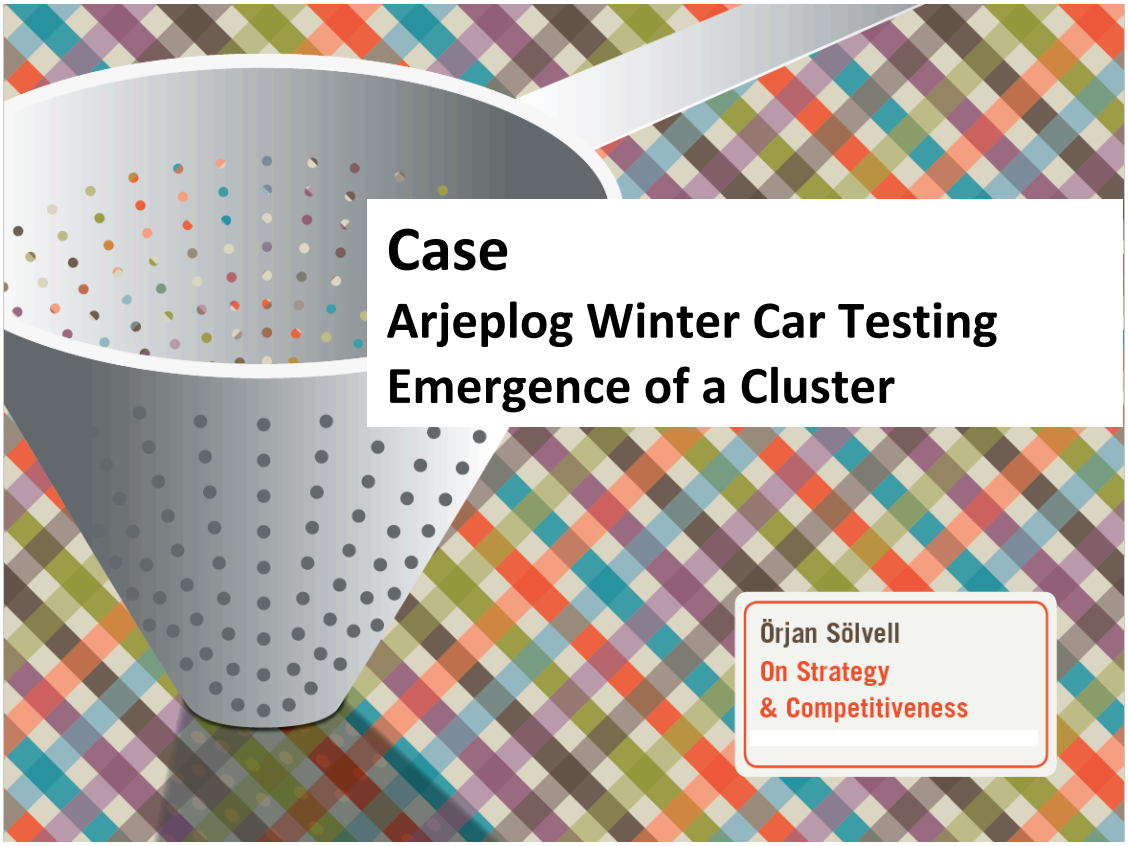

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An accompanying textbook can be downloaded for free at:

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Arjeplog Winter Car Testing – Emergence of a Cluster

"At that time, the atmosphere in the region was quite depressed. But when the car testing business emerged and absorbed many of the employees, who had lost their jobs following the shutdown of the sawmill, most people realized that there was something else to do after all. A sort of flexibility was imbedded in the mentality."

Bengt-Urban Fransson, Mayor of Arjeplog

Arjeplog, a municipality with around 3,000 inhabitants and located in the very northern part of Sweden, had been struggling for years. It had experienced the shutdown of both the local sawmill and the mine, and the population was decreasing as younger people moved to the southern parts of Sweden. By the 1980s and 1990s, a new industry began to emerge.

Introducing Northern Sweden

Sweden had experienced a stable macro environment, with a balanced budget and modest levels of public debt for a long time. GDP growth was in the top half of Europe, and inflation had fluctuated between 0-2% in the 2000s, which was under the Swedish Central Bank target. The public sector had shrunk during the past decade, but was still large both in terms of value and employment. Around 30% of the work force was employed in the public sector, while general government expenditure had shrunk over a 20-year period from 74% of GDP in 1995 to 34% in 2015. Sweden used to be a major recipient of foreign direct investment (FDI), and outgoing FDI amounted to almost 70% of GDP in 2013[1].

