Early stage cluster development: a manufacturers-led approach in the aircraft industry

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Abstract

Purpose – The purpose of this study is to explore the early stage of development of a cluster. The literature on early stage of cluster development shows that there are often random effects such as an entrepreneur and spin-off companies, and in this study, a coordinated approach for cluster development is described.

Design/methodology/approach – A single exploratory case study approach is followed. The aerospace cluster in the Spokane region, State of Washington, is described. Data from a variety of sources are triangulated to enhance the credibility of the case study findings.

Findings – It was found that although there are many types of collaborations occurring in the region, which involve policy and government organizations, the main driver of the early-stage cluster development is manufacturers-led coordinating mechanism. Individual manufacturers are too small to be successful in the aerospace industry, and they are collaborating to present a united "front" to out-of-the-region customers. Once customers place an order, then within this coordinating mechanism, the work is divided among different manufacturers.

Research limitations/implications – The research has two main limitations. First, it is a single case study, and therefore, the results may not be generalizable. Second, the cluster is in an early stage of development, so it is not (yet) clear whether this manufacturers-led coordinated approach will have long-term success.

Practical implications – The studies offer potential for cluster development that go beyond relying on a single entrepreneur or on mostly government- or policy-driven initiatives. Instead, this is an approach that can be used by industry to lift the overall competitiveness of their region.

Social implications – This cluster development approach offers potential for economic development of smaller regions which mainly consist of small- and medium-sized companies without endowment benefits or a large local customer base.

Originality/value – This study adds to the existing knowledge on clusters and cluster types. The identified cluster approach does not fit with the main types of clusters that have been identified in the literature. The companies involved are mainly small- to medium-sized companies, but by coordinating their capabilities, they are able to present core capabilities in a much more attractive manner to customers. This cluster development approach is not driven by or achieved through advantages in

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innovation, vertical or horizontal supply chain competition and advantages, creation of spin-off firms, or a regional demand base as customers are located outside the region. It deviates in terms of the types of companies involved and, mostly, in a sense that it acts as one unit to customers who are located outside the region.

Keywords Competitive strategy, Cluster analysis, Regional development, Small to medium-sized enterprises, Case study

Paper type Research paper

Introduction

Almost 25 years ago, Porter (1990) described how, in terms of exporting, industries in some countries are more competitive than those in other countries. This competitiveness was captured in the so-called Diamond model, but an additional phenomenon was also discussed, that is clusters. Clusters can be defined as "geographic concentrations of interconnected companies and institutions in a particular field" (Porter, 1998). Although, in particular, economic geographers had been studying clusters already for an extended period before that, Porter's (1990) contribution increased the popularity and attention of the concept of clusters in several fields, and remains a current topic (Keller *et al.*, 2015; O'Dwyer *et al.*, 2015; Sasson and Reve, 2015; Wilson *et al.*, 2014). For example, clusters can be viewed as enhancing the competitiveness of an industry in a location (Davies, 2001; Delgado *et al.*, 2014) and is linked to theories about networks (Bryson *et al.*, 1993; Lundberg, 2010; Niu *et al.*, 2008), as well as firm aspects (Niu, 2010; Niu *et al.*, 2012), and clusters have also frequently been linked to the performance of a region (Blair, 2004; Feldman and Tavassoli, 2014; Porter, 2003).

Although there is some argument to the contrary (Simmie, 2006), in this paper, the assumption is made that clusters indeed play a vital role in the competitiveness of industries. Therefore, if the rise of clusters is understood, then competitiveness can also be better explained. This then leads to the question: how do clusters develop?

In recent years, there has been a growing recognition of the need to further develop and elaborate on dynamic perspectives on clusters to gain better insights into how they evolve (Fornahl *et al.*, 2015; Trippl *et al.*, 2015). Several theories exist that have explored this issue and that have shown that clusters go through several stages. For instance, Feldman and Braunerhjelm (2006) concluded that clusters go through three stages. First, a stage where clusters emerge and, then, a stage when one particular location starts to pull ahead of other locations. This can be the result of purely random processes, or it may stem from some unique resources in the location's developmental logic. Finally, a stage in which a location and industry intensify its competitive advantages, extend and consolidate its market reach, while other locations enter a period of comparative stagnation or decay – the location simply becomes a place to be. Another stage model is proposed by Belussi (2006), who identified four stages in the development path: development, expansion, maturation and transition. Locations that have some favorable starting conditions initiate growth, thanks to the rooting in the territory of some founder firms. The development of extensive external economies allows the starting of a recursive trend towards the consolidation of the industrial district or cluster. Similar to Feldman and Braunerhjelm (2006); Bergman (2008) uses a three-stage model. The initial phase, existence, includes what must happen before a cluster emerges sufficiently to be recognized as "existing". Existence could be triggered by a variety of processes that lead to co-location. This phase is followed by an expansion phase. The

initially favorable existence conditions are necessary prerequisites for a cluster's critical mass to suddenly take off, where self-organized "swarming" of new firms, technologies and innovations, products and cluster-related activities occur rapidly and promiscuously. Bergman identifies two types of expansion. Exploratory expansion can be described as an exuberant exploration of how initial pecuniary spillovers originating in cluster-specific infrastructure, specialized worker training and education, key supplies of skilled labor, emerging specialized suppliers and increasingly compliant institutional or regulatory practices that favor expansion and competition might be incorporated into successful business models. For exploitive expansion, Bergman (2008) noted that once this cluster expansion has been attained, it appears to be the best of all worlds to participants. Success is easy in this phase. Members tend to focus less on exploring new options and more on protecting advantages that earlier arose quite spontaneously. The last phase, exhaustion, arises at the point in a cluster's life cycle when maturity itself poses a clear threat to continued cluster viability. Whatever are causes, growth and regeneration occurred almost automatically in earlier phases grind to a complete halt, and the cluster pauses. At this point, either one of the two different directions is possible. Lock-in occurs when the pause extends, and is "locked-in" for an extended period. Renaissance can occur perhaps immediately or following a temporary period of lock-in. This includes marked transitions. Painful readjustments take place in nearly all exhausted clusters, although not all recover satisfactorily and some not at all, even with lengthy passages of time. Three additional assets in some clusters and region may help speed or ensure a process of restructuring: agent diversity, polyvalent technology sources and knowledge/science base. Additional cluster life cycle models are provide by Andersson *et al.* (2004) and Zettinig and Vincze (2012).

