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# Creative destruction and creative resilience – Restructuring of the Nokia dominated high-tech sector in the Oulu region

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**ABSTRACT**
The Oulu region, a globally recognised hub of mobile technology development in Northern Finland, provides a textbook example of how the various features of an innovation ecosystem can cause serious problems for regional development when a region faces a shock. The Oulu region is also an interesting example of how the effects of shock can be alleviated through creative actions and effective regional policy. In this article, we develop a framework for analysing resilience using creativeness as the key element. We contribute to the literature by showing how this framework can be used in the operation and management of the regions hit by creative destruction types of shocks. We argue that the dynamic process that Oulu has gone through, in which obsolete and unproductive business activities have been replaced by new fields of technology and knowledge, can clearly be compared in many ways with Schumpeter's description of "creative destruction". We call this dynamic process creative resilience. We identify three elements as the core of creative resilience; knowledge creation, entrepreneurship and community spirit. Our paper will show how they materialised in the Oulu region.

**KEYWORDS**
ICT cluster, resilience, regional development, sudden structural change

**JEL CLASSIFICATION**
J6, R1, R23, R58

## 1. Introduction

High-technology firms and their success in international markets have been an engine of economic growth over the past two decades in Finland. The strong growth of the information and communication technology (ICT) cluster led by Nokia Corporation has played an extremely important role, especially in the early 1990s when the Finnish economy was recovering from a deep recession. In Finland, many regions were active in pursuing regional high-technology policies and development programs to promote their economic growth. Because of these policies, a number of regional high-technology centres were built in different parts of Finland. One of the most important regional technology clusters was established in Oulu in Northern Finland. Nokia and some other smaller companies in the electronics industry were the main employers in the region. In the 1990s and the beginning of the millennium, Oulu was widely recognised as the global leader in wireless and mobile ICT. In fact, most of the new Nokia phones were designed in Oulu. At its peak, Oulu was considered the largest wireless telecommunication technology R&D centre worldwide, with approximately 14,000 employees (Simonen et al. 2016). During the last ten years, its role has decreased, but the high-technology cluster still remains an important part of the local economy.[1]

The high-technology cluster in Oulu has largely been built around the Nokia business. The establishment of the cluster has been a multi-stage process, with an important role of close cooperation among firms, universities, and research institutes. The growth of the Oulu region as one of the most significant centres of high-technology firms is often described as the 'Miracle of Oulu'. However, a structural change in the high-technology sector in Oulu, mainly owing to the collapse of the Nokia mobile phone business, has caused major challenges for the economy.

[1] Figure A1 in appendix provides information about the location of Oulu and Finland's international flows related to trade, FDI and migration in 2013.

Over the past few years, the concept of regional resilience has been used to describe how regions respond to changes in their economic and technological environment (e.g. Reggiani et al. 2002, Martin 2012, Martin & Sunley 2015, Martin et al. 2016, Bristow & Healy 2014). Traditional regional studies related to, e.g., the local industrial structure and structural properties of innovation networks are closely linked to the issue of regional resilience. Regional resilience refers to a region's capability to adapt to changes in a way that provides good opportunities for the development of both production and employment after a shock. Equally important is the ability of regions to anticipate and prepare for disturbances and to recover from them through regional policy (e.g. Foster 2007, Hill 2008, Martin 2012). Regional policy measures played an important role in Oulu too. However, a region's resilience depends not only on the adaptation capability of local firms or local industrial structure or regional policy but also on the adaptation of workers to the altered circumstances (van Dijk & Edzes 2016). Oulu's case is an excellent example of this. Based on this example we formulate a framework that can be used to analyse this kind of development. The aim is that our framework will help to identify regional measures that will contribute to the development of region as an area of creative resilience.

Regional development authorities have launched several projects to control the negative effects of the sudden structural change in the Oulu region. The focus of structural change management has been to support the employment and creation of new entrepreneurship, and the aim has been to build an innovation ecosystem that is based on cooperation between local industries and actors. Supporting start-up firms and re-education of unemployed people have been the key measures. However, the restructuring of innovation networks and ecosystems has been challenging in many ways due to the former dominant position of the electronics industry led by Nokia Corporation.

In Schumpeterian creative destruction, entrepreneurial dynamics overrides incumbents, and new work possibilities are created. Increased internationalisation and globalisation have diversified the destruction and creation processes. Regional development has become a more shock-prone process. The technological and economic shocks can be local national or global in origin (e.g. Martin and Gardiner 2018). Thus, regional creative destruction processes may result from changes outside the region. This is exactly what happened in Oulu, when Nokia lost its market share in the mobile phone market to Apple and Samsung. Changes in market share caused hundreds of lost jobs in the mobile phone business in the Oulu region. However, today the high-technology sector in Oulu employs more people than in the best days of the Nokia hype. How is this possible? What kind of adjustment measures exploiting the regional cooperation network and the resources of human capital were taken to relaunch growth? We call this dynamic process *creative resilience* and show how it worked in the region. We formulate the framework of creative resilience based on three pillars: knowledge creation, entrepreneurship and communal spirit. We show how the actors in the Oulu region implemented these pillars.

We have chosen to employ a case study approach because it enables researchers to gain an in-depth understanding of a complex issue by scrutinising the phenomenon with multiple data sources – documents, artefacts, interviews and observations, as well as quantitative data. A case study provides a deep understanding of the region as an individual entity and its unique evolutionary pathways (Sensier, 2016). However, there are very few region-specific case studies (e.g. Hill et al. 2010, Foster 2007) that describe and analyse regional development within the framework of resilience, especially from the point of view of regional economics. The analysis of the labour market in the high-technology sector of Oulu region is based on data provided by the Statistics of Finland. Furthermore, we have analysed some selected unpublished reports and documents of the local authorities concerning the development of the

Oulu region. We also collected material from the Ministry of Economic Affairs and Employment of Finland related to re-education and entrepreneurship projects.

The paper is organised as follows. In section 2, we discuss the concept of regional resilience and its links to some well-known concepts of economic geography and regional economics (e.g., the role of industrial diversity vs. specialisation in regional growth). Furthermore, we summarise the main actors and actions, which we define as necessary building blocks for resilience to be creative. In section 3, we provide a short review of our data and the development of the high-technology industry and business environment in the Oulu region over the past three decades. We devote special attention to the stages of the sudden structural change starting in 2009. In section 4, we analyse the recent development of the high-technology sector in the Oulu region from the viewpoint of regional resilience. Our aim is to find answers to the following questions. What caused the sudden structural change in Oulu? What kind of consequences did it have for the high-technology sector? What measures have been taken to promote adaptation and recovery? How well has Oulu recovered, and has it reverted to the pre-shock growth path or a completely new growth path? In section 5 we summarise the resilience of the Oulu region by utilising Martin's (2012) four-dimensional description of resilience and our creative resilience framework presented in section 2. Section 6 provides some conclusions.

## 2. Economic views of regional resilience

One of the most important factors for regional competitiveness is regions' capability to adapt to changes in their economic and technological environments. Regional resilience is a concept that has received increasing attention and has become one of the most common ways in academic (in several disciplines), public and political discourse to explain this adaptation capability (e.g. Martin & Gardiner 2019, Pinto et al. 2019, Martin 2012). From a regional

economics point of view, the concept explains why some 'highly resilient' regions are less vulnerable and more capable of adapting to and recovering from external shocks and disturbances than some other 'less resilient' regions. The concept of resilience closely relates to other concepts in regional studies and mainstream economics, such as uneven development, multiple equilibria, self-restoring equilibrium dynamics, growth path and path dependency. Regional diversity and specialisation, as well as innovation networks and ecosystems, are also concepts that are closely linked to the idea of regional resilience (Christopherson, Michie & Tyler 2010, Martin 2012, Martin and Sunley 2015).

The idea of regional resilience plays a key role in assessing the ability of regional economies to adapt to different disruptions in economic and business environments. However, there is considerable ambiguity about how resilience should be defined, how it can be empirically measured and how it should be interpreted from the perspective of regional policy (Crespo, Suire & Vicente 2014, Reggiani, De Graaff & Nijkamp 2002, Martin 2012, Martin and Sunley 2015). In fact, there is no 'theory of regional resilience'. Overall, the complex, multidimensional concept of resilience has caused considerable academic debate in various fields of science, not only in regional economics (Sensier 2016).