The political environment in Sweden was stable and had been dominated by the Social Democratic Party for most of the last centennial. During the 1990s and into the 2000s policy shifted to solidifying public finances, increasing labour market participation and implementing EU integration. While Sweden in many ways was a homogenous country, it had large regional differences, and immigration was substantial. Traditionally, regional policies focused on levelling out regional disparities across the country. More lately, the government had signed regional "growth programs" based on local strengths and local private-public initiatives, and had implemented a range of innovation, entrepreneurship and cluster initiatives. EU Structural Funds played a significant role in regional policy. Arjeplog and Kiruna were the municipalities that had received the largest amount of funding within the most northern County of Norrboten.

According to EU standards, Sweden was divided into eight regions as shown in Exhibit 1. Upper Norrland, the northernmost region, made up almost 40% of Swedish territory, but only some 6% of the Swedish population of close to 10 million. Upper Norrland was one of the most sparsely populated areas in Europe, with about 3 inhabitants per km^2. In comparison, the Swedish and EU average were around 20 and 120 inhabitants per km^2, respectively. The region borders Norway to the west and Finland to the east. Norrbotten was the northernmost county of Upper Norrland. It

[1]http://www.kommers.se/Documents/dokumentarkiv/Verksamhetsomr%C3%A5den/Utrikeshandel/Handelsutveckling%20och%20statistik/Direktinvesteringar/Direktinvesteringar.pdf

was characterized by its contrasts; when ice and snow covered the mountainous areas of the west, people were sunbathing along the coast of the Bothnian Sea.

During winter seasons, ridges of high pressure came in over northern Sweden from Russia. This had a greater effect on the temperature than the Gulf Stream that moved along Norway's coast to the west. The consequence was typically cold weather in the region for long periods of the year. Furthermore, the Polar Circle intersects Upper Norrland, making the seasonal shifts very distinct with cold, dark winters and summers with midnight sun. Yet another factor influencing the cold climate was the terrain. The valleys had microclimates of constant temperature, which was quite specific for the region. In some parts, the mean annual temperature was close to zero degrees Celsius. The first snow usually fell in October and sometimes continued to fall as late as May. The coldest temperatures were found during December to March and could reach minus 40 degrees Celsius.

The infrastructure was reasonably well developed. There were several airports[2] in northern Sweden, the largest of which, Kallax, was located in Luleå. In the counties of Norrbotten and Västerbotten there were more than 25,000 kilometres of public roads. All major roads were asphalted and in fairly good condition. The main roads were cleared from snow on a regular basis. The speed limit was 110 km/h on main roads and 70 km/h on smaller roads. There was one railway line connecting the northern and southern parts of Sweden. The line passed through Boden, where it forked to Norway and Finland. Most imported and exported goods were transported by sea. There were harbours open year round in Luleå, Piteå, Skellefteå, and Umeå. Traditionally, the timber, mining, and waterpower industries had provided employment in most municipalities in northern Sweden. These industries had had a large effect on economic performance in the past, but in recent decades less people were employed in these traditional industries. During the past decades, the Northern Norrland region had seen productivity go up but the numbers of workplaces go down. Local industry was heavily dominated by capital intense industries.

The level of education differed widely among the inhabitants of Upper Norrland. More women than men had both high school and post high school education. 27% of the inhabitants in the coastal municipalities and 15% of the inhabitants in the inner parts of Upper Norrland had a post high school education. Entrepreneurship and new firm formation had historically been below the national average.

[2] Kiruna opened in 1960, Skellefteå in 1961, Umeå in 1962, Luleå in 1984, and Arvidsjaur in 1990.

Figure 1 Map of Northern Sweden

Arjeplog

The municipality of Arjeplog had the largest area of water among all the municipalities of Sweden, 1,790 square kilometres distributed among some 8,000 lakes. The oldest occupations in the area were connected to reindeer herding. There were six Inuit communities in Arjeplog continuing this traditional occupation. The biggest challenge for the area's residents and the local government was to maintain traditional values while at the same time actively participate in "Europe and the world".

Arjeplog had experienced a downsizing within traditional industries. First, the old sawmill was closed, which historically had been one of the largest industries in the region. Second, the old lead mine, which was the largest of its kind in Sweden (employing 17% of the working population), was closed in 2001. The primary employers in Arjeplog were the municipality, the tourism industry and a service business making clocking-in cards. A department of a national agency[3] responsible for shipment grants and other areas also provided employment opportunities in the region, as well as a division of the Swedish National Road Administration (SNRA) handling vehicle registrations. The SNRA office had been placed in Arjeplog as a direct result of the shutdown of the local mine.

Bengt-Urban Fransson, the mayor in Arjeplog, stressed that although there was an issue involved in attracting young people to the municipality, the emigration of young people was not seen as a serious problem. The greatest challenge was to convince them to return and create employment opportunities in the region after receiving their education. For upper secondary schooling students had to move to either Piteå or Luleå. The closest universities were in Luleå and Umeå.