What these cluster life cycles have in common is that the initial phase of the life cycle is not well understood. As Motoyama (2008, p. 353) stated: "The current theory is more focused on describing how a cluster is organized today rather than how a cluster emerged". Furthermore, Feldman and Braunerhjelm (2006) state that they cannot predict which of the locations identified in the first phase of this process will become the dominant location in the third phase, except that it will have achieved this status by reason of its superior command of localized increasing return effects. In other words, the development of a cluster seems to take off based on seemingly random events that can be explained on hindsight, but are not easy to foresee. Part of this randomness can be the existence of a particular (successful) person or entrepreneur, such as Michael Dell for the Austin region or Bill Gates for the Seattle region. With growth, additional businesses or spin-offs might be created. This aspect for several industries has, for instance, be described by Harrison *et al.* (2004); Kenney and Patton (2006); Scott (2006); Feldman (2008) and Mason (2008). Examples also exist of government-planned approaches toward clusters, such as the policy-driven approach in the Chinese biotechnology cluster (Pervezer and Tang, 2006). The North Carolina Research Triangle experience shows the difficulties of this type of approach, that is, it was started towards the end of the 1950s and progress was slow for 20 years. Aside from becoming dependent upon entrepreneurs becoming very successful or a government-planned approach, it is possible that other alternatives exist. The aerospace industry in the State of Washington, USA, and more specifically, the developing cluster in the Spokane region provides an example.

The location quotient (LQ) measures a region's share in cluster employment, relative to its overall or national share of employment. In other words, a high LQ indicates a concentration in terms of employment. The LQ is a frequently used method to identify clusters, see for example Porter (2003) and the US cluster mapping project (www.clustermapping.us). Based on the LQ measurement, the aerospace vehicles and defense cluster is an important industry for the Seattle region (Gray *et al.*, 1996), and it has one of the highest LQs in the State of Washington (www.clustermapping.us). The aerospace industry in the State of Washington has been heavily tied to Boeing, located in the Seattle area on the west side of the state. But aerospace has not been limited to the west side, and has spread across the state. For example, after Tom Foley of Spokane was elected as the Speaker of the House in the US House of Representatives in Washington, DC in 1989, Boeing became more interested in the Spokane region, and Boeing established a Spokane plant in 1990. This was initially to produce floor panels and air ducts that were already produced at its Auburn plant. When looking at different counties in the State of Washington, it can be seen that several regions in the State of Washington have significant aerospace-related activities, but the Spokane region is the most developed (Washington Aerospace Partnership, 2001, p. 38). Figure 1 provides a schematic of the State of Washington and several of its cities, interstate highways (red) and other main highways (blue). The distance between Seattle and Spokane is roughly 300 miles (almost 500 km). The research question for this study is:

RQ1. How is the aerospace cluster in the Spokane region developing?

Before these developments are discussed, the next section describes the theoretical background of different types of clusters. Understanding different types of clusters is important because this also relates to understanding why clusters develop.

Types of clusters

Asheim *et al.* (2006) describe how Porter has been one of the most important contributors to the literature on clusters. Although very influential, several people have pointed out that Porter's definition of clusters (Porter, 1990, 1998) has been somewhat problematic (Malmberg and Power, 2006; Martin and Sunley, 2003; Paniccia, 2006; Simmie, 2008). Some of the problems stem from the identification of what is included and the geographic scope. Other issues are related to the measurement of the cluster. Porter (1990, p. 739) measured the presence of significant exports or foreign direct investment

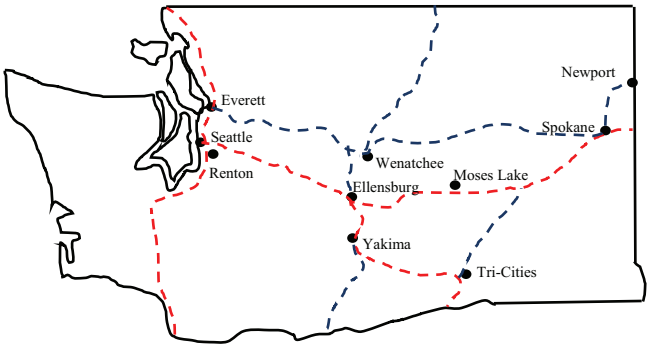

Figure 1.
State of Washington

to determine international competitiveness, and used this to identify clusters. Often clustering is measured by LQ, which relates to employment concentration (Porter, 2003), but employment concentration does not necessarily mean that the cluster is competitive in export markets (Simmie, 2006). This leads to the point that not all clusters are equal or, in other words, that there are different types of clusters. The following discussion presents different types of clusters based on some of the most often cited studies (Lazzeretti *et al.*, 2014).

Clusters and economic development

Porter (2003) distinguishes three different types of industries, that is, cluster types, and relates them to regional development. First, some industries are local industries. Local industries provide goods and services primarily to the local market or region, in which the employment is located. Such industries compete in only a limited way with other regions. In terms of the economy, these industries mostly circulate the money within a region. The second type of industry is the resource-dependent industry. Employment in these industries is located primarily where the needed natural resources are found, but these industries compete with other domestic and international locations. In terms of the economy, these types of industries attract money flows into the region. The last type of industry is the traded industries that are not resource dependent. These industries sell products and services across regions and often to other countries. They locate in a particular region based not on resources but on broader competitive considerations, and employment concentration varies markedly by region. In terms of the economy, these types of industries also attract money flows into the region based not only on natural resource advantages but also on more sustainable basis of competition. Thus, Porter (2003) distinguished clusters by their role in the regional economy. Porter (2003) found that in particular, the traded clusters are important for regional development and wages, and that their competitiveness is related to the ability to innovate. This is also tied to region's entrepreneurial activity and knowledge base (Harrison *et al.*, 2004; Malmberg *et al.*, 1996; Maskell, 2001), although a firm's linkages with firms in other regions also play a role (Wolfe and Gertler, 2004).

Types of interactions of cluster firms

Another distinction about types of clusters is provided by Gordon and McCann (2000). They distinguish three types of clusters based on the characteristics of the "clustering". First, there are pure agglomeration clusters. These are clusters where there are some advantages for firms to locate in the same geographical area. These advantages relate to, for example, a local pool of specialized labor or an increased local provision of non-traded input specific to an industry. Second, there are industrial-complex clusters. These are clusters where firms co-locate due to their interactions, and co-location reduces the cost of these interactions. This can include buyer–supplier relationships. The third form of cluster is the social-network model. This goes beyond the simple interactions from the industrial-complex type, and leads to increased performance, for example, in terms of innovation (McCann, 2008). Gordon and McCann's (2000) distinction of different types of clusters relates to the types of interactions that occur within the cluster. For agglomeration clusters, these interactions are virtually non-existent. For industrial-complex clusters, there are some interactions, and they

reduce cost. For the social-network model, there are many interactions, and companies work together for better products, etc.