As shown above and on the following pages, resilience has been extensively studied in the context of regional development. We argue that an element of creativity has not been on the research agenda in ways that it deserves. Schumpeter based his creative destruction analysis on the drive of entrepreneurs and organisations for new solutions and innovations, and this process requires a hunger for curiosity and creativity. Especially in our globalised world and economies, shocks hit regions from the 'outside', and thus the destructive driving forces do not show up in endogenous construction processes in the same regions. A new recipe for success has to be invented inside each region, and this necessitates creativity from all agents and organisations.

Today, one of the most common ways to approach the topic is the four-dimensional "evolutionary economic geography model" presented by Martin (2012). The first dimension of the complex multi-dimensional system is *resistance*, i.e., how vulnerable and sensitive the region (its firms and workers) are to shocks and disturbances. The second is *recovery*, i.e., how quickly and to what extent the region returns from disruption. The third is *re-orientation*, i.e., the change that the regional economic structure goes through owing to disturbance. The fourth dimension is *renewal*, which means a region's capability to recover and revert to the pre-shock growth path. These dimensions and their elements are closely linked to each other. They concern a process that a region goes through in response to shocks and disturbances.

According to Martin (2012), resistance means the sensitivity or vulnerability of regional economies to various disturbances. Recovery implies how quickly and to what extent a region returns to its pre-shock equilibrium or steady state. If a region can react quickly to the shock, it will also recover quickly. Re-orientation describes the structural change that the regional economy experiences owing to the disturbance that it faces. The more adaptive the region, the more capable it is to change its business structure after the disturbance. One aspect of re-orientation is whether the region will resume to the pre-shock growth path or to a completely new higher or lower, more or less favourable growth path. In other words, the question is whether its industrial structure will change, and if it does change, how much must it change for us to be able to argue that the region has been pushed to another 'equilibrium state or path' (Martin and Sunley, 2015).

Regional development is a cumulative process of continuous change where technological waves and industrial changes follow each other (Martin and Sunley, 2015). On the other hand, regional long-run growth paths are shaped in many ways by small and large, regional, national, and even worldwide economic and technological shocks and recoveries.

Sometimes the development of regions can be locked into an earlier development path through various self-reinforcing mechanisms (e.g. Martin and Sunley 2006, 2015)

One of the most-studied issues in the regional economic literature is the role of industrial structure in regional development. Is it the regional specialisation within the narrow set of economic activities (à la Marshall - Arrow - Romer) or the diversity and variety of complementary competencies (à la Jacobs and Boschma - Frenken) that promotes regional innovation and economic growth? Regarding regional resilience, it is clear that when a region's industrial structure becomes increasingly specialised, the risk of a slowdown in growth arising from external shocks also increases (e.g., Frenken et al. 2007, Siegel et al. 1995.). A diversified industrial structure provides regions with better resistance against such shocks by acting in the same way as a decentralised investment portfolio against risk (e.g. Simonen et al. 2015).

The general argument presented in the literature and in most of the cases favouring a diversified industrial structure is that all regions, regardless of their size, should try to pursue a highly diversified, technology-related industry structure. However, Simonen et al. (2015) have shown that the "optimal diversified structure" is highly dependent on the size of the region. Our argument is that the "optimal" structure of the industry can be more diverse in larger areas than in some smaller areas. A very narrow industry portfolio is not capable of creating growth-generating externalities that promote innovations, and the risks for industry-specific shocks are higher. On the other hand, diversification might not be a good strategy for small regions because they probably do not have enough networking energies to grasp potential knowledge externalities. The literature has largely ignored this issue. Furthermore, Boschma and Frenken (2007, 2009) have argued that industrial diversity promotes regional growth when industry and technology are related. On the other hand, Martin and Sunley (2015) introduce an interesting counter-argument. From the viewpoint of regional resilience, it is important that different industries are not closely inter-linked locally. Martin and Sunley (2015, 28) discuss modularity,

i.e., “the degree to which sectoral and organizational components of a region’s economy and functions are separable, or only weakly interlinked”. Or is it diversified specialisation (Farhauer and Kröll 2012) that enhances regional resilience and growth?[2]

Localised knowledge networks and technology clusters also have an important role in a region’s and individual actors’ capability to react to changes in the global economic and technological environment. Especially in technology-intensive industries, networks facilitate the diffusion of knowledge and innovation activity; thus, they are important for regional success (e.g., Crespo et al. 2014, Saxenian 1990, 1994). Silicon Valley is a good example of an innovation milieu where cooperation between SMEs and big companies has been essential for regional growth. Silicon Valley has been able "to create its skin again and again" during the different phases of the high-tech industry lifecycle (Cooke 2011, Crespo et al. 2014).

However, the effect of networks on regional resilience is not entirely unambiguous. The question is the balance between the efficiency of the network and the resilience of the cluster (Crespo et al. 2014). According to Brede and Vries (2009), a closed network, where knowledge diffuses efficiently among key actors, firms and institutions, increases mutual trust between actors. From the viewpoint of regional resilience, however, the risk is that the network becomes too closed and that the utilisation of the new opportunities offered by the development of different industries is thus hampered (Crespo et al. 2014). The region may lock into an inefficient state (Martin and Sunley, 2015). From the viewpoint of the cluster and the development of the region, such a lock-in situation will become particularly challenging if the activities of the key players become less regionally orientated. The closure or reallocation of establishments is a practical example of this. Martin and Sunley (2015, 29) talk about the ‘rivet effect’. Some actors may have such an important role or position in the innovation network or ecosystem that their collapse or removal will have a catastrophic effect on the whole system

[2] Sunley and Martin (2015) provide a good, compact review of this particular issue.

(Martin & Gardiner 2019). Especially in the case of a 'hub and spoke' innovation network, a sudden change in key firms' operations (e.g., moving activities to cheaper areas, mergers and acquisitions with foreign companies, or some significant strategic changes in R&D activities) can engender major difficulties for their local suppliers to find new customers from other regions or countries.

The resilience of a highly centralised cluster depends significantly on the cooperation between the peripheral and core nodes. The diffusion of knowledge among firms and institutions, not merely through one actor or just among the few core players in the network, offers great opportunities for new ideas and innovations (Crespo et al. 2014). At the same time, it strengthens the structure of the entire network and facilitates adaptation to the various shocks that key players might face. This type of intensified innovation network, i.e., increased cooperation with other actors, is especially important for SMEs, which cannot afford to run their own in-house R&D (e.g., Galbraith, Rodriguez & DeNoble 2008, Sakata and Kajikawa 2008, Breschi and Lissoni 2001).

However, regional resilience depends not only on the industrial structures or features of innovation networks or the ability of companies and industries to adapt to changing conditions but also on the policy pursued at both the national and regional levels. At the national level, growth can be promoted through subsidies for infrastructure improvements, investment subsidies and increased and redirected subsidies for R&D. Supporting the development of entirely new sectors or changing education policy based on future forecasts can also prevent negative impacts of structural change. The problem concerns how these changes can be anticipated. On the other hand, regional needs concerning subsidies and other development measures may vary, among other factors, owing to differences in industry structures. In addition, stakeholder opinions at not only the national but also at the regional level may diverge regarding how regions should be supported and how support should be

targeted. However, we may argue that at the regional level, it is easier to prepare for changes in sight, e.g., to observe a certain risk position in some sectors, and thus to act in a manner that improves adaptability (Martin 2012). Areas that have undergone multiple shocks may have expertise in handling future shocks, and therefore the effects of shocks may be smaller and/or transient. However, it is possible that a region may be resilient to smaller shocks but less resilient to larger shocks or to the series of shocks (Sensier 2016).

