyses

Martin and Scott (2000) propose to classify government support for ongoing cluster growth into four basic support structures: (i) public support for venture capital markets, (ii) R&D cooperation and financial support, including subsidies, (iii) high- and low-tech bridging institutes to facilitate technology transfer, and (iv) support for the development of infrastructure technology. The question arises whether these support structures should be promoted as part of an explicit strategy of cluster development, or whether cluster analysis and an embedded analysis of the above four support structures should be part of a broader set of innovation policies.

Overall, there appears to be consensus in the literature for the latter. Feser's (2002) work implies that, from a policy perspective, clusters could be regarded as a means to an end toward successful innovation policies. Further, cluster analysis has been regarded as a general mode of inquiry in regional economic analysis (Feser and Luger 2003), so that it can become part of a broader strategic planning process that incorporates private sector involvement and public opinion (Feser 2008). Feser (2002) also suggests that the cluster concept in itself could be regarded as a strategic framework for motivating and coordinating targeted interventions and investments, designed to foster innovative activities – thereby implicitly supporting the notion that analytical distinctions of innovation phases and phases of cluster development are useful for guiding theory and policy (Utterback 1994; Maskell and Kebir 2005).

3.1. The nature of clusters and phases of cluster development

Porter (1990) provides empirical evidence from ten countries to conclude that industry clustering is a central feature of advanced national economies. According to Porter (1998), clusters can affect competition in three ways: by increasing the productivity of the companies, stimulating the formation of new businesses and by driving direction and pace of innovation. Similarly, Lagnevik et al. (2003) argue that the innovation process as part of food cluster development cannot be separated from a company's strategic and competitive context. Lemmens (2004) provides more recent evidence that firms outside of clusters have a lower innovative performance. He suggests that the low performance of non-participating firms is particularly evident under cumulative technological change, and in a disruptive and turbulent technological environment.

This innovation-enhancing potential of clustering has received significant attention in both the literature and from policymakers (e.g. Blien and Maier 2008), particularly in cases where governments aim to increase innovative activity to help overcome regional productivity gaps (Dachraoui and Harchaoui 2003; Gera, Roy and Thitima 2006). However, as governments interfere with markets, what are some of the potential risks and benefits that go along with the promotion of clusters at different stages of their development? What are benefits from clustering that emerge for individual firms, the local economy as well as for society as a

whole? In order to answer these questions, it is useful to first distinguish different stages of cluster development.[4] Such a distinction could be particularly useful with regards to an analysis of innovation clusters (food innovation clusters, as referred to by Lagnevik et al. 2003), both as a guidance for policy considerations, as well as due to the relationship with Utterback's (1994) theoretical framework of three development phases that characterize the evolution of industrial innovation processes.

Munn-Venn and Voyer (2004) suggest that the development of a cluster could be broken down into four distinct stages. In the first stage, the cluster is mainly a vehicle for the creation and diffusion of knowledge. Many of the participating firms are introducing new concepts or products, and have not yet made any substantial commercial gains. Since venture capitalists prefer to finance early-stage firms (Stuart and Sorenson 2003), and because venture capital constraints can aggravate innovation market failures (Martin and Scott 2000), it is likely that venture capital constraints have their greatest negative impact during this stage. Therefore, it is of great policy interest that Martin and Scott (2000) emphasize that public support for venture capital markets, aiming to address innovation market failure that arises in financial markets, can be well-suited for the development of innovative inputs. Similarly, Callahan and Muegge (2003) suggest that governments can strengthen clusters by facilitating the formation of regional venture capital and angel investor funds. Evidence from food clusters and functional food processing is somewhat limited, yet suggests that venture capital is an important driver of clustering success (Lagnevik et al. 2003, p.95).[5]

In the second "growth-stage" (perhaps closest to the transitional phase of Utterback 1994), knowledge is rapidly transformed into products and processes (Munn-Venn et al. 2004). Companies participating in the cluster typically start to become internationally recognized and their exports begin to grow. At this point, significant movement of labour between firms occurs, but neither the firms nor the employees incur substantial relocation costs. Munn-Venn et al. (2004) suggest that while access to skilled labour is important at all stages of cluster

[4] Maskell and Kebir (2005) go further, to suggest that it is desirable to consider cluster life cycles for theory guidance.

[5] Further, it is likely that spatial clustering of venture capital by firm type accompanies this (and the following) development phase. Munn-Venn et al. (2004) show that young firms will go to where risk capital is located, while mature firms attract such capital to their own locale.

development, it is most critical during the "growth-stage". Evidence from food clusters suggests that mobility of highly qualified professionals is a significant contributing factor for clustering success (Lagnevik et al. 2003). However, we have no evidence from food clusters on the implications of a lack of access to skilled labour.

The third stage of a cluster cycle could be labelled as the "mature-stage" (Munn-Venn et al. 2004), and it develops when the number of new entrants into the cluster declines, employment growth slows and cluster firms start to become "cash cows" (this phase could be compared to Utterback's (1994) specific phase in the innovation process, during which production processes and products are increasingly refined). Munn-Venn et al. (2004) suggest that research and development (R&D) funding often declines during the third stage.

When a cluster reaches the 'renewal or decline stage', it has reached the final stage (Munn-Venn et al. 2004). In this stage, the cluster can reinvent itself and its products to maintain consumer interests in its products and services (Ahuja and Lampert 2001 and Lagnevik et al. 2003 emphasize that the "maturity trap" can be a significant development trap during innovation processes). Therefore, this final stage has been considered as the most critical one, as consumer demand may shift away from cluster products, and its products may become obsolete (Munn-Venn et al. 2004). Evidence from Lagnevik et al. (2003) suggests that the European food industry was in this renewal stage during the early 2000s (Utterback's (1994) specific phase), as the industry faced the occurrence of new technologies and the invasion of actors from other industries, which changed the competitive landscape of food clusters significantly (Lagnevik et al. 2003, p.28). Perhaps the emergence of centers of functional food processors within the food sector has helped the European food industry to overcome the challenges of a 'maturity trap' during the final stage of cluster development. The evidence from Lagnevik et al. (2003) and Holbrook et al. (1999) also suggests that governments can have an important role to play during such a 'rejuvenation' phase, in the form of a strong competition policy.

Throughout all of the above phases, labour mobility has an important role to play for successful cluster evolution, especially during the early phases. Porter (2000) suggests that

successful clusters attract the best employees, firms, and both domestic and foreign investors to a local economy. While these benefits of a successful cluster are contingent on how successful the cluster can market itself externally and develop its reputation, a higher concentration of firms within the cluster makes it easier, *per se*, to attract new talent to the local economy (Porter 2000). Wolfe (2003) goes somewhat further to suggest that in order to attract the firms necessary to build a successful cluster, a skilled and competent labour force is possibly the most important element.

3.2. Knowledge creation and diffusion: a role for government?

Lagnevik et al.'s (2003) study of the world's leading food innovation clusters suggests that there is a broader base for clustering success than that of enabling organizations. They isolate three key factors that characterize successful food innovation clusters. First, they identify supply determinants ('groundings'), such as unique resources and knowledge, as well as a well-developed infrastructure. Second, they suggest that several structural determinants matter, such as world class (multinational) companies in the food chain, and coherent ambitions of cluster participants with regard to competition and cluster development. Third, the authors suggest that there are two key demand determinants, namely local markets with 'demanding' consumers (food safety, organic, animal welfare) and good access and outreach to external markets. Thus, for each of the above three factors, knowledge diffusion is likely to play an important role – in the form of knowledge exchange about processes, technologies, consumer tastes, and through various types of infrastructure, firm alliances and networks.

Considering the above evidence (section 3.1.), knowledge creation and diffusion in a food cluster could be promoted through a skilled and mobile labour force. However, what is the role of virtual interactions and network relationships for increasing knowledge transfer, innovation and food cluster growth? We have evidence that knowledge creation and diffusion can not only take place through spatial proximity, but also through a virtual learning and networking environment (Passiante and Secundo 2002; Kaufmann, Lehner and Tödling 2003; Darmon and Torre 2004). Preissl (2003) proposes a combination of spatial and virtual cluster configuration for studying innovation clusters. Preissl (2003) backs up her argument of

abandoning the strict location-oriented approach to clusters with empirical evidence on knowledge transfer in local and non-local settings from Germany's automotive industry. However, as for food industry clusters, and the role of the food processing sector within these clusters, could it be that the mature nature of the food industry (Henderson et al. 1995), which borrows significant amounts of technology from the biotechnology sector (Prevezer 1997), requires a low level of virtual learning and diffusion of tacit knowledge, such that virtual clustering may have a relatively small role to play? Although this question is inherently linked to a measurability problem of tacit knowledge transmission and virtual learning, the very limited literature on this issue in the context of food clusters suggests that this may indeed be the case.