Types of interactions within or outside the region

Another typology was proposed by Markusen (1996). She distinguished four different types of industrial districts, that is, clusters. According to Markusen (1996), the Marshallian and Italianate industrial districts are characterized by small, locally owned firms that make investment and production decisions locally. Within the district, substantial trade is transacted between buyers and sellers, often entailing long-term contracts or commitments. Linkages and/or cooperation with firms outside the district are minimal. What makes this type of industrial district so special and vibrant is the quality of the local labor market, which is internal to the district and highly flexible. In the Marshallian version, it was not necessary that any of the actors consciously cooperate with each other. In the more recent Italian version, concerted efforts to cooperate among district members and to build governance structures to improve district-wide competitiveness can improve prospects, that is, improve stickiness of the district (Markusen, 1996) (Figure 2).

Markusen (1996) characterizes the hub-and-spoke industrial districts by a few key firms or facilities that act as anchors or hubs to the regional economy with suppliers and related activities spread out around them like spokes of a wheel. Hub-and-spoke districts may exhibit intra-district cooperation, but it will generally be on the terms of the hub firm. Substantial intra-district trade will take place among suppliers and hub firms, often embodied in long-term contracts and commitments. Cooperation may entail efforts to upgrade supplier quality, timeliness and inventory control, and it may extend outside district boundaries to suppliers farther afield (Markusen, 1996) (Figure 3).

The satellite platform district is a congregation of branch facilities of externally based multi-plant firms (Markusen, 1996). Tenants of satellite platforms may range from routine assembly functions to relatively sophisticated research, but they must be

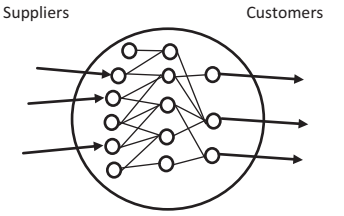

Figure 2.
Marshallian industrial district

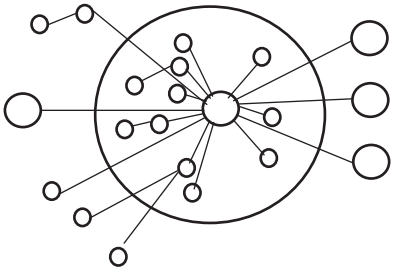

Figure 3.
Hub-and-spoke district

able to more or less "stand alone", detachable spatially from either upstream or downstream operations within the same firm or from agglomerations of competitors and external suppliers or customers. In satellite platforms, business structure is dominated by large, externally situated firms that make key investment decisions. Minimal intra-district trade or even conversation takes place among platform tenants. Orders and commitments to local suppliers are conspicuously absent (Markusen, 1996) (Figure 4).

Finally, according to Markusen (1996), state-anchored districts are where a public or non-profit entity, be it a military base, a defense plant, a weapons lab, a university, a prison complex or a concentration of government offices, is a key anchor tenant in the district. Here, the local business structure is dominated by the presence of such facilities, whose locational calculus and economic relationships are determined in the political realm, rather than by private-sector firms. This type of district is much more difficult to theorize, because contingencies particular to the type of activity involved color its operation and characteristics. It is apt to look much like the hub-and-spoke district, although a facility can operate with few connections to the regional economy, resembling the satellite platform. The typology as proposed by Markusen (1996) is largely based on the type of interactions that take place between firms inside the region and between firms inside and those outside the region (Markusen, 1996).

Structural agglomeration features

Paniccia (2006) provides a fourth insight into types of clusters; her typology is based on several structural features of agglomeration leading to six types of clusters. A summary of these six types is presented below (Paniccia, 2007):

(1) *(Semi)canonical industrial district*: This type is characterized by an extended division of labor mostly based on family-owned and family-run firms with few employees and which rely on family members and relatives.

(2) *Diversified urban industrial district*: This is characterized by the location and the embeddedness of manufacturing activities in an urban setting, which makes the economic structure more diversified than that in the case of canonical industrial districts.

(3) *Satellite platforms or hub-and-spoke agglomerations*: Generally, it comprises a limited number of small firms (compared to the canonical type but not in absolute terms and not compared to the diversified type) usually operating as sub-contractors to larger commissioning firms, which may be localized in the same area or outside.

(4) *Concentrated or integrated agglomerations or industrial districts*: This type is characterized by the integration of two or a few parallel technological sector

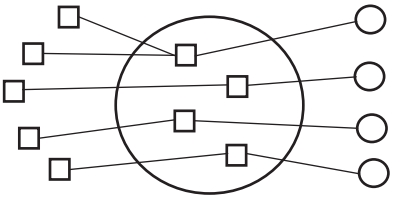

Figure 4.
Satellite platform district

networks (without a diffusive or science-based nature), which leads to the discovery of new markets where local firms occupy leadership positions.

(5) *Co-location areas*: This type is characterized by the co-location of firms specializing in similar activities, performing most of the activities of the network and producing for the final market, generally through the intermediation of buyers. This type may be seen as forms of organization of production typical of the early stages of a process of industrial agglomeration, from which some of the existing canonical or craft-based industrial districts have evolved.

(6) *Science-based or technology agglomerations*: This type may be distinguished as a variant of integrated industrial districts when the specialization industry by convention can be labeled "science-based".

Paniccia's (2006) typology looks at a range of variables to characterize clusters, such as the size of the firms involved, where the financial decisions of the firms are made, etc.

The literature reviewed above demonstrates that not all clusters are the same. Additionally, explanations about why clusters exist and form are similarly diverse. Asheim *et al.* (2006) discuss five different scientific or theoretical perspectives on clusters:

(1) Italian neo-Marshallian industrial economics is based on the Marshallian idea of external economies of localized specialization. They depart from the traditional Marshallian approach by stressing that the industrial district is a socio-cultural as well as economic entity.

(2) New economic geography and new trade theory also references Marshall's model of localization economies. This approach builds upon traditional location theory and regional science to develop highly formalized models of localized industrial specialization. A well-known scholar representing this perspective is Krugman.

(3) New endogenous growth theory, similarly, uses formalized models, that is, production function models, to suggest that the increasing returns to educated labor and R&D spending are highly localized, so that regional growth paths may diverge.

(4) Neo-Schumpeterian and evolutionary economics' central theme is that innovation and entrepreneurship are quintessentially spatially embedded and localized processes. Attention focuses on network theories of innovation and the emergence of "regional innovation systems", localized "collective learning" and local entrepreneurial milieu. For this reason, much of this literature is heavily directed towards successful high-tech districts and clusters, for example, biotechnology.