When we analyse the capability of regions to adapt to and recover from shocks and disturbances, it is important to extend the analysis to the adaptation capability of local workers, not merely the adaptation of firms and industries (e.g. Diodato & Weterings 2015, Van Dijk & Edzes 2016). We may argue that it is relatively easy for firms to adapt their functions, e.g., in the form of termination and lay-offs of workforce. However, for workers, it is much more difficult to adapt to the shocks owing to the changes linked to the place of residence or the nature of the work. Glaeser (2005) and Bristow and Healy (2018) have argued that a region's ability to retain skilled labour is one of the most important factors affecting regional resilience. However, there are very few studies on this particular issue (e.g. Bluestone 1984, Nyström 2017 and Hane-Weijman et al. 2018), i.e., how can the region prevent out-migration and what affects the labour market's absorptive capacity.

Regional innovation capacity has an important role not only in the economic growth but also in the resilience of regions (e.g. Bristow and Healy 2018, Simmie & Martin 2010). The question of the role of regional industrial structure in the innovativeness of firms and regions is one of the most-studied regional economic issues. On the other hand, a number of studies have shown that the innovation capability of firms and regions is highly dependent on the employees (e.g. Solheim et al. 2020, Eriksson & Rodríguez-Pose 2017, Simonen et al. 2010, 2008a, 2008b, McCann & Simonen 2005). As we already argued, good regional resilience is significantly based on the capabilities and adaptability of workers (see, for example, Martin

2012, Simmie & Martin 2010). In other words, an important reason for the high resilience of innovative regions is that their highly educated employees are resilient (Van Dijk & Edzes 2016). For instance, their readiness and capability to re-educate themselves and to move to new jobs is higher than that of lower-educated people (e.g. Wooden, 1988). There is empirical evidence that redundant workers generally face adjustment costs in terms of e.g. unemployment, education, lower occupation and wage levels (e.g. Ohlsson & Storrie 2012, Bailey et al. 2012). An interesting question is how education, skills or individual characteristics affect the resilience of workers (Van Dijk & Edzes 2016). Another interesting question is whether highly educated people with 21st century and lifelong learning skills are less mobile across regions and more willing to use their knowledge bases locally. This is what we claim to be an important feature of creative resilience.

There is still one particularly important factor affecting regional resilience – the entrepreneurial culture and the supportive institutional environment. Regions that provide various supporting facilities for start-ups and SMEs (e.g., support for setting up a business and the availability of venture capital) as well as possibilities for re-education for employees are well placed to resist and adapt to disturbances. A successful triple helix strategy, i.e., university–industry–government collaboration, also improves a region's ability to adapt to changes in the local business environment. A collective and forward-looking development strategy is perhaps the most important way in which local public development authorities can intervene and support resilience in its various forms.

Combining these important features of regional resilience, we state that the framework for analysing creative resilience can be summarised as in Table 1.

We have identified three elements as the core of creative resilience; knowledge creation, entrepreneurship and community spirit. These naturally have all been considered widely in the literature. What is new in our analysis? We identify two main ingredients that are important for

knowledge creation. Destruction-hit unemployed workers must be willing to consider education possibilities as part of life-long education. Creative destruction means that new job possibilities necessitate new types of knowledge and work abilities. On the other hand, the educational institutions and authorities must be ready and willing to offer new types of educational programs that deliver these new forms of abilities and knowledge. Hanging on to existing programs does not deliver these results. Creativity is needed.

Related to entrepreneurship, our basic ingredient for creativity is willingness to take risks. New types of products and services must be invented and created, and this does not happen without taking risks. The formation of a vital start-up community is a necessary condition for the region to be resilient. Obviously not all start-ups succeed in hitting the growth path from a start-up to middle-and large-scale volumes. This puts strong pressures on the region to manage the negative sides of risk taking and calls for the establishment of new types of business services and incubators. Strong mutual trust, community spirit is also needed. A good example of this is well-functioning cooperation of a triple helix network. Actors trust each other and they are committed to the commonly agreed goals. In our empirical analysis, we show how this type of creative resilience can be identified in the Oulu region.

Why then call this type of resilient development creative resilience? Why not use e.g. transformational resilience, à la Doppelt (2016)? Transformational resilience is clearly meant to be used in other types of shocks than creative destruction. Based on one definition: "It (transformational resilience) calls on mental health, education, and faith leaders to expand beyond post crisis-treatment to emphasise building preventative personal and psychosocial resilience skills". Obviously, our creative resilience is meant to be used in other types of creative destruction-based economic shocks.

In the next section, we will examine the development of the high-technology sector in the Oulu region. In section 4, we analyse the recent development of the Oulu region from the

viewpoint of regional resilience. Utilising both quantitative and qualitative data, we survey and describe the main aspects of the sudden structural change in the Oulu region. The Oulu region provides a textbook example of how the factors described in this section, e.g. the features of the industrial structure and innovation networks can cause serious problems for regional development when a region faces a shock. On the other hand, Oulu is also a very good example how the effects of a shock can be alleviated e.g. through creative resilience and effective regional policy.

## 3. The development of the high-technology sector in the Oulu region

In this article, we have analysed a dataset that comprises all high-technology establishments in Finland, as defined according to the standard industrial classification 2002 (SIC 2002) and listed in Table 2. Based on this classification, there are five high-technology manufacturing industries and four high-technology service industries. Our research focuses on the development of high-technology industries in the Oulu region. We pay special attention to the labour mobility of the electronics industry in the Oulu region. The regional labour mobility data of the Oulu region is derived from the Finnish Longitudinal Employer–Employee Database (FLEED) maintained by the national statistical authority, Statistics Finland. This unique data contains all individuals aged 15–70 living in Finland. The most important feature of the data is that it connects individual-level information with firm- and establishment-level information. It means that the data that we use in this research cover all workers employed in high-technology industries in the Oulu region in 2008-2013.[3]

[3] FLEED data is based on Statistics Finland's Employment statistics, which is composed of approximately 40 different administrative registers. The most important data sources are the registries of the Population Register Centre, Finnish Tax Administration, Finnish Centre for Pensions, State Treasury and Pension Insurance of the Municipalities.

Employment in the high-tech sector increased significantly in the Oulu region after the deep recession in the early 1990s. In the early 2000s, there were nearly 14 000 high-tech employees in the region, almost 10 000 employees more than a decade earlier (figure 1). During the industry's prime years, the high-technology sector accounted for 16 % of total employment in the region.

At its peak, Oulu was considered a hub of mobile technologies and wireless networks not only in Finland but also across the world. The success of Nokia has been a major factor in the development of Oulu as an internationally known high-tech cluster. However, the growth of the high-technology sector in Oulu has been a multidimensional and periodic process from one stage to the next.

The first steps in this process were taken in the 1970s, when collaboration among research actors, such as the University of Oulu and the Technical Research Centre of Finland, and regional authorities and firms created the well-functioning spirit of a triple helix network around radio wave technologies. Based on this cooperation, Scandinavia's first Technology Park, currently known as Technopolis Ltd, was founded in 1982. The next significant phase took place in the mid-1980s, when not only the availability of a skilled labour force but also strong local R&D expertise attracted Nokia to invest in the mobile phone business in Oulu. The presence of Nokia and the Technology Park were the main factors that attracted several small- and medium-sized firms to locate their operations in Oulu.

In the 1990s, Nokia's operations rapidly expanded in Oulu, mostly because of the company's success in international markets. At the start of the millennium, the company employed approximately 5 000–6 000 workers in Oulu. During its growth years, Nokia created a dense subcontractor network in the area, which employed several thousand high-technology workers. Many of these local subcontractors provided equipment, machines, software and

services only for Nokia, and as a result, the high-technology sector was largely concentrated on Nokia-led manufacturing activities.

When we analyse the structure of the high-technology sector more closely, we notice that industry # 32, manufacture of radio, television, and communications equipment and apparatus, has played an extremely prominent role in Oulu (figure 2). Employment in this industry increased rapidly after the deep recession at the beginning of the 1990s and, at its peak, accounted for 60 % of total high-tech employment.[4] However, after the early 2000s, employment in the electronics industry started to radically decrease. One of the main reasons for this was Nokia's problems in the international mobile phone market. At the same time, employment in the high-technology service sector, especially in industries # 72 and # 74, increased and compensated for the drop in employment in the electronics industry.