Nevertheless, we have evidence from empirical analyses of food clusters about the relative role of a firm's internal environment (existing trust relationships, customer focus) versus government support through specialized organizations in fostering networks to share a common knowledge base as part of clustering. Wolfe (2006) presents an extensive review of case studies from Canada's food and non-food clusters, to conclude that government interventions that aim at promoting network growth are less important than the firm's internal environment in affecting innovation in the food sector (wine, specialty foods). Other studies from the wine industry confirm the relative importance of a firm's internal environment. A study on Canada's Okanagan wine cluster suggests that direct and indirect government interventions (tradeshows, sponsoring of networks) are less important than the firm's internal environment and customer feedback in influencing innovation (Holbrook, Hughes and Finch 1999). Hickton's (2004) study on the Okanagan wine cluster also confirms the importance of such firm-internal factors, yet points to the importance of networks between firm and non-firm actors in food clusters. The study highlights how important collective and socially negotiated ties and relationships, and thus social capital, can be for a successful cluster and community development.

But why do those firm-internal networks, and networks between firm and non-firm cluster participants matter so much, yet are seemingly difficult to promote through government

efforts? The lack of relational trust among cluster and thus social network participants could result in a failure to keep knowledge flows open, resulting in the reduction of the cluster's innovative potential (Rousseau, Sitkin, Burt and Camerer 1998; Porter 2000; Castilla, Hwang, Granovetter and Granovetter 2004). Liyanage (1995) provides cross-industry empirical evidence from Australia which suggests that cluster members and their support network should be open if they are to contribute to diverse product development and adapt to diverse market demands. Considering Lagnevik et al.'s (2003, p.87) emphasis on the importance of *demanding consumers* in specialized areas of development like health, food safety, and animal welfare for food innovation clusters, trust relationships and the (in)ability to keep knowledge flows open are likely to be significant in the case of food innovation clusters. However, what could the government do, in support of such trust relationships, anticipating that it is difficult for governments to promote open support networks and the creation of 'demanding consumers'?

Considering trust as a conditional good of risk (Wicks, Berman and Jones 1999), could the government provide an institutional environment that reduces perceived innovation risk, for example through "*specialized organizations … with a long-term perspective*", which Lagnevik et al. (2003; p.86) identifies as a key factor for successful food innovation clusters? Building trust and exchanging tacit knowledge requires the physical encounter of individuals; hence, spatial proximity is likely important for cluster development (Bergman and Feser 1999; Preissl 2003). Thus, if governments could reduce transaction costs between cluster agents, thereby facilitating repeated face-to-face information and knowledge exchange, it may also contribute to reducing scope for opportunism between agents in a cluster. This contribution through government support (though difficult to measure) could be significant, particularly in those food sectors, where health, food safety and credence attributes in general are of significant importance. This could be expected since consumer trust into the products originating from these food clusters is likely to put significant pressure upon the cluster's participating agents for process innovations, while raising the scope for agency costs (Jensen and Meckling 1976). Although it is disappointing to see that previous cluster analyses suggest that such government support aimed at increasing networking and trust has not been too effective (Holbrook et al. 1999; Hickton 2004), this may not be too surprising since these

analyses largely focused on the wine sector. Compared to those sectors where health, food safety and thus credence attributes are of greater importance (e.g. meat processing, natural health products, functional foods), the scope for building trust and networking may be significantly smaller among cluster stakeholders who are processing a product with significantly lower food safety and health risks – wine.

Beyond the specific means through which governments could potentially increase clustering growth and innovative performance, a more fundamental question is whether governments should contribute to the creation of new clusters and/or to sustaining ongoing cluster growth. Although there is a significant debate in the literature, economic efficiency would suggest that it is undesirable that governments pick companies as a means of creating new clusters (Glavan 2008). Porter (2000) and Feser (2002) suggest that it is more desirable that governments reinforce established and emerging clusters, rather than attempt to create new ones. Lagnevik et al. (2003) also support this view, by emphasizing that a government can contribute by creating an organizational framework for the collective supply of important capabilities and technologies that support cluster development. Through such organizational frameworks, governments can reduce the administrative costs associated with cluster growth, thereby strengthening the linkages between bridging organizations, research institutions, firms and government bodies (Porter 2000; Lagnevik et al. 2003).

3.4. The role of government support for food cluster growth: evidence from previous food industry studies

We have evidence from the Brazilian food processing sector, which supports Lagnevik et al.'s (2003) proposition that government support through the promotion of an infrastructure of specialized cluster organizations can have significantly positive implications on innovation in the food sector. Based on a survey among Brazilian food-processors, Cabral and Traill (2001) explore the role of firms' characteristics on their likelihood to innovate and their capacity to generate innovative outputs. The authors concentrate on hypotheses related to the relationship between complementary assets (resources and capabilities) and innovative outputs. These complementary assets are related to marketing, distribution and other functional areas of the

firm. In this way, their study tests the hypothesis of Teece (1986) that innovative firms use complementary assets, which support their innovative capacity and secure the benefits of innovation.

This hypothesis about complementarities is also related to the systemic character of innovation clusters, which has been proposed to consist of complementarities, coordinated firm linkages and resulting synergies (Preissl 2003). Considering evidence from outside of the food sector (car manufacturing), Preissl (2003) not only suggests that virtual links complement the physical links in a cluster, but also that complementarities among cluster members' competencies promote cooperative interaction and thus result in desirable synergies. It is therefore remarkable that the key findings of Cabral and Traill (2001) relate to complementary assets and firm linkages. Firm linkages with other firms, Universities, and/or agencies of research for developing innovative projects were found to be an important mechanism for inducing innovativeness. However, while controlling for other determinants of innovative activity, the authors found no evidence for the effect of complementary assets on innovations. The likelihood of food firms to innovate was found not to be significantly determined by complementary assets, in terms of market orientation, vertical integration and horizontal diversification. A key policy recommendation of Cabral and Traill (2001) favors government support through specialized organizations in fostering innovation and cluster growth. In line with Porter (1998), Lagnevik et al. (2003) and Preissl (2003), Cabral and Traill (2001) suggest that government support can have a significant role to play, in the form of elimination of institutional barriers to innovation and through the promotion of inter-firm linkages.

Other empirical evidence on clustering and government support in the food sector is sparse, or has concentrated on identifying food clusters. O'Malley and Van Egeraat (2000) perform an aggregate analysis of all Irish manufacturing sectors, with regards to the presence and role of industry clusters and their relation to growth performance in the Irish indigenous industry. The authors match the (SITC) export categories to the corresponding (NACE) production sectors, identify which (NACE) production sectors have a majority of employment in foreign-owned firms and identify the (SITC) export categories coming from those (NACE)

production sectors as originating from industrial sectors which are predominantly foreign-owned. By matching SITC trade data to the corresponding NACE production sectors in this manner, the authors find that the balance of international trade is negative for 11 of the 14 sectors - by a large margin in most cases. The three exceptions that have a positive balance of trade are other food products (NACE 423), tobacco products (NACE 429) and furs and fur goods (NACE 456). However, other food products and tobacco products are predominantly foreign-owned industries. Therefore, the authors suggest that Porter's (1990) assertion that multinationals can help to promote indigenous industries in a host country, finds merit in the Irish case. However, O'Malley et al. (2000) conclude that, apart from the food-related industries, there is very limited evidence of location-based clusters in the Irish indigenous industry.

Nevertheless, these findings are not in line with earlier evidence from an Irish case study analysis. Clancy, O'Malley, O'Connell and Van Egeraat (1998) analyze three Irish industrial sectors and focus on the relevance of clusters for competitive advantage. Considering the dairy processing industry, the music industry and the Irish indigenous software industry, the authors conclude that these industries are not characterized by fully developed industry clusters. This contradictory finding of Clancy et al. (1998) may be explained by the fact that O'Malley et al. (2000) did not investigate the actually existing cluster linkages between firms and cluster agents.[6]

Considering that our next section presents empirical evidence of government support for cluster development in Alberta and a policy assessment of these empirical findings, it is desirable to summarize the pros and cons for promoting regional clustering through public intervention as following from the above discussion (section 3):

[6] "We have simply used our judgement to allocate all of the qualifying Irish industries into what appear to be the most appropriate sub-groups in a standard cluster chart, without investigating the extent of connections between industries in each group or cluster. Our arrangement of the industries into clusters, therefore, should be seen in the spirit of a hypothesis or suggestion that there could potentially be relevant connections between the industries in each "cluster", rather than a claim that there definitely are such connections." (O'Malley et al. (2000), p.66).