(5) Economics of firm strategy and Marshallian localization economics views local clustering as the driver of productivity and competitiveness. A well-known scholar representing this perspective is Porter.

This demonstrates the complexity of clusters. Clusters are not uniformly defined, and it is clear that how they operate may depend upon the situation or context, leading to the distinction of several different types of clusters (Ingstrup, 2013). Adding complexity to this is that academics have used different perspectives to explain this same phenomenon, resulting in different types of assumptions and, therefore, different types

of explanations. For example, Breschi and Lissoni (2001) provide a theoretical discussion comparing the localized knowledge spillover perspective with that of the new industrial geography (which they view as part of the neo-Schumpeterian perspective emphasizing innovation systems) and new economic geography. They explain how knowledge spillover is typically not considered in the new economic geography perspective due to the assumptions made in that approach. With this theoretical background in mind, the aerospace cluster in the Spokane area can be explored to determine whether this fits any of the existing models.

Methodology

The purpose of this research study is to explore the development of the aerospace cluster in the Spokane region. Because this study is exploratory in nature, a descriptive case study approach was considered as the most appropriate approach (Yin, 2009). A single case study approach was followed, that is, the aerospace cluster in the Spokane region is considered the single case. This aerospace cluster meets the criteria for conducting a single case study compared to the usually preferred multiple case studies because it provides new insights into the formation of clusters at an early stage of development (Yin, 2009).

There are several types of case study approaches (Steenhuis, 2015). For this study, an open approach similar to Eisenhardt (1989) was followed so that insights could be developed as the study progressed as well as from a variety of sources. Data were collected from a variety of sources, such as the use of different types of documents and interviews with aerospace company representatives. Triangulation was applied to facilitate the interpretation of the story for which credibility is the main criteria (Janesick, 1994). This was enhanced by sharing interview notes with people that were involved, that is, applying a member check (Swanborn, 2010). Other case study concerns, such as reliability, internal validity, construct validity and external validity, (Yin, 2009) were handled by strategies such as developing a database and following the same interview format, that is, questions and sequence in each of the interviews with cluster companies.

An exploratory study of early-stage cluster formation: the Spokane aerospace cluster

The roots for the development of the Spokane aerospace cluster can be traced back to the mid-2000s, but before describing that, it is important to provide a little history. One aerospace company with a long history in the Spokane area is Kaiser Aluminum. This is a major supplier to the aerospace industry with a history that traces back to the Second World War. Another important development was that after the September 11, 2001 terrorist attacks which involved airplanes, the aviation industry was down and Boeing, similar to companies in several other industries such as the automotive industry, made a strategic decision to focus on design and assembly and to outsource the production of parts. As a consequence of this, by late 2001, it was looking at closing or selling the Spokane plant that it had established in 1990. In November 2002, an agreement was reached with the Triumph group who bought the plant and continued to produce floor panels and air ducts for the aerospace industry.

In 2004, the US Airforce had awarded Boeing a contract for an aerial refueling tanker, but allegations about corruption caused the contract to be canceled, and it would be open

to foreign competition. EADS was planning on entering the competition and, if it would win the contract, was planning on building a plant in the USA. It sends out a Request for Information (RFI) to all 50 states as the first step in a process to site a US manufacturing and engineering center for its Airbus tankers. Within the State of Washington, three locations were interested in attracting an EADS plant: Moses Lake, Everett and Spokane (Daly, 2005). For Spokane, the Manufacturing Roundtable group[1] prepared the response to the RFI. Eventually, the State of Washington was not selected by EADS, but the process increased the awareness of manufacturers in the Spokane area of the potential in the aerospace industry.

The selling of the Boeing Spokane plant to Triumph as well as the EADS RFI process coincided with changes in thinking within the Manufacturing Roundtable. Some companies felt that the general topics within the Manufacturing Roundtable had limited applicability to what they were doing. They felt that the manufacturing "in general" did not apply that much to them and a related issue was that general manufacturing was not doing so good, but the aerospace industry was doing good. Eventually, representatives from Triumph Composites, Haskins Steel and Altek decided that they needed an alternative to the Manufacturing Roundtable with a focus on aerospace, and in 2007, the Inland Northwest Aerospace Consortium (INWAC) was founded. This was supported by Greater Spokane Incorporated (GSI) which was a merger of the Spokane Area (Economic) Development Council and the Spokane Regional Chamber of Commerce. GSI invested resources, for instance, to develop a Web site, and there was a plan for financial support and administrative support but this eventually did not materialize.

Over the next years, a number of initiatives involving mostly government/policy organizations developed. Possibly as a result of the experiences with an eight-week machinist union strike and the subsequent establishment of a Boeing 787 production line in South Carolina, the State of Washington increased its efforts to keep Boeing work in the State of Washington. This included lobbying for the (non-unionized) Spokane region as an alternative production location. INWAC and GSI participated in these efforts. For example, in 2011, Governor Gregoire of the State of Washington launched Project Pegasus, a tactical effort that was intended to keep Boeing from deciding to build the 737MAX, the successor to the Boeing 737, outside the State of Washington. One of the locations that was promoted for the 737MAX assembly line was the Spokane region. The Aerospace Competitiveness Study showed that as an alternative to Renton where current 737s were assembled, Spokane would be a good alternative (Washington Aerospace Partnership, 2001, p. 52). Boeing decided, after several labor concessions, to keep the 737MAX assembly at the Renton plant. Another example was in 2013, when a competition took place with many other states for the assembly plant of the new Boeing 777X. The State of Washington offered Boeing $8.7 billion in tax breaks. This represented the biggest state subsidy in the US history. Again, Spokane was pitched to Boeing; this time as an alternative to the Everett plant where the Boeing 777 was already being produced (Camden, 2014a). In January 2014, after pay and retirement concessions from the workers, it was decided to produce the 777X in Everett.