Nokia's growth and success had a reverse effect too. The high-technology industry structure became increasingly more specialised, which created a big risk for regional development even though Nokia was still number one in the mobile phone market and offered thousands of high-paying jobs in Oulu. In the late 1990s and early 2000s, the high-technology network in the Oulu region was a good example of a 'core-periphery' or 'hub-and-spoke' type of network. Many of the small- and medium-sized high-technology firms were extremely dependent on Nokia. The risks of this dependency began to appear after the first years of the 2000s, when Nokia started to move its activities into low-cost countries. Local subcontractors faced major difficulties in finding new customers. Some of the local subcontractors followed Nokia to low-cost countries, but several of them were forced to close their establishments or at least reduce their activities in Oulu (Simonen et al. 2016).

[4] Nokia's share of total employment in the electronics industry was over 70% at the highest point, and the share of the high-technology sector in total employment in the region was almost one fifth.

Soon afterwards, in the mid to late 2000s, Nokia faced new problems and challenges in the mobile phone market. A new generation of smartphones took over the market and moved consumers' focus towards high-quality digital services. At that time, Nokia was still the market leader in the traditional mobile phone business, but the shift towards digitalisation forced the company to reformulate its business strategies and functions. Furthermore, strong links and successful collaboration with Nokia caused "blindness" for local subcontractors such that they did not find it necessary to follow the trends of global business strategies. When the competitive advantage of the mobile industry was no longer based only on wireless technology expertise, these local firms were not able to enter new markets after they lost their "Nokia business". Consequently, unemployment grew rapidly, especially among individuals who were specialised in high-technology manufacturing functions (Simonen et. al. 2016).

In 2009, Nokia laid off its own workers in Oulu for the first time. These reductions were initially made based on volunteers, but they were the first concrete sign of the upcoming structural change. In 2011, Nokia launched a new strategy and started to use a Windows-based platform in its smartphones. This strategic change caused large-scale mergers and layoffs in the region, especially among the professional group of product developers. In 2012, the severity of the problems appeared in full, when Nokia dismissed several hundred employees in Oulu. At the same time, many local subcontractors were forced to downsize their operations. Due to these layoffs, the Finnish government classified Oulu as an abrupt structural change area. In 2013, Nokia decided to sell its entire mobile phone business to Microsoft and focus primarily on manufacturing telecommunications and wireless network equipment. In the following year, not only Microsoft but also Broadcom, another important employer in the region, closed their establishments in Oulu. Finally, at the end of 2014, after these events, there were more than 2 000 high-technology workers without a job in the Oulu region.

Overall, approximately 3 500 people were laid off by high-technology companies between 2009 and 2014 in the Oulu region, most of whom were from the electronics industry. As we can see from figure 3, since 2009, the worker outflow from the electronics industry has been significantly higher than the inflow. However, when we analyse the outflow more closely, we notice that not all of those who lost their jobs in the electronics industry remained unemployed. Many of them found new job opportunities in other industries, especially in the high-technology service sector (totally 1350 people in 2008-2013). Actually, the availability of skilled workers attracted a number of foreign companies to the region. Consequently, during 2010 and 2011, employment in the high-technology service sector increased by more than 1 000 employees (figure 4).[5] Despite the expansion of the high-technology service sector, the negative effects of the structural change were inevitably reflected within the whole regional economy. At the end of 2015, the unemployment rate in Oulu was over 18 %. At the same time, Oulu's ability to retain its position as one of the world's leading high-technology clusters was challenged.

At the most critical phase of the structural change, the number of unemployed individuals in the high-technology sector was extremely high not only among assemblers but also among expert-level employees. There was also a clear trend that the share of unemployed, highly educated people increased year-by-year (figure 5). In addition, many people suffering from unemployment had gained strong experience over decades in the field of high technology.

When we look more closely at redundant employees who became unemployed (936 in total, approximately 25 % of those people how lost their job in high technology firms), we see that approximately 40-50 % of them were without a job at the end of the next year (figure 6). However, every year, approximately 30 % of unemployed people found a new job in Oulu. Furthermore, in the first years of the observation period, 25-30% of the redundant, unemployed people started re-education. After two years, approximately 60-80 % of those who had been unemployed a year after losing their job were still without a job (figure 7). Figure 8 shows how wages changed when people moved from the electronics industry to other industries. In most cases, salaries decreased. A more detailed analysis (presented in Herala et al. 2017) reveals that for 46 % of re-employed people, salaries either increased or decreased (in most cases) by a

[5] This significant growth is mainly explained by Nokia's acquisitions, where several hundred employees moved to work for Renesas Electronics and Accenture, which are classified as high-technology service industries.

maximum of 500 € per month. However, for 42 % of re-employed people, salaries decreased more than 500 € per month, and only for 12 % did salaries increase more than 500 € per month. These results support the findings that redundant workers typically face adjustment costs in the form of re-education and lower wages.

## 4. Resilience and governance of structural change in the Oulu region

Oulu provides a textbook example of how certain features of industrial structure and innovation networks can cause serious problems for regional development when a region faces a shock. In the same way, it is also a very good example of how well a region can adapt to and recover from shocks and disturbances through effective regional policy and the resilience of highly educated people. Oulu was clearly pushed out of its prior stable or 'equilibrium' state or path by a shock, but it has shown how a region can recover from a shock and 'bounce forward' to a new growth path by adapting its structure (Martin and Sunley 2015).

In the case of Oulu, it was well-recognised that the *industrial structure of the high-technology sector was too specialised* in electronics and too dependent on Nokia's success in the international market. Furthermore, the *innovation network/ecosystem was built around Nokia* and some other medium-sized companies. Therefore, it was clear that if Nokia faced problems in its mobile phone business, it would cause serious problems for Oulu. The development of the Oulu region is a good example of a 'rivet effect', where one or a few actors (Nokia and a few other companies) have such a prominent role or position in the innovation network that their collapse will have a catastrophic effect on the whole system (Martin and Sunley 2015).

When Nokia first decided to move its production activities to cheaper areas in Eastern Europe and the Far East and later made some significant strategic changes in R&D activities by employing not only global contract manufacturing but also global contract R&D strategies, it started to become clear that the region would face a serious structural change in the high-

technology sector. This is a good example of how a *strategic decision by a major company* in a wider context, i.e., strategic level, can suddenly cause problems for the innovation ecosystem of the region. The final hit was Nokia's problems and failures in smartphone development, which finally lead to a merger with Microsoft in 2011. In Oulu, this merger meant the end of Nokia's smartphone development. It is clear that this had a negative multiplier effect on the whole innovation ecosystem in the Oulu region. *Local suppliers and subcontractor firms faced serious problems in finding new customers* from other regions or countries and entering the worldwide market after they lost their local business with Nokia.

When we examine Oulu's development (figures 1 and 2), the number of high-technology employees had already started to decrease in 2000, after the burst of the IT bubble. This is particularly clear in the development of the electronics industry. In the first decade of the 2000s, this industry lost approximately 3 000 employees. Most of them had worked on the assembly side. However, at that time, Nokia's position in the global mobile phone market was still strong, and it employed 4 000-5 000 workers (approx. 35 % of total high-technology employment) in Oulu, mainly in R&D activities. However, it was clear that Oulu was highly vulnerable to the possible shock and that its capability to absorb the shock was weak.

Once this type of specialised portfolio is hit by a massive sudden structural change, the waves hit hard. In this case, the important factor is *how regional and national actors respond to the changed situation.* Fortunately, the key actors (local authorities and research & education institutes) in the Oulu region anticipated this kind of crisis. One good example of this forward-looking anticipation is the formation of the Oulu Innovation Alliance (OIA).[6] OIA was founded in 2009, and the founding members were the City of Oulu, University of Oulu, Applied University of Oulu, State Technological Institute and Technopolis Ltd. The Oulu region had long been a good example of triple helix co-operation, but several features of the OIA contract

[6] For more about the Oulu Innovation Alliance, see http://www.ouluinnovationalliance.fi/

took this collaboration to a new level. First, it was agreed in the alliance contract that *the partners would commit to investing in the agreed areas.* Such investment would be made both in new joint projects and in structural changes in their organisations. These structural changes were concentrated on the identified know-how in the area. [7]

Another important opening was the founding of the so-called Tar Group.[8] The City of Oulu was already proactive in this regard in 2010 in calling all central organisations in the area to informal discussions related to the possibility that Nokia would face severe difficulties. At the same time, the City of Oulu reorganised all of its business development units into BusinessOulu, which is the strategic hub for boosting start-ups and ecosystems in the area. Its CEO came from Nokia. The Tar Group agreed on, e.g., how to allocate responsibilities for using the Sudden Structural Change funding that the region received. One basic principle of this agreement was that *all funding would be used for genuinely new activities* so that old agents would not be subsidised to continue their outdated activities. Education projects were oriented to offer new knowledge and know-how to unemployed workers so that their employment possibilities genuinely increased.[9] We can also argue that the *expertise gained in crisis management over the years* certainly played an important role in Oulu's successful recovery.