PROS	CONS
• increase innovative activity to help overcome regional productivity gaps (Dachraoui and Harchaoui 2003; Gera, Roy and Thitima 2006) • overcome venture capital constraints which can impede the formation of regional venture capital, and aggravate innovation market failures (Martin and Scott 2000; Callahan and Muegge 2003) • reduce lack of access to skilled labour (Lagnevik et al. 2003; Wolfe 2003) • targeted cluster policy can be part of a broader competition policy (Holbrook et al. 1999; Lagnevik et al. 2003) • promote cluster growth through support of infrastructure of specialized cluster organizations, with the objectives to eliminate institutional barriers to innovation and promote inter-firm linkages (Porter (1998; Cabral and Traill 2001; Lagnevik et al.'s 2003; Preissl 2003)	• evidence suggests that government support aimed at increasing networking and trust has not been effective (Holbrook et al. 1999; Hickton 2004) • governments picking companies as a means of creating new clusters is undesirable/ can be associated with efficiency losses (Porter 2000; Feser 2002; Lagnevik et al. 2003; Glavan 2008)

4. Evidence for networking and clustering from industry surveys in Alberta

Our review of the clustering literature (section 3) has identified that the sharing of information and knowledge, trust, networking among firm and non-firm actors, as well as access to skilled labour and venture capital can be important for the propensity of firms' innovative activity to cluster spatially. Section (2) has highlighted the potential importance of communications technologies to productivity growth in the Canadian food manufacturing sector (Baldwin, Sabourin and Smith 2004). Evidence from section (2) also suggests that although capital constraints are unlikely to be an issue in the Alberta food processing sector for expanding towards a food cluster, business R&D spending and access to skilled labour could be considered as a key constraint for food cluster growth.

An exploratory mail-back survey was developed with two overall objectives in mind. First, it aimed to explore the extent to which industry participants perceive that they operate in a supportive business environment. Second, the survey aimed to capture industry participants' perceptions with regards to potential constraints for cluster development, as identified in sections (2) and (3).

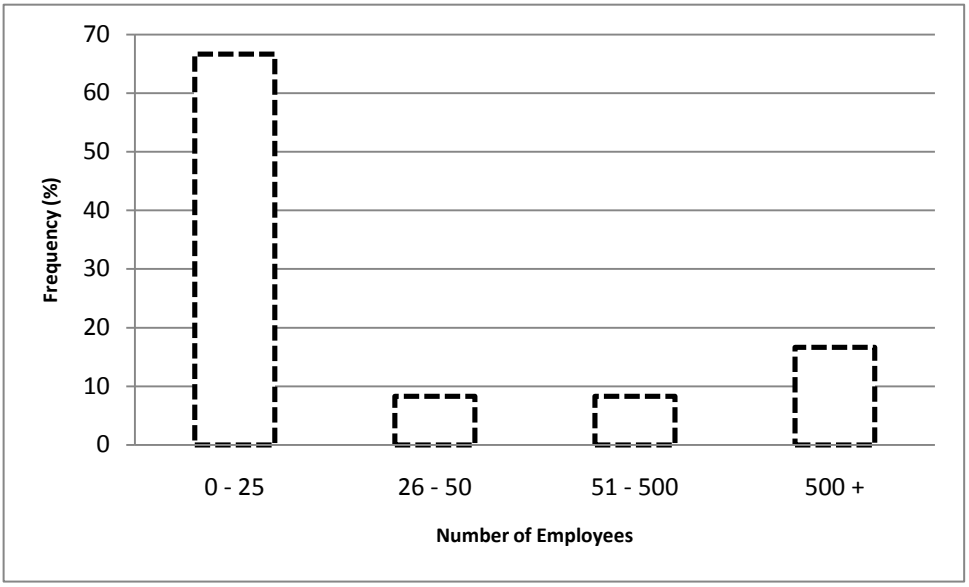
4.1. Survey methodology and approach

Survey participants for the 2005 survey were identified from the Alberta Food Processors Association Business Directory (AFPABD 2007), from the directory of the provincial's Agricultural Ministry (Alberta Agriculture and Rural Development), and from academic staff at the University of Alberta. A total sample of 55 individuals (senior stakeholders) was identified, based on the overall objective to represent a wide (and thus representative) range of food processing activities, as well as trying to capture some of the non-firm actors in a potential cluster (academics, consultants, managers from input supply industries). In the spring of 2005, these individuals were first contacted by telephone to inform them about the nature of the survey and inquire about their potential willingness to participate. No incentive payment was provided. Based on the respondents' preference as voiced in the telephone

screener, an anonymous mail-back survey was sent by regular mail, or the survey was sent as an email attachment.

After one round of reminder emails and a second round of telephone reminders, only thirteen completed surveys were returned. Although the response rate was thus rather low (23.6%), the breadth of the respondents was diverse: food processors (8), senior government officials (2), a senior University researcher who also has an ownership stake in a food processing operation (1), a professional consultant (1), and the senior manager of a commodity group (1). As Figure 1a shows, the size of the respondents' firms/institutions varied widely in terms of number of employees (more than 65% of the firms had less than 25 employees).

Figure 1a: Size of firm/institution by number of employees (2005)

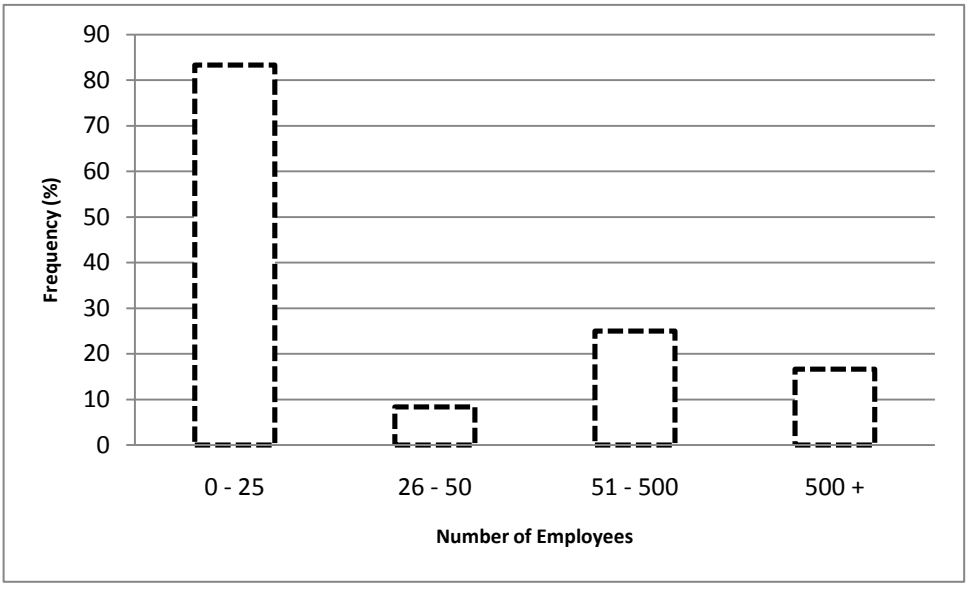


The 2005 survey was reviewed by the Human Ethics board of the University of Alberta, and pre-tested with a small sample (3) of University of Alberta academics who are working

closely with food industry participants, as well as with a small sample of firm managers (4) from the food sector, who were excluded from participation in the final survey.

Given the low response rate of the 2005 survey, and the diversity among those who responded, we conducted a follow-up survey between the last week of July and August 15 of 2009. With support from the Alberta Food Processor Association, a reduced version of the 2005 survey (the last three questions [Appendix A] were taken out) was sent to the 300 members of the Alberta Food Processors Association.[7] In order to maintain confidentiality, the survey was mailed out electronically to food processors by the Food Processor Association's secretariat. No incentive payments were provided. After an initial period of two weeks, an email reminder was sent out, and the survey closed after an additional week on August 15. Surveys could be returned to the secretariat by email or via Fax. These anonymous survey responses were then processed by us. The survey response rate was 5.7% (n = 17).