There were similar government-involved efforts to attract a large aerospace manufacturer or supplier to the Spokane area, in particular at the airport (Lind, 2012). In 2010, Associated Painters, an established aerospace company that does refinishing and paints all types of domestic and international aircraft, opened a subsidiary in the Spokane region (www.associatedpaintersinc.com). One thing that was key to this

decision was that the lease for the hangar was kept down; this was possible because the publicly owned airport used a low-interest state jobs loan to build the hangar (Prager, 2011). Also, in March 2014, it was announced that Exotic Metals, a metal company with an established history in aerospace, had selected the Spokane region for a new plant (Prager, 2014a). The State of Washington played a role in attracting Exotic Metals, as well as Exotic Metals was eligible for a reduction of the state B&O tax granted by the legislature as an incentive to Boeing (Prager, 2014a). In addition, the state contributed $200,000 for pre-planning work under the governor's strategic reserve fund for economic development. Also, a state work training grant of $100,000 is available to the company as it gears up. Another incentive is from the city Airway Heights (where the Spokane airport is located), which is paying two-thirds of the cost of bringing a Spokane city-owned sewer line to the site at $167,000. Airway Heights also granted a guarantee that it would review building permit plans within 48 hours (Prager, 2014a). However, Greater Spokane Incorporated calculates the annual economic impact for the project at more than $100 million (INWAC, 2014). Another example is Aero-Flite, a company that flies and maintains tankers that fight wildfires around the country, which moved part of its operations to the Spokane airport in November 2014 (Camden, 2014b). Aero-Flite was expected to create 50 jobs (Prager, 2014b). Aero-Flite moved into a former Air National Guard hangar, which was renovated by the airport for $2.2 million (Prager, 2014b) and for which Aero-Flite will pay $170,000 a year to the airport for rent (Camden, 2014b). Another company that was considering locating in the Spokane area around December 2013 was Aviation Technical Services, a company that specializes in maintenance of Boeing jetliners and which is based in Everett. But the company would need new facilities and local officials for reworking on preparing to sell $19 million in tax-exempt bonds to pay for the construction of a plant that would be leased by Aviation Technical Services (Prager, 2013). More efforts are underway to attract additional companies such as the Air Spokane initiative[2] to attract large Tier-1 and Tier-2 suppliers (Delaney, 2013). What has helped in the past is also the support of politicians; for example, a Spokane County Council member has been helpful for aerospace development (Walters, 2013), as well as sometimes for economic incentives. These have included (Greater Spokane, 2014) for manufacturing:

- sales and use tax deferrals and exemptions on new equipment and construction costs for new or remodeled buildings (Community Empowerment Zone);
- new job and job training tax credits (Community Empowerment Zone); and
- sales and use tax exemption for machinery and equipment used directly for manufacturing, research and development or testing operations.

And for aerospace:

- reduced B&O rate for the manufacturing or selling of commercial airplanes or their component products and FAR Part 145 repair stations reduced B&O tax rate for aerospace businesses;
- B&O credit for preproduction development expenditures;
- B&O credit for property/leasehold taxes paid on aerospace business facilities; and
- sales and use tax exemption for aerospace businesses for computer hardware/software/peripherals.

Therefore, these top-down government-driven initiatives had some effect. Some progress has been made in attracting additional aerospace companies to the region, but an aircraft final assembly line or the assembly of major components such as wings have not (yet) been established.

Instead, the bottom-up INWAC initiative has led to other significant aerospace cluster development in the Spokane region. INWACs mission is stated as:

> […] to develop and promote collaborative relationships between aerospace manufacturers and service providers in the Inland Northwest; facilitating regional business growth by increasing our collective value as an integrated supply chain and expanding the awareness of aerospace manufacturing and services provided within our region. (http://inwac.org/board/)

The key idea behind the formation and development of INWAC was that aerospace was growing rapidly and would continue to do so in the next several decades, demand is greater than supply in the aerospace industry and the overall size of the aerospace industry (in terms of demand, that is, the "pie") is huge, but it is challenging for any one individual company in the Spokane region, which is typically a small company with limited resources, to get noticed by the large aerospace multi-national companies and, therefore, to become a supplier. The exception to this is that a small company may get noticed if it is operating in a very specific niche. One of the challenges in the industry is that aerospace companies typically do not want to buy just pieces, but instead, the trend is to buy modules or sub-components. It is important to note that related to first and second items mentioned above, it is relatively rare for a manufacturer to switch suppliers for a particular aircraft program. In other words, once a company is established to supply a particular component for a particular aircraft type, it typically will supply those components for the production of all of the aircraft of that particular type. However, when significant modifications are made to an aircraft, as in the case of the 737MAX, or when new aircrafts are designed, as in the case of the 787, then opportunities exist for new suppliers. This means that new suppliers typically do not compete with existing suppliers (or existing clusters) for established aircraft programs.

The idea of INWAC was that "Spokane region" companies have to work together to be able to attract work and become suppliers in the aerospace industry. They have to combine the "voice", capabilities and capacity, and this combination would lead to better visibility and more production opportunities, that is, aerospace contracts. A key mechanism for this combined voice, capabilities and capacity was the establishment of the INWAC Manufacturing Services Network. This provides a regional network of aerospace-certified manufacturers working together to simplify, for customers outside the region, the procurement and streamline orders. To say it differently, INWAC presents a one-point contact for potential customers. It provides potential customers with the combined regional capabilities of the aerospace companies without identifying specific companies with those capabilities. Once a customer approaches INWAC, then within this system, one of the companies acts as the integrator and then outsources pieces of the work to other regional companies that supply components. Some examples are: L&M Precision Fabrication sending seat braces to MultiFab, which attaches seat-belt brackets (Walters, 2013) and MultiFab produces molded plastic, especially for UTC Aerospace Systems to ship its brake pads. Altek and Accra-Fab are the two companies within INWAC that have functioned mostly as integrators. Figure 5 shows a schematic representation of the Spokane area, some of the main roads and the location of

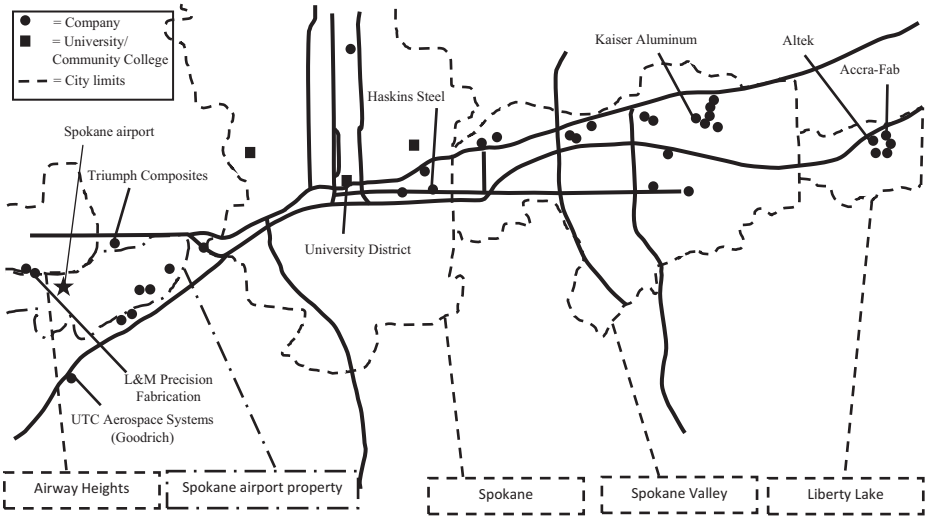

Figure 5.
Spokane aerospace corridor

several aerospace-related companies. The travel distance between UTC Aerospace Systems (bottom left) and Altek (top right), which are both located closely to the I-90 main highway, is about 25 miles (roughly 40 km), and takes about 30 minutes. This illustrates the close proximity of many of the companies. Note that Altek and Accra-Fab are literally neighbors.