The local community was tied together through a web of voluntary organizations, such as educational associations, non-governmental organizations, local associations of households, athletic associations and sewing circles. Historically, hunts were common ways of socializing, and there

[3] Swedish Agency for Economic and Regional Growth

were several hunting parties in Arjeplog with members from all corners of the municipality. In total there were about 80 non-profit associations within the municipality.

Car Testing

Car manufacturers invested heavily in new models and product features to stay ahead of competition. To ensure that every part of a new car model was working perfectly, extensive testing had to be done. Tests could be conducted through simulations, but it was also necessary to perform some tests in actual conditions. Because most cars were sold worldwide, they had to be able to handle all possible conditions such as high and low temperatures, snow, ice, sand, water, etc. To test under such different conditions, car manufacturers typically managed a number of testing facilities, some of which were located close to the plants whereas others were in remote places with harsh climate. The tests were often performed in cooperation with local entrepreneurs, so called service providers. In most cases, the local entrepreneurs owned the garages, test facilities, etc., but an increasing number of car and component manufacturers were investing in their own facilities. For example, in the early 2000s the German supplier of car components, Bosch, had invested around 200 MSEK in its own facilities.

Summer testing could be performed almost everywhere, and was usually conducted in the home base of the car manufacturer, close to R&D centers. There were also special places such as Nardo, Italy, where high-speed tests were performed. Barcelona, Spain, had become a center for special summer testing. For winter testing there were only a few places in the world where it was possible to conduct such tests: Sweden, Finland, Canada, Japan, China and New Zealand. U.S. manufacturers typically tested in Canada, European manufacturers in Finland and Sweden, and Asian manufacturers in Japan.

The different countries had different advantages and foci. Finland had a focus on tire producers. Canada had a longer testing season compared to Finland and Sweden. Japan, on the other hand, had a shorter testing season, only about three months compared to Canada's about six months and Finland and Sweden's five months. New Zealand had a different season but also had unstable weather conditions during the test season. In Sweden, it was possible to test close to 100% of the days during the testing season. Car testing was centered in Arjeplog and Arvidsjaur in Norrbotten. Volvo, however, had carried out their tests in Kiruna and Jokkmokk since the beginning of the 1970s. Some of the service providers offered specialized testing services to their customers, whereas others focused on providing overall solutions, including accommodation, leisure activities, food, special requirements, rental cars, etc.

The division of space on the lakes, where most of the actual testing was performed, was done through agreements among the service providers. The tests were carefully scheduled so they were not performed at the same time. Since much of the testing was done on prototypes, secrecy was key. Paparazzi photographers were not popular. A system had been developed in Arjeplog to deal with the problem, where suspicious behaviour was reported to the service providers as well as to the Arjeplog Times. Another way to keep secrecy was keep the cars strictly within the boundaries of the testing territory. The cars were transported in covered trailers from the home site to the testing facility. The delivery of the prototypes and the testing then took place behind closed gates. When

the testing was finished, the prototypes were loaded on the covered trailers again and transported back.

"Due to the fact that gas stations are located inside the testing facilities, the cars never have to leave the actual facility, which is also guarded with gates, fences and security guards."

Lars-Gunnar Gyllenberg, owner of Colmis

Arjeplog in the 1970s

The two friends, David Sundström and Per-Axel Andersson, had been running various businesses ranging from shoe production, scooter production and construction of residential houses, to running a fishing and camping site, and a tourist air service company. Sundström, the entrepreneurial of the two, was described as a man who saw opportunities, whereas Andersson was more of a businessman.

Figure 2 Carl David Sundström (to the left) and his colleagues

In the beginning of the 1970s, three engineers had been sent from Teldix in Germany (later Bosch), with the mission of finding a location for winter testing of new car models and components. At the time, the three men were working together on an ABS[4] prototype. They had been to Kiruna, Jokkmokk and other locations before coming to Arjeplog. In Arjeplog, Sundström and Andersson had a landing strip on the ice on Lake Hornavan for their air service company. The Teldix engineers and Sundström and Andersson got along well, and it was agreed that the Germans could use the runway to test the cars' performance. The three engineers went out on the ice with a broom each to clear the runway, and so began winter car testing in Arjeplog. In the early years, Sundström and Andersson had their hands full with their air company and tourism, but they assisted the Germans with their expertise in making plane testing strips on the ice when necessary.

With time, however, Sundström and Andersson realized the business opportunities within the car testing sector and changed their focus from merely being kind and helping the engineers with their testing to providing professional service. The two friends started a service company, **Andersson & Sundström** (later renamed **Icemakers**).

[4] Anti-lock Break System

"We would only invest byu the company's previous profits, there was no such a thing as borrowing money."

David Sundström

People in the community would sublet rooms in their own homes, and also assisted with private garage space for the engineers. The three engineers from Teldix later ended up in three different companies within the German automotive cluster: Opel, Bosch and BMW. The word spread in Germany, France and across Europe about a new testing facility in the north of Sweden. The area had everything needed for winter tests: cold climate, snow, and frozen lakes. Furthermore, the infrastructure was sufficient and there was a potential for increasing the activities.