In Oulu's case, *the specialisation in the 'new economy' and innovative high-technology industries provided a good starting point for recovery.* High-technology firms are dynamic in order to "reconfigure, renew and recreate their resources and assets in response to adverse circumstances" (Martin and Sunley 2015, 29). Their capability to configure strategies and exploit new strategies and ideas is also high. Furthermore, the highly skilled workers of these

[7] Based on the identification of such know-how, five centres were founded: the Centre for Internet Excellence (CIE), Printed Electronics and Optical Measurements Innovation Centre (PrintoCent), Martti Ahtisaari Institute of Global Business and Economics (MAIGBE), Centre of Expertise in the Water Industry Cluster (CEWIC) and Centre for Health Technology (CHT). The partners agreed to focus their strategic operations on these centres in order to boost innovation and new knowledge creation in these areas. Thus, they started to develop new paths for redirecting operations once the crisis hit.

[8] The name of this group comes from history. Tar was one of the most important export goods in the Oulu region from the 17th century to the late 19th century.

[9] We have access to some unpublished records of the Tar group meetings.

firms are more capable of adapting new ideas, and their readiness to retain and set up their own businesses is significantly higher than in the traditional sectors.

It has been amazing to see how committed the workers who lost their jobs at Nokia and some other companies have been to living and working in Oulu. No more than two to three hundred workers left Oulu after their jobs were terminated. Hence, *a massive outmigration of human capital in the region of Oulu has not occurred*. More importantly, many of the employees who previously worked in the electronics industry have found new jobs in other technology-related industries such as the high-technology service sector (see figure 4.). This is in line with the findings of e.g. Hane-Weijman et al. (2018), Boschma (2014) as well the original conclusion of Marshall (1890) that the presence of related industries in a region improves significantly workers' re-employment opportunities. Overall, we may well argue that the resilience of workers has been clearly one of the most important factors in the recovery of the Oulu region.

The Oulu region has undergone major structural re-orientation since the 'Nokia shock'. Today, the industrial structure of the *high-technology sector in Oulu is much more diversified* than it was at the beginning of the 2000s. Although the role of Nokia and the electronics industry has decreased, they are still important employers in the region. Nokia's establishment in Oulu, which specialises in the mobile phone network business, is Nokia's only factory in Europe and the largest electronics factory in Northern Europe. However, the output, employees and turnover have significantly increased, especially in the high-technology service sector, e.g., architectural and engineering activities and related technical consultancy, and in computers and related activities (see figures 2 and 9). Furthermore, *SMEs are no longer as dependent on Nokia's success in the international market*. We can describe the situation with the words of Crespo et al. (2014, 211): "The targeted shocks on core members do not weaken the whole structure to the same extent as in the previous structure". Hence, the resilience of Oulu has

improved considerably, and its resistance and robustness to subsequent shocks are significantly greater.

We also cannot underestimate *the role of the "high-technology history"* in Oulu's recovery from the sudden structural change. The rapid growth of the electronics industry led by Nokia in the 1990s created an entrepreneurial culture and a strong atmosphere of self-confidence in which people truly believe in their knowledge and the success that it will bring them and the whole region. The innovativeness of SMEs and start-up companies and their readiness to adapt in a changed environment have been absolutely crucial in the recovery and re-orientation of the regional economy. Oulu has not bounced back to its pre-shock state. Rather, in our view, Oulu has been pushed to a new growth path. Thus, its capability to resist and absorb shocks is significantly stronger now than ten years ago.

## 5. From creative destruction to creative resilience

The resilience of the Oulu region can first be summarised by utilising Martin's (2012) four-dimensional description of resilience (Table 2). Related to the *resistance* dimension of resilience, two main features of the Oulu region can be identified. First, the highly specialised industrial structure and the central role of Nokia within it created a risk for the Oulu region. Second, the innovation network/ecosystem was basically built around Nokia and some other medium-sized companies. Therefore, it was not surprising that Oulu suffered serious problems when Nokia faced problems in the mobile phone business. On the other hand, long-lasting strong collaboration and a forward-looking attitude among the local actors provided a good starting point for the right policy measures.

Several features related to *recovery* can be identified. Workers who lost their jobs at Nokia and some other companies have been highly committed to living and working in Oulu. We did not see a massive outmigration of human capital in the region of Oulu. This naturally

created a massive supply of mobile technology know-how in the area. In fact, many of the employees who previously worked in the electronics industry found new jobs in the high-technology service sector. From the viewpoint of regional recovery, it was also extremely important that local authorities promptly realised the potential for the labour force to be laid off. Regional policy actions were directed to the re-education of local high-technology employees.

There has also been active start-up development behind this recovery. Over 200 start-ups have been founded in the area since 2012, and most of them remain active.[10] Nokia played an important role in this process in 2011-2013 by providing not only financial support but also coaching and sparring for new start-ups. The purpose of the so-called Bridge program was to support the re-employment of redundant workers in the form of new jobs, study places or entrepreneurship. In Oulu and all other regions of Finland, this process involved close cooperation with local authorities.[11]

Related to *re-orientation*, the ongoing structural change can be seen in figure 8, which shows how the increase in high-technology services has balanced the decrease in employment in high-technology manufacturing industries. During the past few years, the high-technology sector has become more diversified and less dependent on one major industry, i.e., the Nokia-led electronics industry. Business activity seems to have developed in a positive direction, and the renewed innovation ecosystem is attracting domestic and foreign companies to the region. Now the Oulu region has one of the most attractive start-up ecosystems nationally. For

[10] According to unofficial sources, the number of start-ups is over 500, and the high-technology sector broadly defined, including e.g. creative industries, employed approximately 18 500 workers in 2017.

[11] In Finland, the entrepreneurship path offered by Nokia's Bridge program selected some 500 redundant workers (representing one tenth of all workers dismissed from Nokia in Finland), who with the help of the program have set up some 400 new companies (Kiuru, Handelberg & Coastline 2013, Rönnqvist, Hakonen & Vartiainen 2015). In the Oulu region, the same figures were 161 redundancies and 114 companies. In 2014, 85 of those firms in Oulu were still active (BusinessOulu 2015).

instance, the health technology sector has grown very rapidly in the past few years and can be considered "a new engine of growth" for the high-technology sector in the Oulu region.

Regional resilience seems to be higher than it was before the shock, and a new growth path has been reached. Most important for *renewal* is that the region has found a new growth path, which is mainly based on the activities of the high-technology service sector. Our view is that the discovery of this new growth path resulted from both creative destruction and correctly allocated policy measures. More light can be shed on this phenomenon of Oulu resilience using our creative resilience framework presented in section 2. The results in the table 4 are mostly based on the analysis we performed for the Economic Policy Council of Finland in 2017 (Herala et al. 2017).

There existed strong far-sightedness in the area in the sense that a coordinating group called the Tar group was already founded in 2009. The group had members from educational, business and management organisations. It defined the coordination of resilience actions as its main task. It negotiated on the need for educational programs and agreed on the roles of different organisations in allocating the grants and subsidies given to the area. In all activities, it emphasised new ways of developing resilience from the shocks. This can be read from the minutes of the group meetings that we have had at our disposal.