Figure 1b: Size of firm/institution by number of employees (2009)



[7] According to the Alberta Food Processor Association, these 300 firms represent more than 70% of the industry's output in Alberta.

As Figure 1b documents, there were slightly more medium-size firms participating compared to the 2005 survey (about 25% of the firms in the 51-500 employee bracket) and more small firms (about 83% in the 0-25 employee bracket) compared to the 2005 participants. Nevertheless, the size distribution is rather similar across both surveys.

4.2. Survey results

Respondents were asked to rate government support for innovation in the food processing industry at several levels (Figure 2a, 2b and 2c).[8] These included three regional levels of responsibilities (federal, provincial and municipal), as well as various levels of support in the underlying business environment (access to funds, educational support and training, research facilities, networking, technical expertise, support and training with regards to regulations, business development expertise). From among the regional levels of government responsibility, government support at the municipal level was judged most unacceptable in both years (2005: 58%; 2009: 38%), together with regulation support in 2009 (38%). Government support at the provincial level was the only one among the three that was judged by respondents as outstanding in 2005 (18%). However, survey respondents were more positive in 2009, since several factors were rated as outstanding, particularly provincial support (33%), technical expertise (22%) and educational support (17%). Considering the above factors that were used to describe the business environment, the access to funds, the educational support and training, and the support and training with regard to regulations were judged as most unacceptable in 2005 (58, 50 and 50 percent, respectively). Although 2009 respondents also judged federal support, research facilities and business development assistance as unacceptably low (all 28%), it is striking that the overall level of dissatisfaction is substantially lower in 2009 (unacceptable ratings all below 40%, in contrast to 60% in 2005).

[8] Industry participants' perceptions were recorded via Likert scale questions (unacceptable, acceptable, outstanding and not applicable; see Appendix A).

Further, in 2005, more than 80 percent of the respondents agreed that government support with regards to research facilities is acceptable. Government support for networking was the only type of business environment support that was judged as outstanding, yet by only 17% of the respondents. In contrast, in 2009, the overall levels of factors related to government support that were judged as acceptable were lower than in 2005, led by access to funds (56%). Further, nearly 25% of the 2009 respondents judged networking as unacceptably low, which contrasts sharply with the view of the 2005 respondents who perceived networking as outstanding.

Figure 2a: Ratings for government support for food innovation (2005)

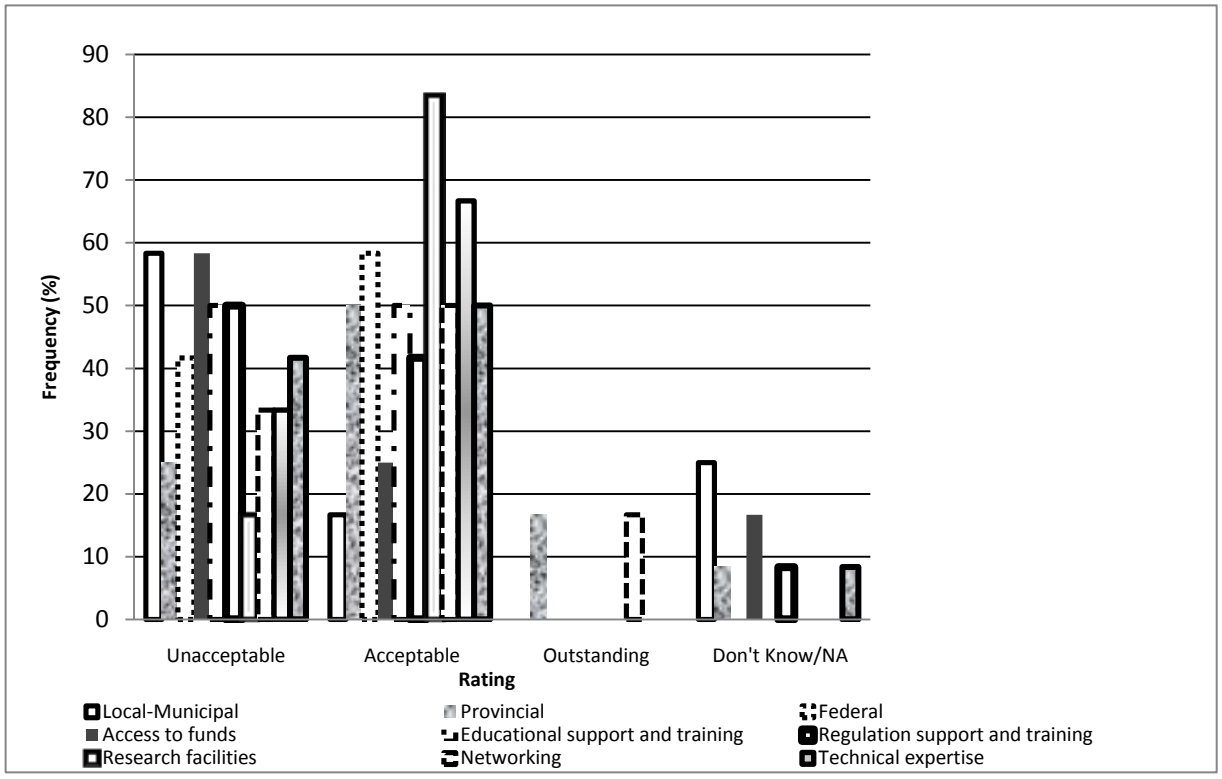
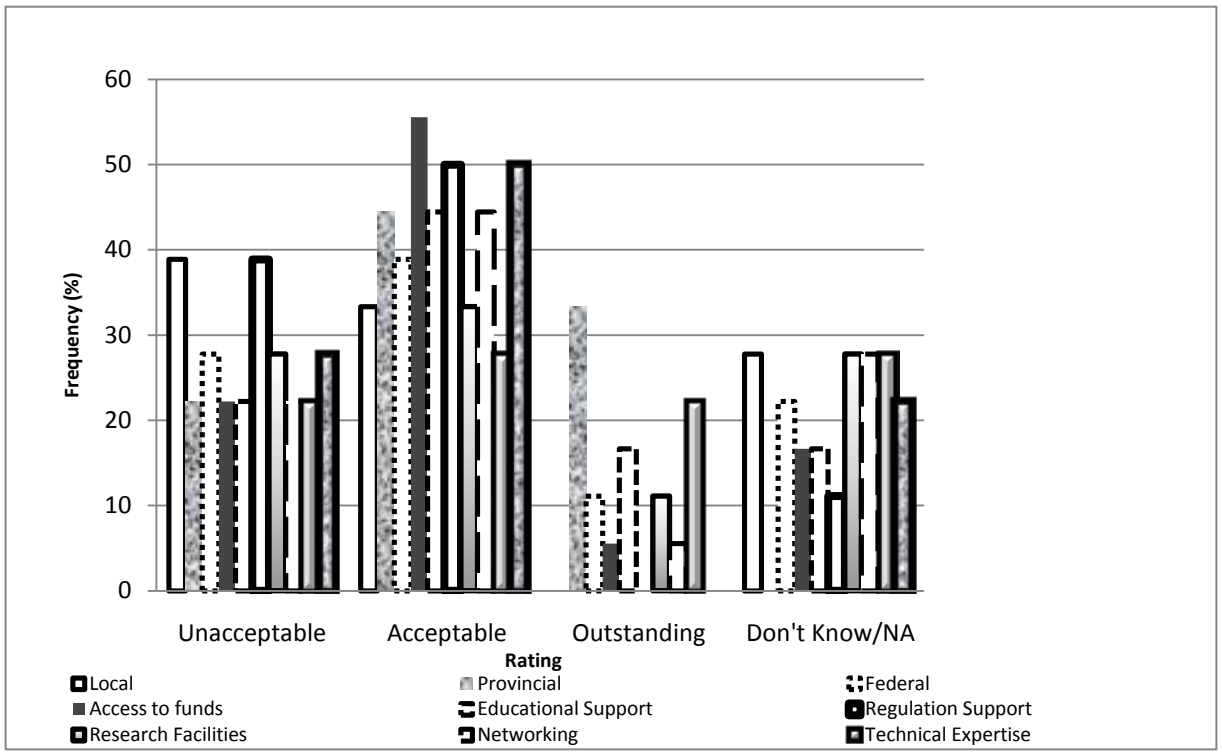
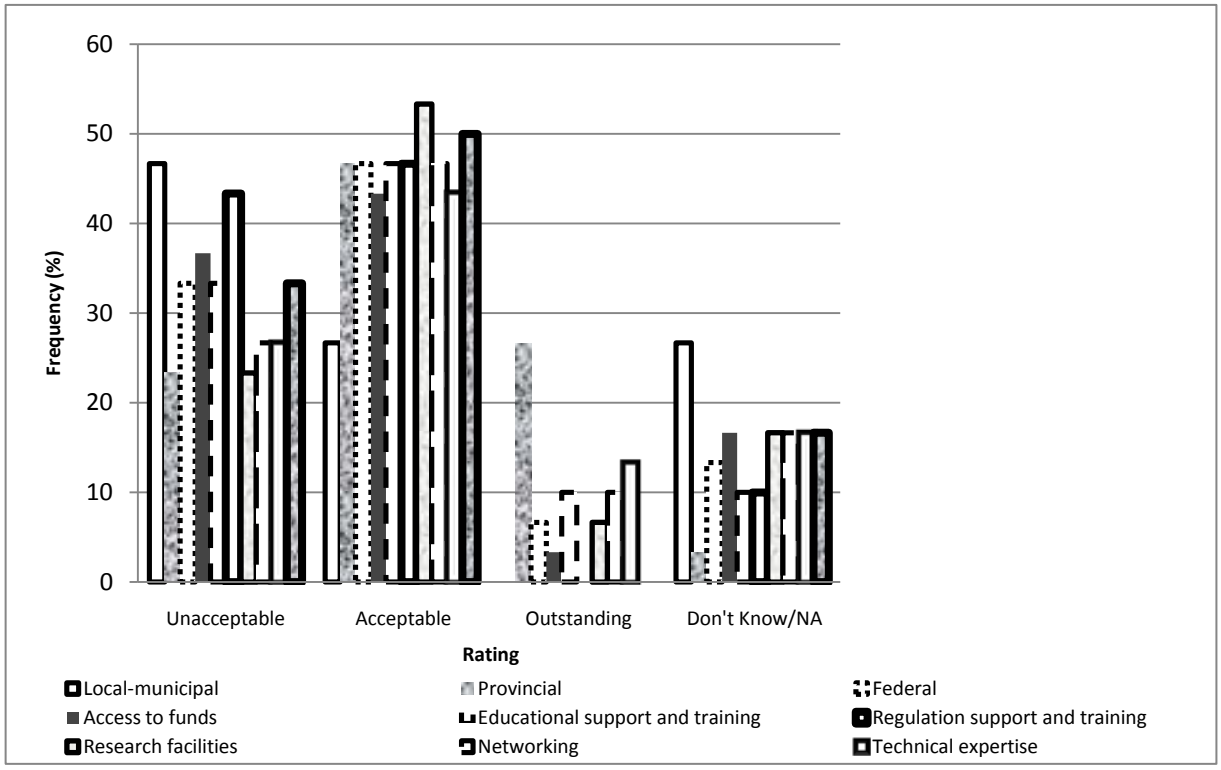