The first car manufacturers in Arjeplog included Porsche, Mercedes, and BMW. With the assistance of Andersson & Sundström, the component manufacturer Alfred Teves was established in adjacent Arvidsjaur, collaborating with a new service provider founded by friends of Andersson & Sundström.

Arjeplog in the 1980s

"When the business emerged here in Arjeplog, there was a lot of partying. Today people are more serious, the 'bons vivants' have not been given the opportunity to return."

Stefan Oscarsen, CEO of Argentis

During the 1980s automotive engineers asked for better garages and storage facilities, and their need for new types of services increased. In order to meet this increased demand, Andersson & Sundström invested in machines to clear the ice of snow, and learned how to plane and water the ice for perfect testing conditions. The testing business was taken to a new level with more customized services at higher standards. The business developed from just offering customized roads on the lakes, to also offering asphalted road-strips and artificial ice-roads on land. Bosch, which at the time was cooperating with Icemakers, formerly Andersson & Sundström, invested in new land tracks.

The demand for services grew so rapidly that Icemakers had trouble satisfying all their customers. Lars-Gunnar Gyllenberg recognized the business opportunities and joined forces with his friend Harald Fjellström. Fjellström owned land and Gyllenberg had good business connections. Gyllenberg had a broad network of international relationships from his earlier business experience. On top of that, he had good local connections from his years as mayor in Arjeplog. Gyllenberg and Fjellström started **Colmis** in 1985. Gyllenberg discovered that, up to that point, British component producer Lucas Gerling (later merged into TRW, one of the world´s largest component manufacturers), had been using local families' garages and was looking for a more permanent garage facility. Colmis offered Lucas a garage on Fjellström's property just outside the centre of Arjeplog. In 1986, the first garage was built, and Colmis later expanded its offering to include the provision of tracks.

Jörgen Stenberg was originally a journalist, and had travelled around the world, writing books and producing TV programs about the art of fishing. Stenberg realized that winter car testing was "the thing" and that there was money to be made in this emerging business. Jörgen Stenberg, Christer

Finnson, Lars Hardell and Karl-Gunnar Ek founded the winter car testing company **Tjintokk** in 1986 and, later, Norrlands Marknadsidéer (the NMI Group).

Cartest was yet another service provider established in Arjeplog during the late 1980s. Åse Sundström, daughter of Alf Sundström (one of the founders of Cartest), described the birth of the company as "*a coincidence because Alf just happened to sit next to the international manager of Knorr-Bremse at the restaurant in Kraja.*" Alf Sundström offered to build a testing facility for them in Arjeplog. The deal was later closed and in 1988 Alf Sundström founded Cartest with his friends Ulla-Britt Nilsson and Håkan Fredriksson. In addition to test services, Cartest arranged various kinds of social activities for the international test drivers, such as sports games and scooter safaris. In general, the atmosphere was friendly and dinner parties were regularly held at the homes of the local population.

The community assisted the emerging business with a range of services. However, because the gains of the new business were limited, some people in the community were sceptical. According to Åse Sundström the antagonists' concerns included the possible pollution of Lake Hornavan, among other things.

"Initially, [the international car testers] were quite few, but they set the tone right from the start. In the early days there were heated conflicts between the international testers and some locals. The community could at this time be characterized as being very 'macho', and with a strong hunting culture. When the international testers appeared, many of them naturally met local women, resulting in many divorces."

Bengt-Urban Fransson

More actors were also established in adjacent Arvidsjaur. Colmis lost their first customer in a bidding contest, where Lucas moved to another service provider after it was acquired by the U.S. company Kelsey-Hayes (later TRW), which already had their testing facilities in Arvidsjaur. However, Lars-Gunnar Gyllenberg maintains that *"Colmis came out as the winner of this process, because Lucas' move to Arvidsjaur resulted in the attraction of Fiat to Colmis' facilities. Fiat, having originally used the same service provider as Kelsey-Hayes, felt it was too crowded in Arvidsjaur."*

With increased business activity, more customers were drawn to the region, first from Europe and gradually also from other parts of the world. Sometimes cultural clashes arose. Alf Sundström had an interesting first meeting with a manager in a high position at a Korean car company. Just before the meeting, Sundström discovered that there was a problem with one of the toilets in the office building. Sundström, who was not afraid of getting his hands dirty, dealt with the problem. While Sundström was fixing the toilet, one of his customers, Delphi, had welcomed the large OEM from Korea taking them on a tour of Cartest's facility. At the end of the tour, the Koreans asked who owned and ran the facility and found out that it was Sundström, the man they had walked past when he was busy fixing the toilet. Ever since, Alf Sundström had accepted that he needed to put on a suit more often.