Two other organisational changes were important. The universities of Oulu, the State Technological research unit in Oulu, the City of Oulu and Technopolis Ltd. founded the Oulu Innovation Alliance. The main goal of this strategic alliance was to identify new fields of research and innovation with the potential of succeeding in future competition. Printable electronics, health technology and green technologies were identified, and all currently have strong research and business ecosystems in the area. All business services in the area were collected into BusinessOulu. The main idea was to collect the distributed communal and other

business services into a common place, BusinessOulu. BusinessOulu services are targeted to start-ups aiming to grow and reach international markets.

Related to knowledge creation, several educational programs were launched, all based on Tar group-led analysis of the needed services. These programs were planned to give unemployed workers the needed abilities to gain work-able status in the markets. For example, business abilities and entrepreneurial abilities were on the agenda. Nearly a thousand unemployed workers passed these programs, and over two thirds of them were quickly employed after passing the courses.

There was also high willingness to take risks in the area. A start-up boom was born, and in a short period of time, a lively start-up ecosystem was established in the area. Over 600 start-up companies have been established, most of them at the initiative of engineers who lost their jobs at Nokia. Over 200 start-up firms participated in projects aimed at supporting highly skilled employment and the creation of new technology companies by exploiting untapped ideas and innovations. In 2012-2016, almost 900 people participated in 68 different training projects organised by numerous local public and private training organisations (Herala et al. 2017). An important feature was that these training projects were tailor-made in partnership with businesses and educational institutions. Several success stories have already emerged, e.g. OuraRing[12] and QuietOn[13], which are quickly capturing international markets.

A very important feature for creativeness to blossom is that none of the grants or subsidies allocated to the area were used to boost the destruction-hit industries and firms. There of course existed a huge risk for this not to be the case in the area. As shown above, there existed a strong risk hub in the area in the sense that Nokia and its subcontractors dominated the business climate. It would have been very natural to try to keep them alive in all possible

[12] See https://ouraring.com/ and https://www.youtube.com/watch?v=Mcsez1NmsjM&feature=emb_title
[13] See https://quieton.com/

ways, including by using the sudden structural change-based money to boost these firms back to life. Fortunately, thanks to the area's forward-looking attitude, trust and creativity, this did not happen.

## 6. Conclusions

Regions where the industrial structure is very specialised and whose success is dependent on the activities of only a few companies are particularly sensitive to cyclical or rapid technological development. Such regions are also particularly vulnerable to various industry-specific shocks. Oulu is a textbook example of such a region.

Oulu was clearly pushed out of its prior stable or 'equilibrium' state or path, but it has shown how a region can recover from the shock and 'bounce forward' to a new growth path. Employment in the high-technology sector in Oulu is currently at the same level as before the crisis, and the growing trend in high-technology employment is expected to continue, especially in the high-technology service sector. Regional innovation networks and ecosystems are now significantly more resilient than they were ten years ago.

Why has Oulu recovered so quickly from the "Nokia shock"? One of the most important factors has been proactive structural change management, as well as intensive cooperation between different local actors and stakeholders. The key actors in the region anticipated this kind of crisis and played an active role in organising support measures right at the beginning of the crisis. Later, due to this cooperation, several large-scale activities proceeded in the same direction and pushed forward common interests. Thus, Oulu is also a very good example of how well a region can adapt to and recover from shocks and disturbances through effective regional policy.

Our creative resilience framework shows how this type of active engagement and leadership can be described conceptually and empirically. Our framework contributes to the literature in the sense that we show how regions hit by sudden structural shocks can

operationally plan and manage their activities in a way that generates creative resilience in the regions.

In Oulu's case, the specialisation in 'new economy' and innovative high-technology industries has provided a good starting point for recovery. The region found a new growth path based mainly on the activities of the high-technology service sector. The innovativeness of SMEs and start-up companies and their readiness to adapt to a changed environment have been absolutely crucial in the recovery and re-orientation of the regional economy. However, clearly the most important single reason why Oulu has recovered so well from the shock has been the resilience of its people. For instance, they were ready to retrain themselves and to accept lower wages in their new jobs. Highly skilled, educated people have affected not only the growth of Oulu but also its resilience. The statement of Hene-Weijman et al. (2018, 778) that "Major redundancies do not need to be disastrous for regional development, but may instead lead to a process of creative destruction" describes the development of the Oulu region extremely well.

Furthermore, the aim of the "new regional policy" in the Oulu region has been not to maintain old structures but to genuinely seek new opportunities based on the fundamental principles of smart specialisation. This kind of dynamic process, where obsolete and unproductive business activities are replaced by new fields of technology and knowledge, can clearly be compared in many ways with Schumpeter's description of "creative destruction".

Based on our three-pillar analysis of resilience, we can conclude that the Oulu region has been genuinely active and creative in all three pillars. Importantly, with respect to knowledge creation, people were interested in participating in new education possibilities for acquiring up-to-date knowledge. People's risk-taking capability enabled new start-ups to be established. Strong mutual trust and effective cooperation among people gave the opportunity to try new challenges. Furthermore, policy measures were coordinated to support new

activities, rather than trying to keep old businesses alive. We may well call this creative resilience.

For future research, it would be interesting to look deeper into the Oulu case using both interviews and more advanced statistical analysis. Furthermore, a comparative analysis of both successful and failed areas of creative destruction could yield important insights.

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**Table 1.** Creative actions and actors

| Actions / Actors | **Knowledge creation** | **Entrepreneurship** | **Community Spirit** |
|---|---|---|---|
| **Workers** | Readiness for retraining in emerging industries | Establishment of start-ups | Commitment to the region |
| **Firms** | Configuration and exploitation of new strategies | Re-orientation to new fields | Self-confidence, seeking new opportunities |
| **Authorities** (incl. educational institutes) | Renewal and customisation of education programs (in cooperation with education institutes and firms) | Incubator programs and financial support instruments for genuinely new activities | Proactive, agile triple helix management |
| **Politicians** | Think tanks | Infrastructure investments | Forward-looking attitude |

**Table 2**. High-technology Industries (SIC 2002)

| | |
|---|---|
| Manufacturing sector | |
| Manufacture of pharmaceuticals, medicinal chemicals and botanical products | (244) |
| Manufacture of office machines and computers | (30) |
| Manufacture of radio, television, and communications equipment and apparatus | (32) |
| Manufacture of aircraft and spacecraft | (353) |
| Manufacture of medical, precision and optical instruments | (33) |
| Service sector | |
| Telecommunications | (642) |
| Computers and related activities | (72) |
| Research & development | (73) |
| Architectural and engineering activities and related technical consultancy | (742,743) |

**Table 3.** Main components of resilience in the Oulu region

| **Resistance** | **Recovery** |
|---|---|
| • Weak and risky because of the highly specialised industrial structure and ´hub and spoke´ innovation network/ecosystem around Nokia<br>• Strong because of the long-lasting strong collaboration and a forward-looking attitude (Tar Group, Oulu Innovation Alliance). | • Strong due to highly educated people who were committed to the region.<br>• Strong due to the fact that genuinely new activities were actively sought (especially in those areas where strong mobile technology expertise could be used) and that people were offered not only financial support but also coaching to start new businesses. |
| **Re-orientation** | **Renewal** |
| • Strong inputs into the fields such as health technologies, cleantech and printed intelligence<br>• Much more diversified innovation/start-up ecosystem. | • Because of local regional and spatial efforts, the growth has recovered to levels before the structural change. |

**Table 4.** Creative actions and actors in the region of Oulu

| Actions / Actors | Knowledge creation | Entrepreneurship | Community Spirit |
|---|---|---|---|
| **Workers** | Nearly 1000 unemployed workers participated in new education programs funded by EGF (European Globalisation Adjustment Fund). By the end of 2016, more than two thirds of them had been re-employed. | High willingness to take risks by establishing new start-ups. | Unemployed workers desired to stay in the Oulu region. Outward migration has been very low. |
| **Firms** | Many start-ups have strong ties to higher education institutions | Over 600 start-ups have been established, many of them with the help of Nokia's Bridge program. | A lively new entrepreneurial, forward-looking ecosystem, based on new activities of the high-technology services |
| **Authorities** (incl. educational institutes) | Forming the Tar group to coordinate different education programs with educational institutes and local firms | City of Oulu reorganised its business services. Business Oulu was established to help local firms, e.g. in international marketing and innovation activities, and to attract new companies to the region.<br><br>More than EUR 60 million support for companies for new investments | Establishment of Oulu Innovation Alliance as a strategic alliance between education institutes and the city of Oulu |
| **Politicians** | Region received EUR six million from the European Globalization Adjustment Fund, which was used to address the changing skill needs of local businesses. | Approximately EUR two million was used for SME's R&D&I projects | Region was granted EUR 30 million sudden structural change money, which was used to support genuinely new activities. |