One of the challenges of INWAC has been to grow the number of regional aerospace-related companies. For example, INWAC organized its second annual meeting on March 3, 2015 to create awareness and discuss, for instance, aerospace developments in the Inland Northwest. One of the keynote speakers was Bob Noble, Vice President of Boeing's Commercial Airplanes Supplier Management, who discussed how to do business with Boeing. This can be seen as a type of knowledge spillover that occurs within the developing cluster. Part of the challenge within INWAC has also been the need to increase the number of companies in the region with aerospace certification because to be able to supply the aerospace industry requires certification, such as AS9100 and/or NadCap. Companies who have accomplished this certification in recent years include Accra-Fab, Altek and Apex Industries (Walters, 2013). These companies have moved more into work for the aerospace industry. Other examples are Inland Northwest Metallurgical and Novation, who were encouraged to get certified. Inland Northwest Metallurgical provides heat treatment, while Novation is a surface finishing company. The metals in many of the aerospace production processes for parts have to be treated, and having companies regionally available to do this provides benefits through proximity and added capabilities to the cluster. By 2012, INWAC consisted of more than 60 companies (Lind, 2012), while by 2014, there were over 100 aerospace-related companies in the region (Hval, 2014). The integrated approach provides customer confidence because the customer does not have to check the sub-contracting companies for their certification, etc.

The allocation of (sub-contracting) work within the network has, so far, been fairly smooth. There are some reasons that explain this. On the one hand, there are not many

competing companies in the network, maybe with the exception of three sheet metal companies. This makes it relatively easy to divide the work among the different companies. On the other hand, for example, for the sheet metal companies, they each have their own specialty areas, so this also facilitates how contracts are assigned. Furthermore, in case of a contract that overlaps, the experience has been that in those situations, there is typically limited competition due to the capacity of each manufacturer. For example, if a contract is due in six weeks, it may be that only one of the manufacturers can handle it. Also, it appears that the regional aerospace cluster has developed somewhat of a specialty in aircraft interiors. That is, for example, the customer service unit (CSU) with seating, luggage bins and ceiling panels, as well as the 737MAX bathroom, etc.

In terms of results, between 2007 and 2012, Spokane County aerospace wages went up from $38.7 to $64.4 million. Also, several companies have become more focused on aerospace such as Altek, for which aerospace was maybe 15 per cent of their business in 2010, but this went to about 45 per cent in 2013, and L&M Precision Fabrication went from less than 10 per cent in 2012 to about 33 per cent in 2013 (Walters, 2013), and at the March 3, 2015 INWAC meeting, the L&M Precision Fabrication president shared that his company's growth in aerospace in 2013 was 181 per cent. Additionally, there are companies that were started in the region and that have grown. An example is Absolute Aviation, which was established in 2004 and has grown its business and expanded its number of employees. Another example is Quest Aircraft, which was officially launched in 2001, delivered its first aircraft, the Kodiak, in 2005 and by 2013 had delivered 100 Kodiak aircraft (www.questaircraft.com). In 2014, Quest was producing two Kodiak aircraft per month (Maben, 2014). Another illustration of this might be the interest of larger companies to take over smaller companies in the region such as XN Air which was established in 2004 (Crompton, 2005) and was acquired by Ross Aviation in 2011 (Sowa, 2011b), which was subsequently acquired by Landmark Aviation in 2014 (www.landmarkaviation.com). The latest example of this type of acquisition is Quest Aircraft, which was acquired in February 2015 by the Japanese firm Setouchi Holdings Inc. (Maben, 2015).

Discussion and analysis

The aerospace cluster as described in the previous section can be described by several characteristics.

Collaborative

One main characteristic of the Spokane aerospace cluster is that it is a collaborative effort. This collaboration extends across the State of Washington, and includes businesses, government and educational institutes. The approach includes both bottom-up as well as top-down approaches to the cluster, and confirms the findings of Ingstrup (2014), who found that clusters most commonly have a mixture of these two approaches. One of the main drivers in forming the cluster is INWAC. Within INWAC, a distinction can be made between two sets of participants. On the one hand, there is the general set of participants in INWAC, which includes airports and service-related companies. The case description shows that the initial efforts to expand aerospace in the Spokane region was oriented on manufacturing-related activities and led to the creation of INWAC. Since then, much top-down effort, especially by GSI and the AIR Spokane

initiative, has focused on attracting aerospace companies to the Spokane area. It has been able to attract several companies, mostly non-manufacturing, into the area which may have been due to the incentives that were offered. In terms of economic development, much of these companies are a part of traded industries, that is, products or services are sold outside of the region (Porter, 2003; 2000). However, while Porter (2003, 2000) states the importance of competition, this competition element is limited in the Spokane region.

On the other hand, there is the bottom-up initiative by a group of manufacturing companies. The Manufacturing Service Network is a part of INWAC that is more specifically oriented on manufacturers, and is an illustration of a manufacturers-driven coordinating function. The INWAC manufacturers present a united front to the outside to attract aerospace work, and then internally, the work gets divided up among the relevant qualified parties. This coordination of work has shown to be an "order qualifier" for manufacturers in the region. That means that without this united front, many of the manufacturers would not be able to compete and be involved in aerospace. The division of work, when it occurs, is another characteristic, and it points to limited competition, rather having parties that produce complementary products. Although Porter (2000) has much emphasis on the importance of competition, Porter (2000) also states that a cluster enhances productivity through facilitating complementarities between the activities of cluster participants. This seems to be the case for INWAC in general and the manufacturers in particular. They especially benefit from the joint marketing of their capabilities.