Sometimes technical mishaps occurred because the car and component manufacturers were not used to the climate, for example a staff person flushed water over instruments in the middle of the winter in order to clean the equipment. Garage doors were left open overnight resulting in unpleasant discoveries the following morning – with temperatures down to minus 40 degrees

Celsius. There were also stories about the car companies renting cars, disassembling them in the workshops, copying the parts and then reassembling the vehicles and returning them. The community was trying to decrease the cultural clashes between the Swedish and Asian cultures by offering seminars concentrating on Asian culture, not only in a business context, but also privately. A Japanese company required a Japanese chef to be present to even consider testing in the area.

Arjeplog in the 1990s

"The business is built on long-term relationships; all service providers work many years with their customers in order to develop goodwill for their companies."

Conny Bergwall, CEO of Tjintokk

The wheels of the automotive industry were spinning faster and faster. The service providers had to keep up with increased speed in developing new prototypes and shorter life cycles of cars. New testing facilities were usually built with little planning in advance, meeting the urgent requirements of customers. The service provider's core product still consisted of the provision of services to the testing business. However, the services had diversified during the 1980s to include tracks on land, workshops, modern garages, cold chambers, gas stations and administrative buildings. The workshops were located close to the tracks to save on travel time. Garages were used to store and hide cars. The cold chambers were used to test functionality in cold climate, with the advantage of providing stable testing conditions compared to outdoor. Colmis was working on a new business concept where they performed less complex testing procedures on their own. The car manufacturer sent a number of cars and a test protocol to Arjeplog. Colmis performed the tests as described in the protocol and then reported the results back to headquarters. This would allow the car manufacturers to focus on more complex testing while they were physically in Arjeplog. There were several advantages with the new system; however, some of the German, Italian, and French test drivers were critical.

The demand for personnel covered a broad spectrum ranging from cleaners to mechanical engineers, and from basic activities to more advanced services demanding education and training. Human resources posed a problem for the service providers because it was only possible to employ people for about six months in a year. The seasonal aspect of the business made it difficult to attract skilled workers. It was common for workers to have two to three different employers during a year. In April, once the test season was over, many people were unemployed or moved on to other seasonal jobs, e.g. construction or tourism in the region. Yet others had to leave Arjeplog.

In the early days there had been very little dialogue between the entrepreneurs and the municipality. The entrepreneurs ran their business without any assistance from the municipality. In a meeting Bengt-Urban Fransson said: *"In the 1970s and the 1980s, no one really realized that the winter car testing industry would turn out to be such lucrative industry."* During 1990s, the involvement of the municipality increased. The municipality met the OEMs on a regular basis, once or twice a year, depending on what was on the agenda. In specific projects, the involvement of the municipality could be more active, for example concerning contracts for the procurement of land and general infrastructure.

"Everyone knows each other, the municipal leadership, the owner of the hotel, the service providers and so on - it is easier to implement decisions."

Åse Sundström, Co-founder of Cartest

Argentis, a non-profit business development agency (78% owned by the service providers and 22% owned by the municipality), was started as a result of the increased involvement by the municipality. It was founded in 1996 with the mission to strengthen business in Arjeplog and functioned as an intermediary between service providers, OEMs and the municipality. Every Friday, fika[5] was arranged by **Företagarna** in Arjeplog (the federation of private enterprises) and all businesses in Arjeplog were welcome. Representatives from the municipalities were also present at the informal get-togethers, which created a forum for sharing ideas as well as problems.

The creation of the organization Swedish Proving Ground Association (SPGA) took place during this period. **SPGA** was a non-profit association of Swedish service providers that specialized in providing automotive testing services. SPGA was founded in 2000 as a result of an investigation of the car-testing region performed by Carl-Johan Korsås for the Ministry of Industry, Employment and Communication. SPGA had 12 member companies and their combined turnover amounted to 250 MSEK. SPGA members operated in the municipalities of Arjeplog, Arvidsjaur, Jokkmokk and Älvsbyn. The primary mission of SPGA was to help member companies in their operations. Through SPGA, member companies worked together to develop industry guidelines and practices both through formal and informal discussions.

"This is the formal forum. But informal conversations also take place during these meetings. Other than that, if something comes up, we call each other."

Lars Holmgren, a local entrepreneur

The association also functioned as an intermediary to reduce long-standing grudges. Lars Sundström, CEO Icemakers, commented: *"several of the entrepreneurs have been more like enemies and did not talk to each other at all. Now, with these meetings, there are things we share, common interests that may solve old issues."*

Carl-Johan Korsås played an important role in many aspects, not only for the creation of SPGA. Ulrika Messing, Minister for Communication and Regional Policy, had appointed Korsås as a special contact person for the car and component industry in Upper Norrland. He had channels into the Ministry and other departments and brought up issues concerning Arjeplog on the agenda in a new way. When Korsås left his assignment, the local government in Arjeplog continued to maintain the contacts he had initiated.