Figure 2b: Ratings for government support for food innovation (2009)



If we consider our survey results from both 2005 and 2009 jointly with regard to levels of government support (Figure 2c), the most outstanding levels of support relate to provincial support (27%), the most unacceptable levels of government support relate to local (municipal) levels of government support (47%), while government support in terms of research facilities was judged most frequently as acceptable (53%).

Figure 2c: Ratings for government support for food innovation for all respondents in 2005 and 2009



To further explore the respondents' perceptions of the underlying (cluster) business climate, we asked respondents to rate several factors that are expected to impact innovation and entrepreneurship in Alberta: Taxes, operating costs, logistics/proximity to markets and access to skilled labour (Figures 3a, 3b and 3c). None of the above factors were judged as outstanding in 2005, which is striking since government sources emphasize a significant tax advantage over other provinces (Alberta Government 2006b). In 2005, the access to skilled labour was perceived to be the most constraining factor (58% unacceptable), followed by proximity to markets (50%) and taxation (32%). In contrast, two factors were judged as outstanding in 2009, although at low levels: location/ proximity to markets (11%) and access to skilled labor (5%). Also, access to skilled labour received the highest rating among factors that were considered as acceptable in 2009 (71%). The latter two findings are not too surprising, considering that the global financial crisis lowered input constraints in Alberta

with regard to transportation (energy) cost and with regard to access to labour. Striking is nevertheless that in 2009, the operation costs were judged as most unacceptable (50%),

If we compare both years' ratings of business factors with respect to food innovation and entrepreneurship, we can conclude that 2009 respondents are more satisfied with those business factors (the overall levels of acceptable ratings are higher in 2009, and those judged as unacceptable were lower in 2009). Considering the responses from both years jointly (Figure 3c), it is perhaps most striking that location/ proximity to markets and operation costs were judged most frequently as unacceptable (both 32%).

Figure 3a: Ratings of business factors with respect to food innovation and entrepreneurship (2005)

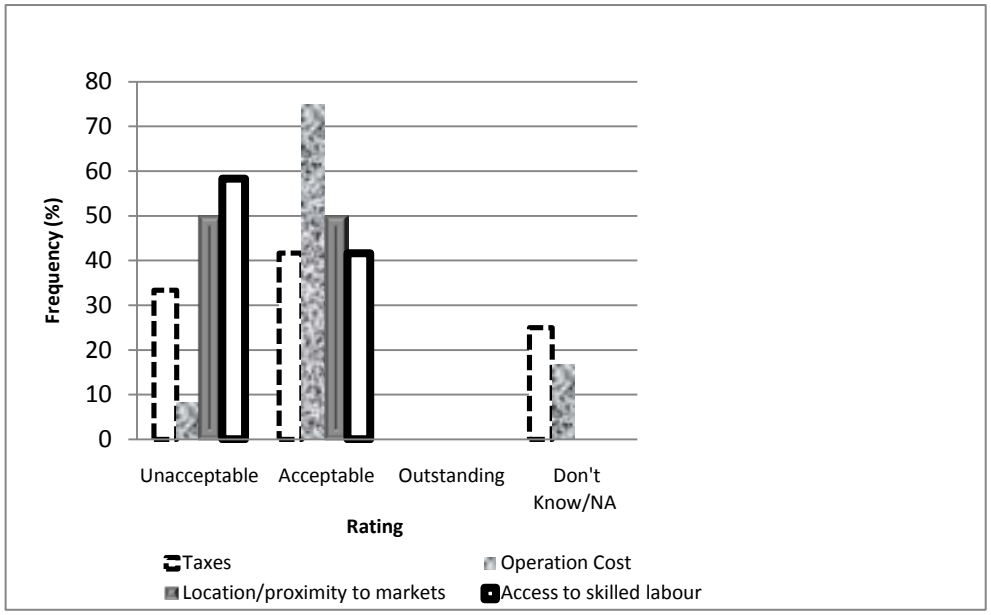


Figure 3b: Ratings of business factors with respect to food innovation and entrepreneurship (2009)