Thus, this collaborative aspect also relates to the types of interactions as discussed in the literature review. This means, the Gordon and McCann (2000) classification, the Markusen (1996) types of clusters and Paniccia's (2006) typology. The manufacturers are mostly part of a network, also described by Lundberg (2010) and Giuliani (2013), but the Spokane cluster description does not align with these previously described theories. It does not fit with any of the three types presented by Gordon and McCann (2000), that is, pure agglomeration, industrial-complex or social-network. Gordon and McCann (2000) point out how the clustering can provide benefits for companies, but the motivation for clustering in the Spokane area is different. Where Gordon and McCann's (2000) reasoning also explains a motive for companies to move into the region and to become part of the cluster due to its advantages, in the Spokane region, the motive for clustering is mostly for manufacturing companies that already exist in the region. There appears to be limited advantages for aerospace manufacturing companies to move to the Spokane area, but for the manufacturing companies that already exist in the Spokane region the INWAC approach offers an opportunity to work together to enhance the ability to compete for lucrative aviation contracts. This also contrasts with the study of Sölvell (2009), who identifies either favorable factor conditions or:

> Historical accidents where an entrepreneurial person in a particular location happened to start a business which in due time led to increasing local demand, new firm formation, spin-off firms and so on, and ultimately to a cluster (Sölvell, 2009, p. 55).

The Spokane cluster also does not conform to any of the four types, as identified by Markusen (1996). A common element with the Marshallian and Italianate type districts is that many of the Spokane firms are small, locally owned and that they also make their production decisions locally. Another aspect where the Spokane cluster has similarities

with the Marshallian and Italianate type district is in terms of the cluster facilitator. INWAC can be viewed as a cluster facilitator, as it primarily seeks new cooperative relationships and to widen the existing substantial inter-firm cooperation and the market opportunities and competencies of the cluster. This confirms with the facilitator role for a Marshallian/Italian type district (Ingstrup, 2013). Furthermore, Altek and Accra-Fab as the two integrator companies in INWAC can be considered lead firms for the cluster development in terms of the points mentioned in the study conducted by Ingstrup (2014). For instance, in facilitating and promoting INWAC and providing resources, for example, meeting space and encouraging companies to become certified. What is different in the Spokane cluster compared to the Marshallian/Italian type district is that there is no substantial trade within the district. Another aspect mentioned by several authors such as Sölvell (2009); Boschma (2014) and Furlan and Grandinetti (2014) and sometimes identified with the Marshallian district is that of spin-off firms which is seen as a primary mechanism underlying clustering (Klepper, 2010; Cusmano *et al.*, 2015; Frenkel *et al.*, 2015). So far spin-offs have not (yet) occurred in the Spokane cluster.

The Spokane cluster also neither shows a hub-and-spoke district, a satellite platform district nor a State-anchored system. At best, it resembles something of a hub-and-spoke system, where Boeing could be considered the hub. However, the spoke in that case would only involve the manufacturers' side of INWAC, and would essentially represent just one spoke. It does not represent the richness of spokes around Boeing in the Seattle area Gray *et al.* (1996). Similar arguments also apply to the six types of clusters distinguished by Paniccia (2006, 2007).

In summary, in terms of the cluster models from the literature review, the description shows similarities on a number of characteristics, but does not fit with any one model in particular:

- Marshallian district which consists of small, family-owned firms that mostly make local financial decisions, but some of this is changing, as some of the local companies have been acquired by larger out-of-the-region firms.
- Hub-and-spoke but not in terms of having a hub from a large company, such as Boeing is a hub in Seattle, but rather, INWAC and its Manufacturing Service Network is creating a hub through which business is attracted and somewhat dispersed.
- Some supply chain linkages (as in the industrial complex) where some of the work is outsourced by the regional lead-integrators to other parties that have the expertise that the lead-integrators do not have themselves. So far, within INWAC, there is limited competition. There are, for example, three metal sheet companies, but they each have their specialties, and generally, there has been limited overlap.
- Some signs of pure agglomeration type, but here too it does not completely fit; it seems more a matter of agglomeration, so that the capacity and capabilities are shared, and this requires agglomeration.

What appears to be fairly unique is the situation where a group of companies take the lead (through INWAC) to offer their combined services and capabilities. That is, the

collective presents itself as one unit with certain capabilities. At this stage, there is limited competition within INWAC.

Innovation

Isaksen (2014) developed a framework consisting of two initiating conditions for the rise of a new cluster. The first condition is: certain pre-existing conditions or assets present in a locality prior to the emergence of the cluster. The existence of the Spokane location in close proximity to the Seattle region, the efforts by State of Washington policy-makers to promote Spokane as a viable alternative to the Seattle region and the goodwill and efforts of local Spokane policy-makers and businesses to promote the aerospace cluster as well as the existence of manufacturing firms can all be considered pre-existing conditions and assets in terms of the observations made by Isaksen (2014).

The second condition is: triggering events that stimulate entrepreneurship (Isaksen, 2014). This can also be seen as a broader theme of innovation. Innovation is the main theme in much of the cluster literature (Ferreira *et al.*, 2012). Innovation is considered a key aspect because it contributes to the productivity of the cluster.

One means of innovation is connected with the already mentioned concept of spin-off firms (Frenkel *et al.*, 2015) and entrepreneurship (Kim, 2015). Innovation is also connected with knowledge spillover from universities (see for example the development of the Boston area biotechnology cluster in Owen-Smith and Powell, 2006) and more generally for technology-based industries (Mowery and Ziedonis, 2014). The Spokane aerospace clustering has so far not led to much entrepreneurship, university knowledge transfer and innovativeness in the "traditional" cluster sense or, for example, in terms of the social network cluster (Gordon and McCann, 2000). This does not mean that the cluster companies are not innovative. For example, Accra-Fab is a company with an emphasis on innovation (Sowa, 2011a). However, a lot of this is a part of the service that they offer as a custom manufacturer, that is, they help their customers with solutions (Johnson, 2012). Another example is Altek, a custom manufacturer doing custom injection-molding work. For new parts, Altek will work with the customer on the design of the part, and will look for ways to improve the product performance and/or cost. For example, Altek has helped with the redesign of the lavatory unit for the new Boeing 737MAX. By working on space requirements inside the lavatory unit, it has become possible to alter the outside of the unit with somewhat of a cut-out for the back of the seats. This allows for an extra row of seats (Walton, 2014). According to Porter (2000, p. 19), "Competition is dynamic and rests on innovation and the search for strategic differences". While "Clusters promote both competition and cooperation. Rivals compete intensely to win and retain customers" (Porter, 1998, p. 79). This aspect of innovation as well as competition was also discussed in terms of the literature review and the lack of innovation in this regard in the Spokane area aerospace cluster is another indication that it does not fit well with the existing literature on clusters.