"Korsås was one of the individuals who were able to start a dialog. It caused a change of attitude here. Thanks to the attention from the government, the inhabitants realized that this was not a 'one-time-happening'. This was a business with greater potential than we understood. From this point forward, it was more accepted to be involved in the testing activity."

Bengt-Urban Fransson

[5] Fika - the Swedish word for having a cup of coffee or tea and a cookie or cake. The word also comprises the social aspect of the get-together.

The whole community developed into more of an international municipality. Some of the tangible adaptations made for foreign test drivers in Arjeplog concerned the large choice of restaurants with international menus. You could now have a pint of beer or a glass of wine with your hamburger at the local bar down on the corner. A catholic mass was held every two weeks by the Swedish church. Reflecting on the international atmosphere Bengt-Urban Fransson said *"during the winter test season, you will often find yourself being the only person speaking Swedish to the check-out assistant, when buying food at Konsum [the local grocery store]."*

Most of the OEMs in Arjeplog had now been in the region for quite some time and had gradually adapted to the community. Test drivers and other specialists often returned year after year. Markus Hofbauer, from Stuttgart, Germany, said: "*Arjeplog is the best test area I have been to because the people are so friendly and warm. We are welcomed as friends here and not as guests. I feel like part of the community.*" Marco Carmagnola from Turin, Italy, said he liked "*the peace here in Arjeplog and the wonderful landscape.*" Cédric Van Essen from Paris, France, added that a positive thing in Arjeplog was that "*everyone speaks English.*"

Arjeplog in the 2000s

More and more people had been attracted to the region, as the awareness of the test site spread not only across Europe, but also to Asia and the U.S. Media coverage had increased. Service providers in Arjeplog now included: A-tent, Cartest, Colmis, Galtis, Icemakers and Tjintokk.

Table 1 Service Providers in 2000

Company	Turnover (MSEK)	Customers
A-tent	1.7	Porsche
Cartest	15	Delphi, Knorr Bremse, Hyundai
Colmis	7	Alfa Romeo, Fiat, Ferrari, GKN, Haldex, Lancia, Mando, Opel and SAAB
Galtis	1.6	Land Rover
IceMakers	7.8	BMW, Citroën, Daimler-Chrysler, Magna Steyr, MAN, Peugeot, PSA, Renault, Scania,
Tjintokk	55	Volkswagen Group

Source: www.affarsdata.se, www.arjeplogtestcenter.com

Canadian subcontractors and component producers active in the European market had moved some of their testing to the region. Lars Sundström argued that: *"differences in climate is one reason, another reason is that they need to adapt their products for the European market, which is easier to do if you conduct your testing in Europe."*

With increased growth, service providers encountered problems with pressures from customers. For example, during peak periods there was a shortage of accommodations. Bosch was now

contemplating to increase its commitment in the region; however, the current service provider would have some difficulty in meeting Bosch's needs. A local entrepreneur, Lars Holmgren, realized this, so he joined forces with the managers of NMI and Tjintokk and initiated negotiations with Bosch. In a business meeting, Lars explained:

"In early 2000 I met these guys from Tjintokk on the airplane. I travel quite a lot and we knew each other from before and enjoyed talking on-board. I brought up the question about Bosch preparing to expand. Tjintokk, the hotel and I had common interests. Tjintokk was very anxious that Bosch would not move to some other place. That would have been devastating for Volkswagen and Audi. Tjintokk was clearly supported by their customers in this regard. Because Tjintokk and the hotel had a common interest, we all chose to join forces. I was given the responsibility and handled the relations and contacts with Bosch to introduce a concept where Tjintokk, the hotel, and Skanska [a construction company] would build the whole thing for them. The first contact was initiated at the airport where I approached the CEO of Bosch Sweden. I introduced us as a group that was interested in realizing Bosch's plans to expand."

In 2001, Arjeplog Test Management, **ATM**, was founded by the people behind the service provider Tjintokk, with the sole purpose of serving Bosch. Bosch decided to join forces with ATM and invested 40 MSEK, followed by an additional 160 MSEK in 2003, for the building of a new testing facility. In late 2003, H.M. King Carl XVI Gustaf of Sweden opened the new facility. Although the investment itself was large and important for the region, the signal it sent was perhaps even more important. Bosch was one of the key players in the testing business since most of the car manufacturers collaborated with them and used their equipment. This trend of local entrepreneurs becoming partners with multinational car manufacturers was increasingly common. Service providers were also cooperating with supporting industries. ATM, for example also cooperated with a plough manufacturer. In 2004 ATM began operations in China and a decade later employed almost 100 people including both expatriates and local staff. ATM also initiated cooperation with the technical university in Luleå, and set up a local drivers' school for test-driving on ice.