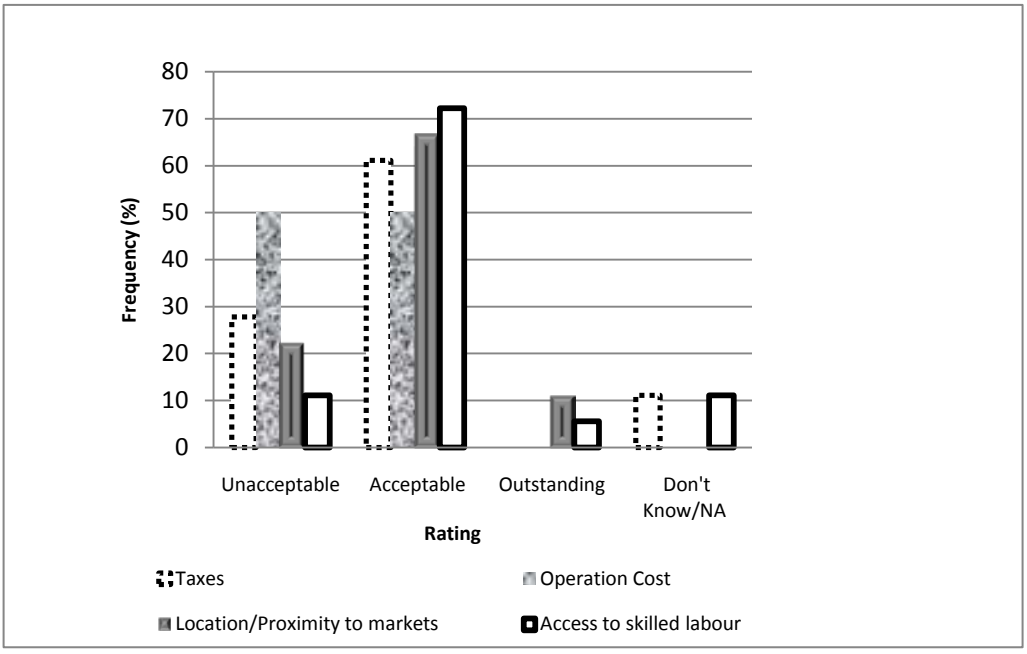
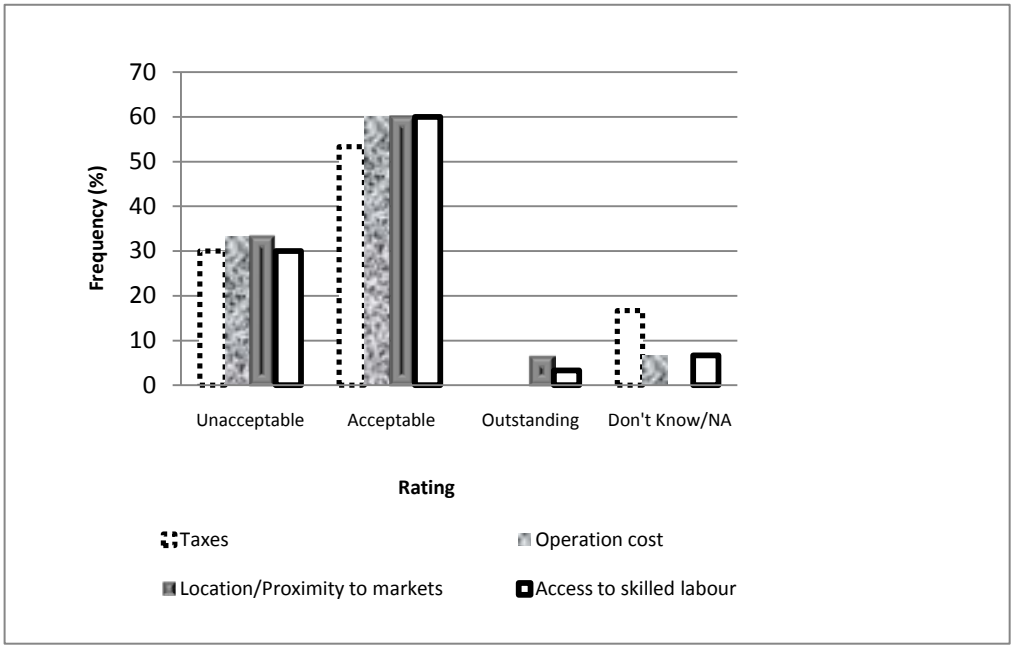


Figure 3c: Ratings of business factors with respect to food innovation and entrepreneurship in both 2005 and 2009



We attempted to disaggregate these issues further by asking respondents to rate the access to capital for food innovation, with regards to the following sources: grants, traditional loans, R&D tax credits, private investment, and venture capital (including angel investors). As Figure 4a shows, access to venture capital as well as access to private investment was perceived as most unacceptable in 2005 (82% in both cases). This contrasts with 2009, where access to loans was perceived to be most unacceptable (56%; Figure 4b). On the other hand, access to traditional grants and access to R&D tax credits was perceived as outstanding in both 2005 (17% and 8%, respectively) and 2009 (17% and 6%, respectively). While acknowledging that the level of "Don't know/ NA" answers is strikingly high here, particularly for responses that relate to venture capital (56%), the 2009 responses suggest that, overall, respondents are more satisfied in 2009 compared to 2005 with regard to access to various sources of capital for food innovation.

Figure 4a: Access to various sources of capital for food innovation (2005)

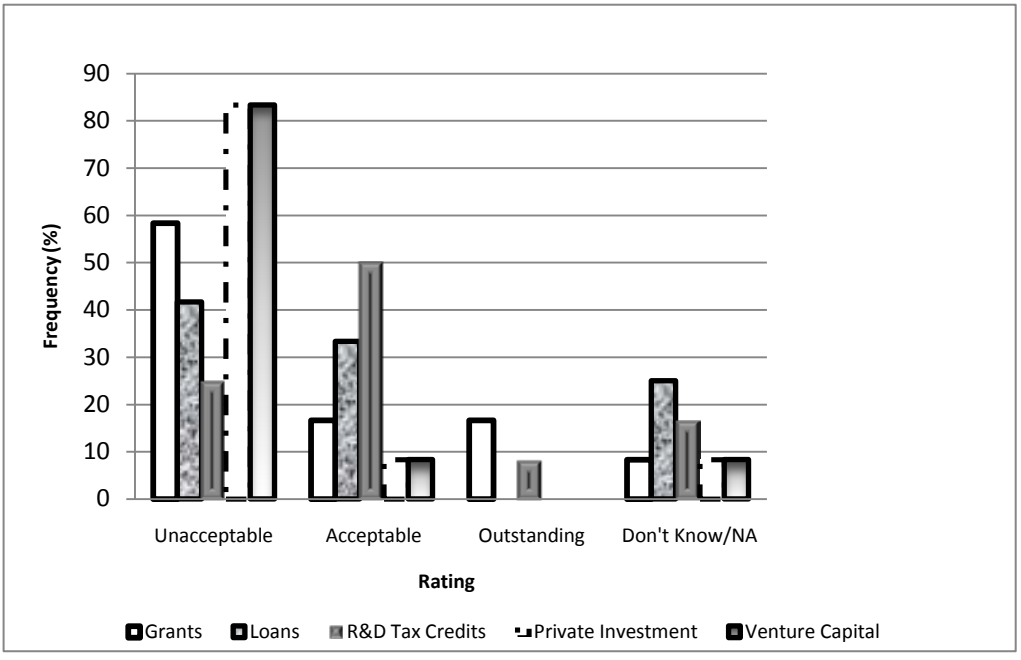
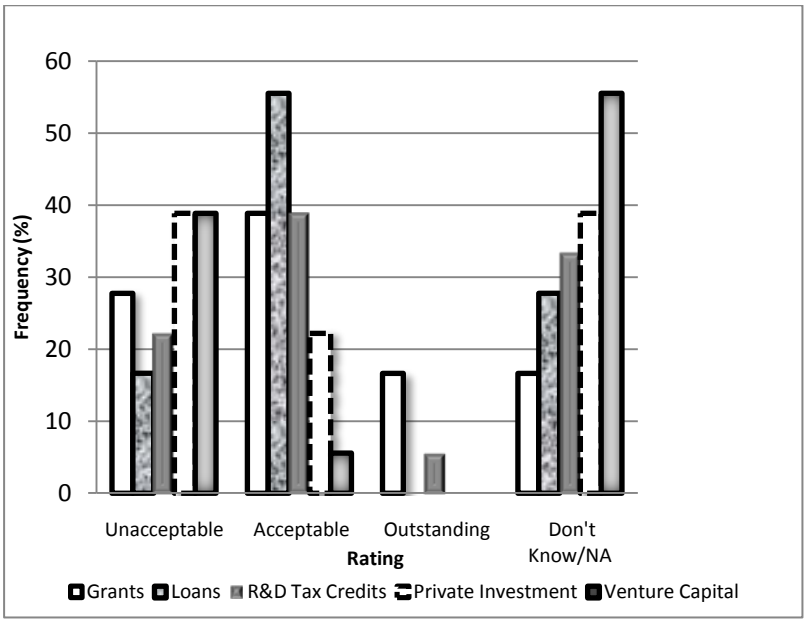
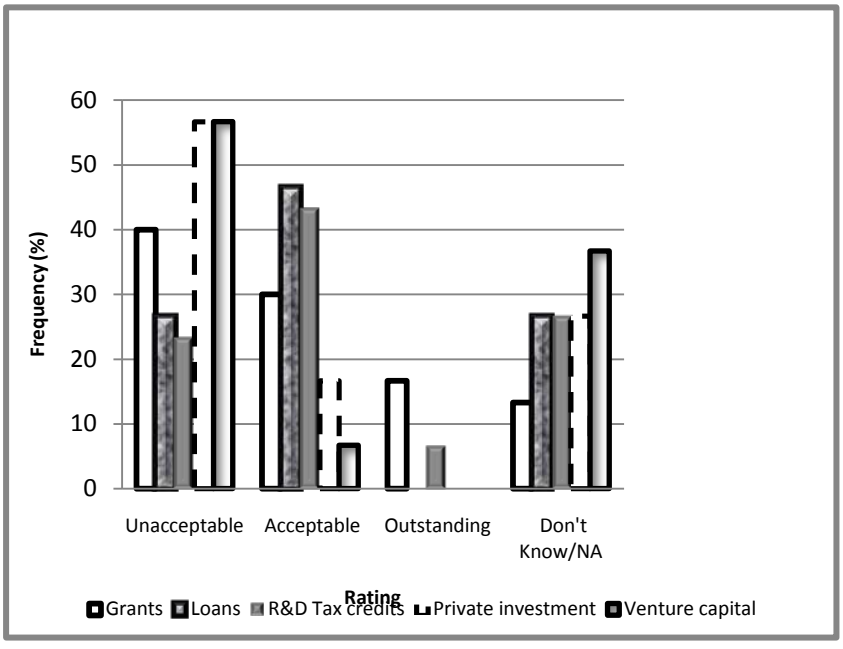