Conclusion and implication

The purpose of this study was to explore the early stage of development of the aerospace industry cluster in the Spokane region in the State of Washington. This cluster is in a very early stage of development. Typical cluster developments such as entrepreneurial activities, spin-offs and local competition are not (yet) occurring, and a critical mass seems not to have yet been achieved. Maybe the early stage of cluster development

should be viewed as consisting of two phases along Isaksen's (2014) conditions. In the first phase, the cluster builds the conditions or assets in the cluster such as favorable public opinion, attracting companies to the region, etc.; while once a certain mass has been achieved in the second phase, there are triggering events for new spin-off companies and entrepreneurial companies. The Spokane aerospace cluster in that way can be viewed as being in the first phase of the early stage of cluster development.

Nevertheless, it is a fast-developing cluster with considerable impact on the region as described above. For instance, the INWAC organization started in 2007 with a small number of companies, and has grown to over 100 aerospace-related companies; Spokane County aerospace wages went up from $38.7 million in 2007 to $64.4 million in 2012; and over 8,000 people are employed in the local industry (Hval, 2014). Additionally, annual economic regional impact from, for instance, Exotic Metals alone is expected at more than $100 million, and companies are experiencing aerospace-related annual growth rates well over 150 per cent. Educational programs were developed for people interested in working in this industry, and companies are recruited into the region. Also, a study by Bochniarz (2014), who focused on social capital in aviation clusters at the State level, found that five cluster management organizations in the State of Washington created a social capital of $2,795,000 in 2013 alone. The cluster also appears to become specialized in aircraft interiors, which may increasingly attract business from aerospace customers besides Boeing as well.

The over 100 aerospace companies are relatively close in proximity. Some of the cluster developments are characterized by cooperation between government, educational institutes and companies aimed at growing the cluster. For example, state-wide incentives, such as tax breaks, are in place to help aerospace companies. Also, the State of Washington has set money aside for aerospace workforce training to insure that its workforce remains competitive. This is in particular important due to, for example, a high minimum wage in the State of Washington and for Boeing, a unionized workforce.

A particularly intriguing part of the cluster is the bottom-up initiative driven by manufacturing companies in the coordinating INWAC organization. The type of cluster that is being created does not seem to fit the previously discussed types of clusters in the literature. The companies involved are mainly small- to medium-sized companies, but by coordinating their capabilities, they are able to present core capabilities in a much more attractive manner to customers. This cluster development approach is not driven by or achieved through advantages in innovation, by vertical or horizontal supply chain competition and advantages, by spin-off firms and by a regional demand base, but rather by customers that are located outside the region. It deviates in terms of the types of companies involved and, mostly, in a sense that it acts as one unit to customers which are located outside the region. In other words, the Spokane aerospace cluster development has different characteristics than those typically found in the literature. This confirms, to some degree, previous observations by Trippl *et al.* (2015) that clusters in the same or similar industries may display different development dynamics. An example of this is also provided by Elola *et al.*'s (2013) description of the development of the Basque aerospace cluster which has a longer history than the Spokane cluster and a different development path, even though the cluster is in the same industry. In particular, the start of the Basque cluster in the 1970s was also related to (international)

growth opportunities and the initiative of two companies, but different from the Spokane cluster, the two companies were an engineering firm and a firm that was already manufacturing for the military (Elola *et al.*, 2013). Also, another difference was a change in the rules of the game, opening the market for system integrators and component suppliers (Elola *et al.* (2013)), while in the current Spokane situation, such change of rules does not exist.

So far, the results of the initiatives have led to growth of the Spokane region aerospace cluster. In terms of the mostly non-manufacturing companies that have been attracted to the region, this shows that the public top-down policy efforts and, for instance, the efforts by the AIR Spokane initiative have been successful. The question is at what cost and how much benefits it is really bringing to the region and whether there are clustering benefits for the companies involved. At this point, it appears that a critical mass of aerospace companies has not yet been achieved, thereby limiting the clustering benefits.

For the aerospace manufacturing companies, it appears that the clustering/networking approach through the manufacturer-led INWAC Manufacturing Services Network has been paying off through the ability to present a united front. This has led to an ability to compete for contracts that the companies normally would not have been able to compete for. Consequently, many aerospace manufacturing companies have experienced high growth in the aerospace side of their business. From a policy perspective and for manufacturers, a lesson learned is that it may be beneficial to establish policies that enhance collaboration around complementary products, so that companies are able to compete together for work in situations where individual companies would not be able to do so. However, it should be kept in mind that the companies involved in the Spokane area are typically small in size and that the industry is offering growth opportunities. Thus, this approach may not work in mature industries.

It is too early to tell whether the approach will have long-term success. Whereas, in particular for the manufacturers, the complementarity has benefitted them and the lack of competition has made it relatively easy to distribute the work among the companies involved, it remains a question what will happen when more companies get involved, who offer competing manufacturing capabilities. This may become difficult for the INWAC Manufacturing Services Network to handle. But, on the other hand, "without vigorous competition, a cluster will fail" according to Porter (1998, p. 79), so maybe the increase will be beneficial and create innovations that are currently mostly lacking, thereby increasing the competitiveness of the cluster. One interesting aspect of the development of the Spokane region aerospace cluster is this aspect of collaboration and complementarity versus competition. Much of the cluster theories emphasize the need for competition and innovation, but more research is needed to determine whether, at least when establishing a new cluster, it might be beneficial to forego this and instead to build momentum through collaboration.

Finally, in terms of theory, this study contributes by describing a new type of cluster formation, in the early stages of cluster development. This adds to the literature that covers types of clusters. However, this study is based on a single case with consequently a limited ability to generalize the results. Therefore, although there are potential practical implications, in terms of the ability to organize similar clusters in other regions and other industries, this has not yet been proven. Additional research into similar cases, if they exist, would be beneficial to strengthen the evidence and to allow more generalization.

Notes

1. Around 2005, there were two government-oriented organizations in Spokane working on business and economic development. These organizations were the Spokane Area (Economic) Development Council and the Spokane Regional Chamber of Commerce. These two organizations merged in 2007 and formed Greater Spokane Incorporated (GSI). As a part of this, there were several standing committees, initially connected to the Spokane Regional Chamber of Commerce but that later became part of GSI. One of these committees was the Manufacturing Roundtable. The Manufacturing Roundtable involved local manufacturers, and was, for example, concerned with the manufacturing workforce and other manufacturing-related issues.
2. This group involves local government, airport and economic development officials who, since November 2011, have taken a collaborative approach.

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