In 2003, General Motors placed its winter testing of all brands at Colmis' facilities. Harald Fjellström, co-founder of the company confirmed that Colmis invested 37 MSEK in its facility as a direct consequence of GM's establishment. All the testing sites throughout the entire testing-region now received broadband access. SPGA was active in pushing this development.

In 2004, the German car manufacturer Volkswagen relocated its long-range testing from Rovaniemi, Finland, to Sorsele, a municipality adjacent to Arjeplog. The test facility employed approximately 40 people. The municipality of Sorsele supported the venture by purchasing the land where the test facility was built. Airport traffic nearly doubled between the mid-1990s and early 2000s. In the autumn of 2004, the airport authority started an expansion of its runway and the addition of a new aircraft taxiway. The Swedish government, the Norrbotten government and the municipality of Arvidsjaur invested a total of 37 MSEK in the airport.

A new secondary school program ("Bilsystemteknik", or Car System Technology), started in Arjeplog in 2004. The motive was not only to educate specialized engineering students, but also to attract younger people to Arjeplog. Before Bilsystemteknik was founded, the closest alternatives for upper secondary school education were in Piteå or Luleå.

In 2005, Icemakers' business grew substantially. One of its customers, BMW, decided to invest 150 MSEK together with Icemakers in a new testing facility, which was built in 2005/2006. With this new investment, BMW tripled its business in Arjeplog.

Between 1987 and 1990, Toyota had conducted its winter testing in Sweden. But for a number of reasons, Toyota decided to move its testing to a competing region in Finland. However, after 14 years in Finland, Toyota Europe conducted an extensive "Winter Test Facility Investigation" and in 2005 decided to return to Sweden and Arjeplog. The same year Hyundai, a Korean car manufacturer, decided to invest in a new testing facility together with Cartest. The investment amounted to some 15 MSEK.

Jan Edvardsson, part-owner of Hotel Silverhatten, took over ownership of Kraja, a group of small cabins serving as accommodation for test drivers. With this acquisition, "King Edvard" as he jokingly was called, increased the size of his kingdom in Arjeplog. The total turnover in the car testing business in 2005 in Arjeplog amounted to around 500 MSEK. About 300 local citizens were employed in the business, with an additional 1,500 visiting car testers and other specialists every winter. The car testing industry was now the second largest employer in the region after the municipality.

In 2007 ATM established its first testing facility in Yakehi in Northern China. The same year Daimler AG invested 30 MSEK in a new 1,700 square meter facility in Arvidsjaur through its subsidiary **Lapland Car Test** . The facility was set up to test Mercedes, Smart and Maybach cars. A new facility to test trains in winter conditions was also establishded by Banverket (in charge of the Swedish railway infrastructure).

Arjeplog in the 2010s

The car testing business continued to grow (revenues of close to 1 billion SEK in 2013) and some 3,000 test drivers worked in the region every winter. However, in 2013 a warm winter threatened the business, as the lakes did not freeze until January.

SPGA had developed into a cluster organization, arranging a range of activities, including the yearly Swedish Automotive Testing Seminar (**SATS**) jointly with **CASTT** (Centre for Automotive Systems Technologies and Testing), at Luleå University of Technology (established in 2005). CASTT was involved in research projects (e.g. engineering acoustics, embedded systems, industrial electronics, CAD solutions, structural engineering), graduate and undergraduate studies, student projects, industry seminars and continuing education. A large number of firms were involved in SPGA activities, including: Alfa Romeo, American Axle, Audi, Autoliv, BMW, Renault, Borg Warner, Bosch, Bridgestone, Continental Teves, Daimler, Dunlop Tech, EvoBus, Ferrari, Fiat, GKN, Haldex, HMC, Jaguar, Knorr-Bremse, Lancia, Land Rover, Magna Powertrain, MAN, Mando, Opel, Pirelli, Porsche, PSA, Ricardo, Seat, Skoda, TRW, Volkswagen, and ZF.

There were now six gas stations located in the centre of Arjeplog, and from 2011 one station also offered hydrogen. In 2014 ATM initiated tests on Greenland. In 2015 SPGA announced plans to build a new large testing hall, an investment amounting to around 1 billion SEK.

In Finland a new testing site had emerged within a former secluded military area in the Northern province, and in China several of the western car manufacturers had now initiated local car tests.