Figure 4b: Access to various sources of capital for food innovation (2009)



Considering the responses from both years jointly (Figure 4c), we conclude that access to venture capital and access to private investment are perceived to be the two key constraining sources of capital for food innovation.

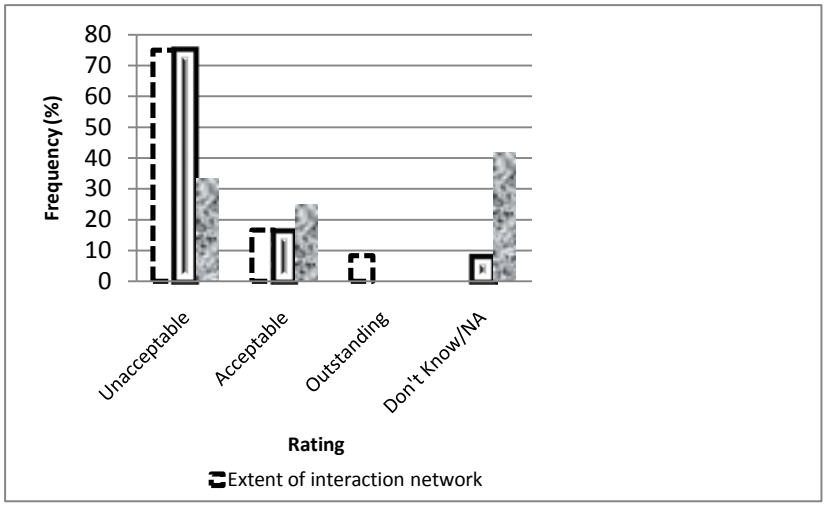
Figure 4c: Access to various sources of capital for food innovation (2005 and 2009 combined)



Our next goal was to explore the nature and extent of networking.[9] When respondents were asked to what extent they perceive that the interactions between clients, suppliers, government and Universities in Alberta can be described as a "network", the highly negative ratings for the extent of network interactions (75% unacceptable in 2005; 55% in 2009) strongly suggest that respondents do not believe that an extensive innovation-supporting network exists in Alberta (Figures 5a, 5b). In order to ensure that respondents did not misperceive the underlying issue, we asked respondents explicitly thereafter of how strong they perceive this network to be in terms of innovativeness ("strength of innovativeness", Figures 5a and 5b). As Figures 5a and 5b suggest ("strength of innovativeness"), the negative picture was consistent.

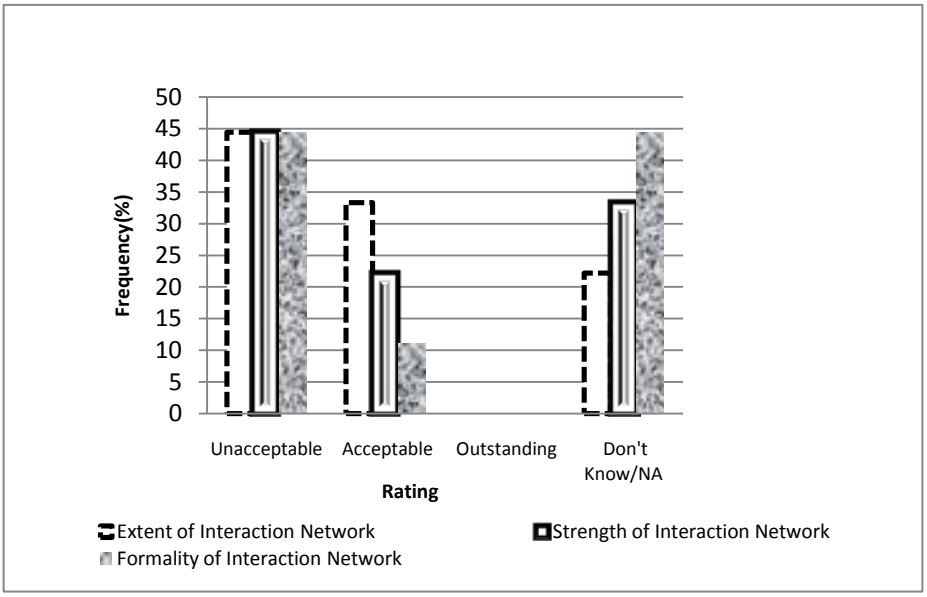
This negative picture for 2005, which is also reflected by the absence of any factor that was perceived as outstanding in 2005, is somewhat more positive in 2009. About 3% of the respondents perceive that the extent of network interactions is outstanding in 2009. The acceptability ratings for the extent and strength of network interactions are also considerably higher in 2009.

Figure 5a: Ratings of interactions between clients, suppliers, government and University (2005)



[9] Throughout the entire survey we avoided to use the word 'cluster', since the goal of the analysis was to indirectly reveal to what extent some key contributing factors to cluster development, as identified in sections 2 and 3, are relevant in the context of Alberta.

Figure 5b: Ratings of interactions between clients, suppliers, government and University (2009)

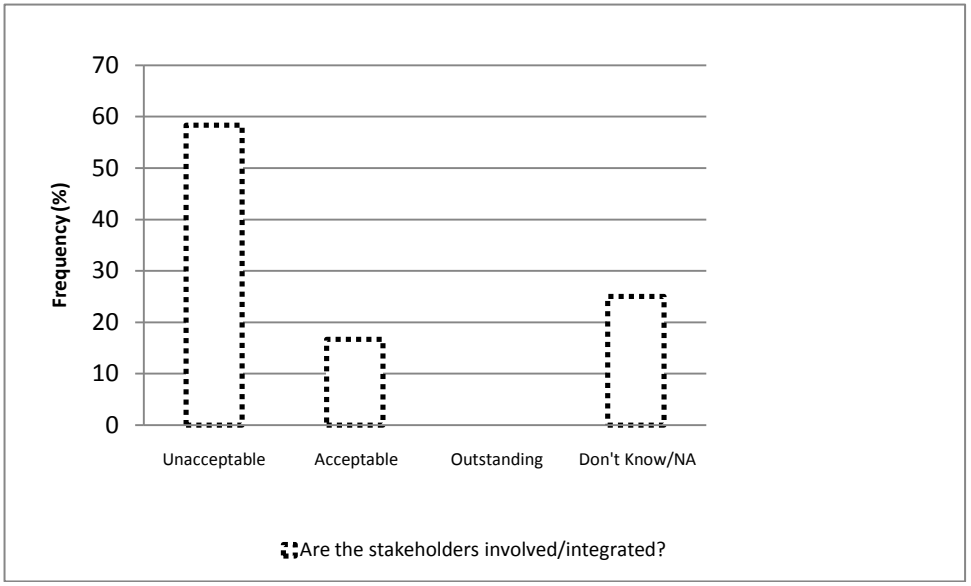


As outlined in section 2, channels for communication and information exchange between firm and non-firm agents are presently available through government agencies and their resources, such as the Food Processing Development Center, the AVAC, and the Alberta Research Council. However, the usefulness of the possible information exchange could be tempered because of agreements of confidentiality with clients, and because the information is likely to be second hand in nature. Therefore, by operating a variety of research institutes and incubators, the government may be unable to overcome important barriers to information and knowledge exchange, and the fear of innovative food processors that trade secrets will be in jeopardy if they participate more closely in an emerging cluster.