Exhibit 1 Map of Sweden (8 EU-denominated NUTS 2 Regions)

Exhibit 2 Distance Between Cities in Norrbotten (km)

	Arjeplog	Arvidsjaur	Boden	Gällivare	Haparanda	Jokkmokk	Kiruna	Luleå	Piteå	Älvsbyn
Arjeplog		86	226	330	361	236	449	241	231	180
Arvidsjaur	86		140	247	275	154	367	156	145	94
Boden	226	140		188	131	135	319	35	81	47
Gällivare	330	247	188		256	93	119	239	287	233
Haparanda	361	275	131	256		266	356	127	174	182
Jokkmokk	296	154	135	93	266		213	169	186	141
Kiruna	449	367	319	119	356	213		339	387	352
Luleå	241	156	35	239	127	169	339		54	62
Piteå	231	145	81	287	174	186	392	54		51
Älvsbyn	180	94	47	233	183	140	384	62	51	

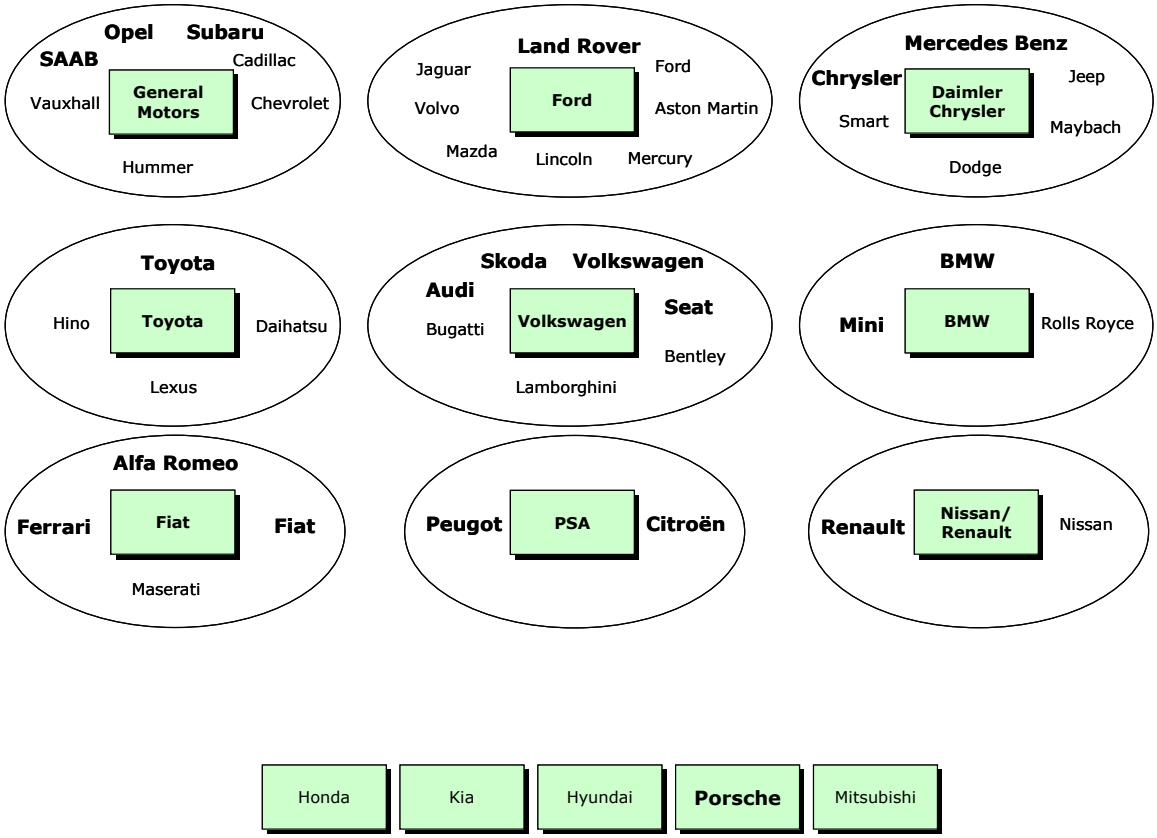
Source: Länsstyrelsen

Exhibit 3 The 15 Largest Employers in Arjeplog (2000)

Name	% of total employment in municipality	Number of employees
ARJEPLOG MUNICIPALITY	24.5	325
BOLIDEN MINERAL AB	17.0	225
VÄGVERKET	5.7	75
NORRBOTTENS LÄNS LANDSTING	5.7	75
TJINTOKK KOMMANDITBOLAG*	5.7	75
TJINTOKK AKTIEBOLAG*	2.6	35
POSTEN SVERIGE AB	2.6	35
COMWELL ARJEPLOG AB	2.6	35
KONSUM NORRBOTTEN EK FÖR	2.6	35
ARJEPLOGS FÖRSAMLING	1.1	15
ALLVACUUM SVENSKA AB	1.1	15
DATARUTIN DOKUMENTOR AB	1.1	15
DIREKTRONIK AKTIEBOLAG	1.1	15
GUSTAFSSON TOURS I SLAGNÄS AKTIEBOLAG	1.1	15
KRAJA AB	1.1	15
Total		1,005
Percent of total employment in the municipality	75.6	

Source: http://www.regionfakta.com
Car testing companies marked with yellow and star.
Public organization marked with grey.

Exhibit 4 Leading Automotive Groups in 2005



Source: Case author
Note: Brands marked with bold letters test their cars in Arjeplog.