In order to explore these issues, we asked respondents two further questions. First, we asked how adequate - in terms of fostering innovation - respondents perceive the knowledge and information sharing to be through the networks (the interactions between clients, suppliers, government and Universities). And second, respondents were asked to what extent they perceive that all stakeholders in the Alberta food industry are involved and integrated. As for the former question, the majority of the 2005 respondents (59%) indicated that the knowledge

and information which is shared is inadequate to foster innovation. Further, 58.5% of the 2005 respondents indicated that the degree of stakeholders' involvement and integration is unacceptably low. Considering Figure 6b, we have again evidence that 2009 respondents are less negative about the extent of involvement and integration of network stakeholders, as reflected in the lower unacceptability ratings.

Figure 6a: Perceived involvement/ integration of stakeholders in network (2005)



4.3. Policy implications

The literature reviewed suggests that government intervention in the form of reinforcing established and emerging clusters can be supported from an economic perspective, whereas the selection of firms as a means of creating new clusters is undesirable, and can be associated with efficiency losses (Porter 2000; Feser 2002; Lagnevik et al. 2003; Glavan 2008). The empirical part of this paper has attempted to provide some measures of the effectiveness of government interventions affecting clustering with regard to the achievement of government goals in the regulations implemented and policies affecting clustering, as well as with regard to the appropriateness of regulatory burden on firms in clusters. We have attempted to measure the effectiveness by capturing industry participants' perceptions with

regards to potential constraints for cluster development. The fact that industry participants' perceptions about government support is largely negative over both years, suggests that government intervention - with regard to support measures for the growth of a regional food cluster in Alberta - has not been effective. However, since we do not provide a comprehensive quantitative analysis, but rather rely on ratings by business managers, policymakers may wish to reject the validity of our findings. However, considering that industry participants provided us not with near identical ratings, but rather with differential judgments across years and issues (e.g. access to traditional loans and access to R&D tax credits were judged as outstanding, despite several factors that were judged as unacceptable), we counter that our empirical findings can be considered as an indication that government efforts have not been effective to create and grow a food cluster in Alberta. Considering the consistently negative perception of survey participants with regard to networking in particular, we also conclude that government efforts have not been effective in promoting elements of virtual cluster configurations.

5. Conclusions

Location-based clusters and virtual cluster configurations have attracted increasing attention from academics and policymakers over the past decade (e.g. Porter 1998; Preissl 2003; Preissl and Solimene 2003; Earl and Gault 2006; Pitelis, Sugden and Wilson 2006; Graf 2007; Blien and Maier 2008). The availability of new communication and processing technologies, competitive pressures for further product differentiation, and increasingly diverse consumer demands have led many food industry participants and industry observers to consider cluster development as an important engine for innovation and regional prosperity (Lagnevik et al. 2003).

This paper reviews evidence on location-based clusters in the food sector, and compares key characteristics of food clusters with those of clusters from other industrial sectors. The

review identifies that trust, the sharing of common knowledge through networks among firm and non-firm actors, as well as access to skilled labour and venture capital is important for the propensity of food firms' innovative activity to cluster spatially. The empirical part of this paper explores government support for food clustering infrastructure in Canada, focusing on the province of Alberta. Following a discussion of key challenges to innovation activity in Canada's food manufacturing sector, as well as a brief overview of existing support infrastructure for innovative processing activity in the Alberta food sector, we present the results from two exploratory food industry surveys that were conducted in the spring of 2005 and in August of 2009. Since previous studies have highlighted the shortage of skilled labour (Wolfe 2003; Munn-Venn et al. 2004), the lack of venture capital and business R&D spending (Martin and Scott 2000; Josty and Godin 2005), and the importance of networking (Porter 2000; Graf 2007) as some of the key constraints to innovation performance and the successful development of innovation clusters, the surveys focus on these issues.

The evidence from our surveys suggests that key stakeholders perceive access to cluster-supporting business infrastructure (access to skilled labour and venture capital, educational support and training, taxation, support and training with regard to regulations) and access to innovation-supporting networks as rather low. We conclude that there is little evidence for the existence or emergence of a regional food innovation cluster in Alberta.

However, we suggest interpreting the results with caution, since the survey results are based on a relatively small sample (13 respondents in 2005; 17 in 2009). Further, we have been unable to generate a comprehensive list of government expenditure on various cluster-promoting efforts, and have not accounted for how this expenditure has changed over time. A direct comparison between our 2005 and 2009 results also requires caution, given the diversity of respondents in the 2005 survey, in contrast to the 2009 survey, which relied entirely on food processors.

Keeping the above caveats in mind, we suggest that our paper has several implications for policymakers, food processors and non-firm actors engaged in the food sector of Alberta, and elsewhere. First, we concur with the literature that government support can have a significant

role to play, in the form of elimination of institutional barriers to innovation and through the promotion of inter-firm linkages in existing clusters (e.g. Porter 1998, Cabral and Traill 2001, Lagnevik et al. 2003 and Preissl 2003). Second, Alberta's explicit government policies aimed at encouraging the emergence and growth of a food cluster do not appear to have been effective. However, this does not imply that other policies aimed at increasing innovation in the agri-food sector have been ineffective.

As the Alberta food processing sector is struggling to overcome the key issues of labour market retention and recruitment, the distance to key consumption centers, and the apparent lack of an innovation-supporting network, future government efforts are unlikely to succeed in attracting venture capital. Increasing efforts toward automation in food processing (ACIDF 2008; AAF 2008) are unlikely to contribute significantly towards establishing a food innovation cluster, since it addresses the cost side, but not the apparent absence of a cluster network and the low level of knowledge spillovers. Further, the automation-induced substitution of capital for labour is unlikely to raise labour mobility and the transmission of tacit knowledge, two factors which are inherently related to the incidence of knowledge spillovers and the propensity of innovative activity to cluster spatially (Audretsch 1998).

In sum, considering the characteristics of one of the leading food clusters in the world, the Öresund food cluster in Europe (Lagnevik et al. 2003), it does not appear justified to refer to a food (innovation) cluster in the case of Alberta. Further empirical work is needed to substantiate our findings and identify the extent towards which the Alberta food processing sector is moving closer toward becoming part of a 'dynamic food innovation cluster'.

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Appendix A: survey instrument

Type of Business	__ Food/Beverage Mfg./Processor __ Food Ingredient Mfg./Supplier __ Processing Equip. Mfg./Supplier __ Packaging Equip. Mfg./Supplier __ Contract Processing/Packaging __ Consulting __ Educational Institution __ Private Research Institution __ Foodservice __ Government __ Independent Testing Lab __ Scientific/Trade Assn. __ Other (Specify):
Size (# of employees)	
Approximate Sales - Canadian	
Approximate Sales - Export	
Formal Links with the University (e.g. projects)	
Informal Links with the University (e.g. former graduate students)	

Directions: Please mark or type an (x) in the appropriate box

	Unacceptable	**Acceptable**	**Outstanding**	**Don't know/Not applicable**
How would you rate food innovation in the Edmonton/Alberta region?				
Overall, how would you rate **government** support for food innovation?				
More specifically…				
Local – Municipal				
Provincial				
Federal				
Access to funds				
Educational support and training				
Regulation support and training				

Research facilities				
Networking				
Technical expertise				
Business Development assistance				
Overall, how would you rate **university** support for food innovation?				
Educated workforce				
Accessibility of information				
Research assistance (clinical trials, etc.)				
To what extent do you think the interactions between clients, suppliers, government and University can be described by a "network", i.e. how would you rate the extent of this network?				
How strong is this "network" in terms of innovativeness?				
How adequate (in terms of fostering innovation) is knowledge/information shared in the "network"?				
Is access free and open to all willing participants?				
How would you rate the value of the benefits of the "network"?				
Are all stakeholders involved and integrated?				
How would you rate the innovation fostering done by industry associations?				

	Unacceptable	**Acceptable**	**Outstanding**	**Don't know/Not applicable**
How would you rate the following factors with respect to food innovation and entrepreneurship in Alberta?				
Taxes				
Operation cost				
Logistical location/Proximity to markets				
Access to skilled labour				
How would you rate access to capital for food innovation?				
Grants				
Loans (traditional)				
R&D tax credits				
Private investment				
Venture capital (including angel investors)				
How supportive would you rate the local media?				
How would you rate public awareness of food innovation in Alberta?				
How would you rate the future of food innovation and entrepreneurship in Alberta?				