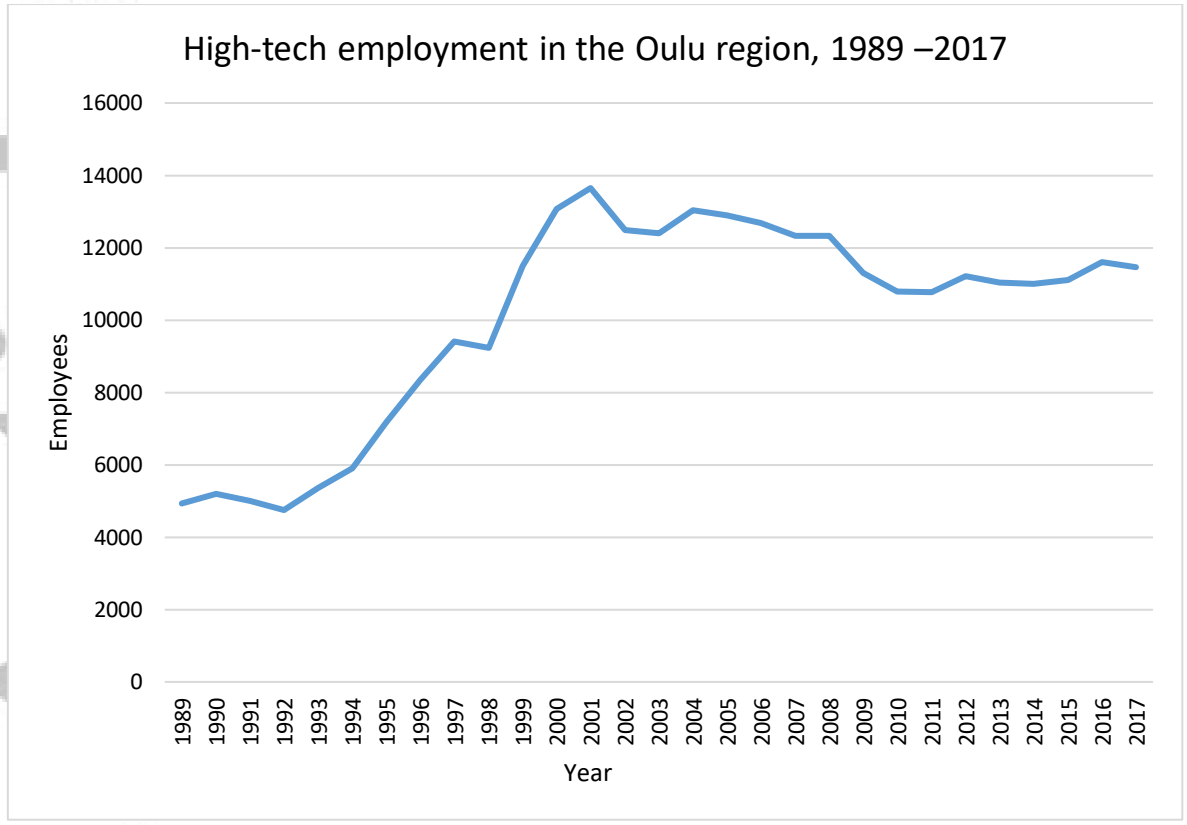


**Figure 1.** High-tech employment in the Oulu region, 1989–2017

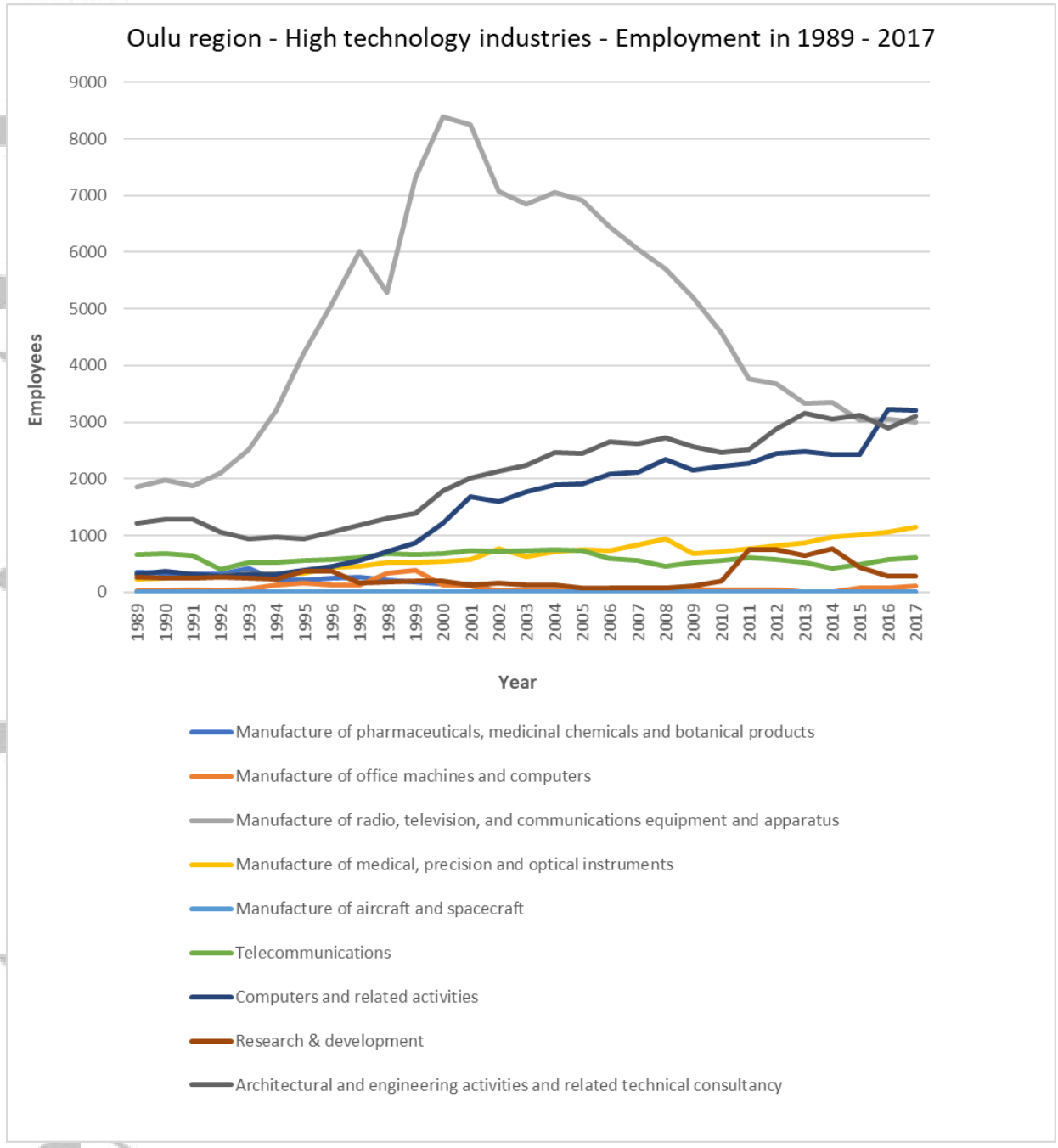


**Figure 2.** Structure of the high-technology sector in the Oulu region, 1989–2017 (Reference: FLEED database)

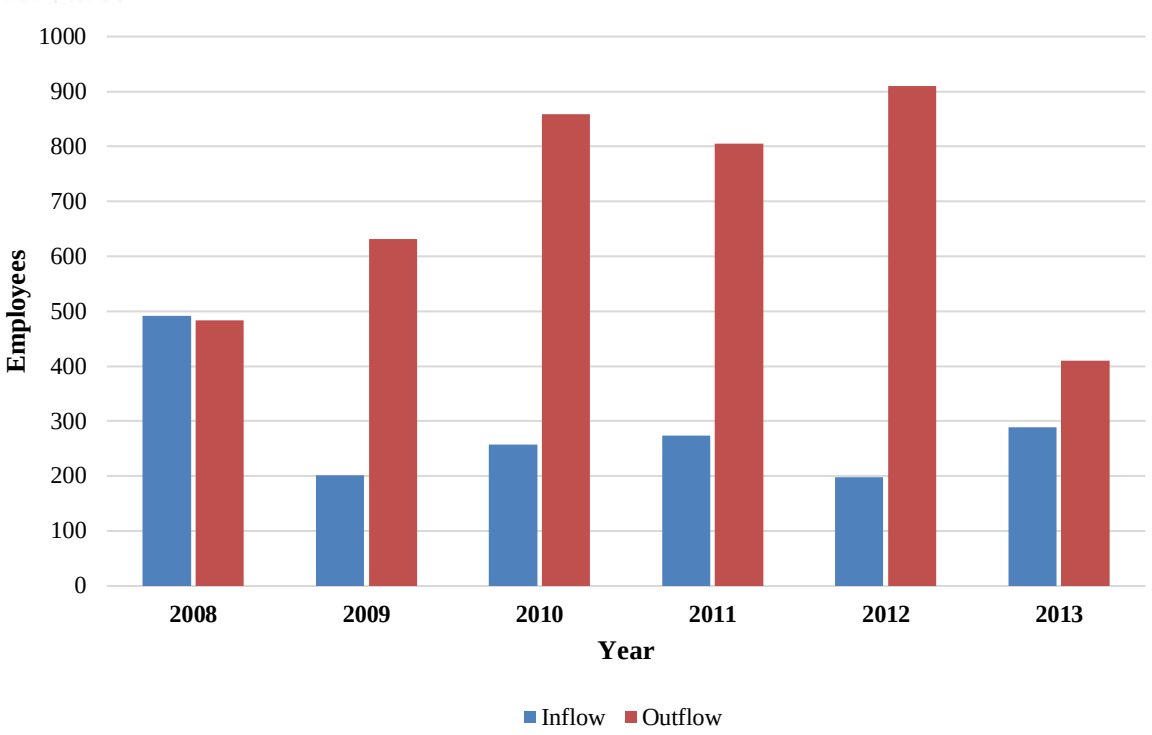


**Figure 3.** *Inflows and outflows* to/from the electronics industry in the Oulu region, 2008-2013 (Reference: FLEED database)

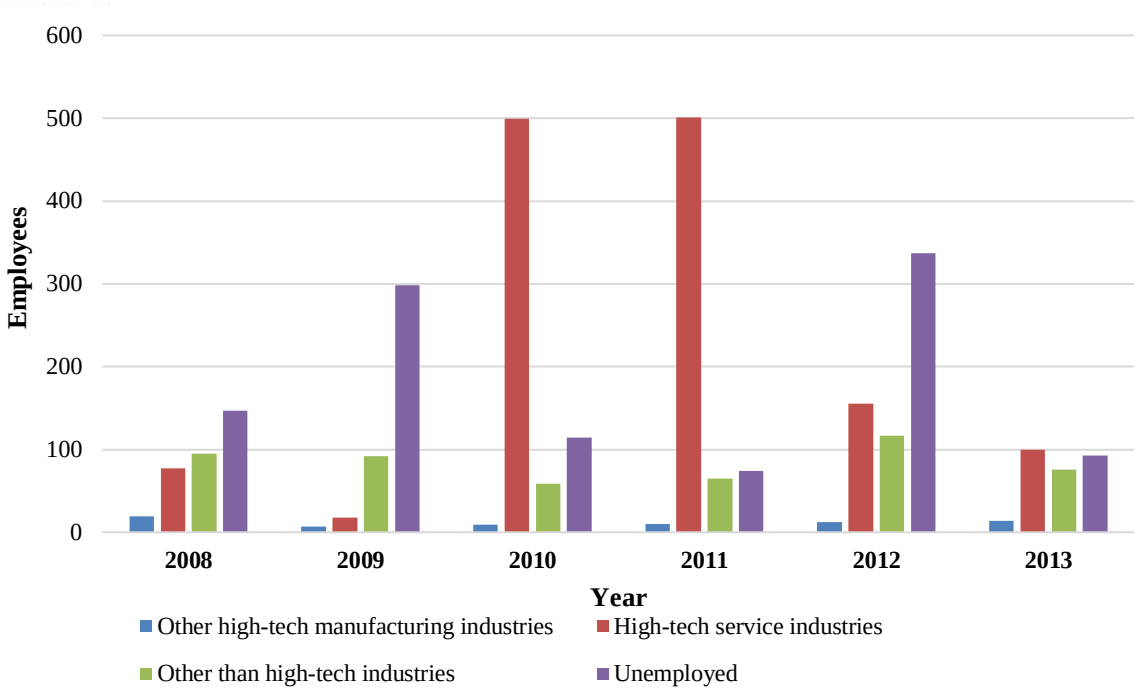


**Figure 4.** *Outflows* from the electronics industry in the Oulu region in different categories, 2008 –2013 (Reference: FLEED database)

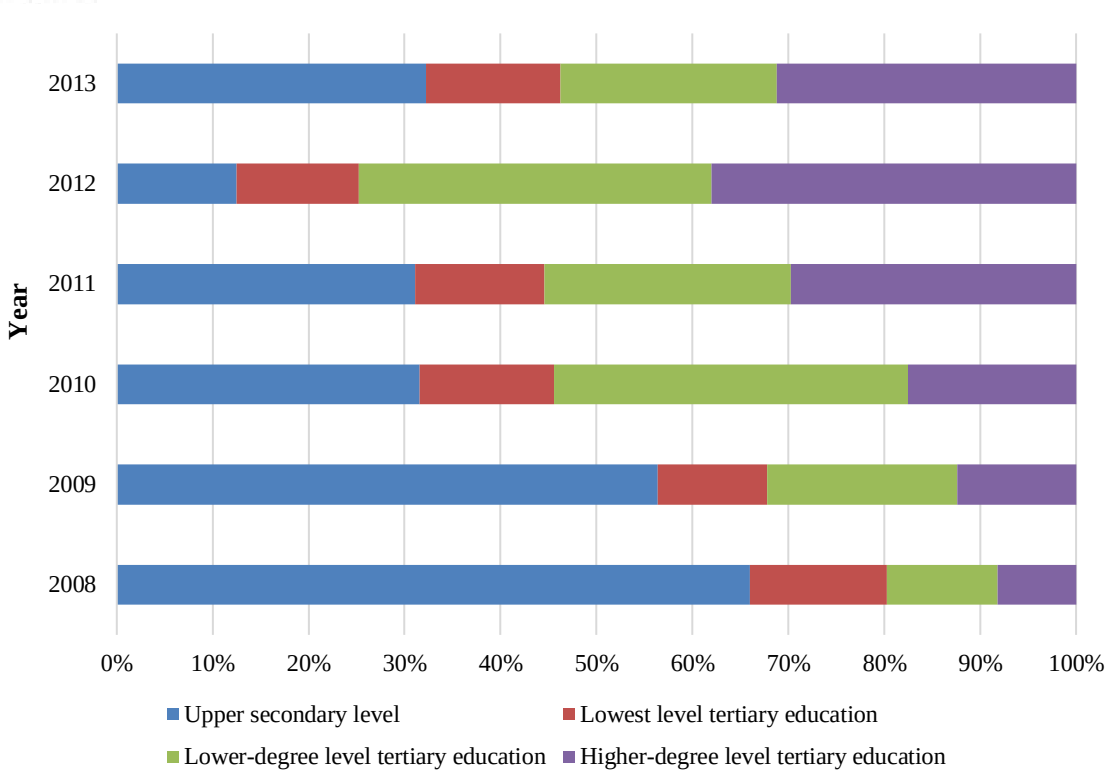


**Figure 5.** Educational distribution of employees who lost their job in the electronics industry in 2008-2013 in the Oulu region (Reference: FLEED database)

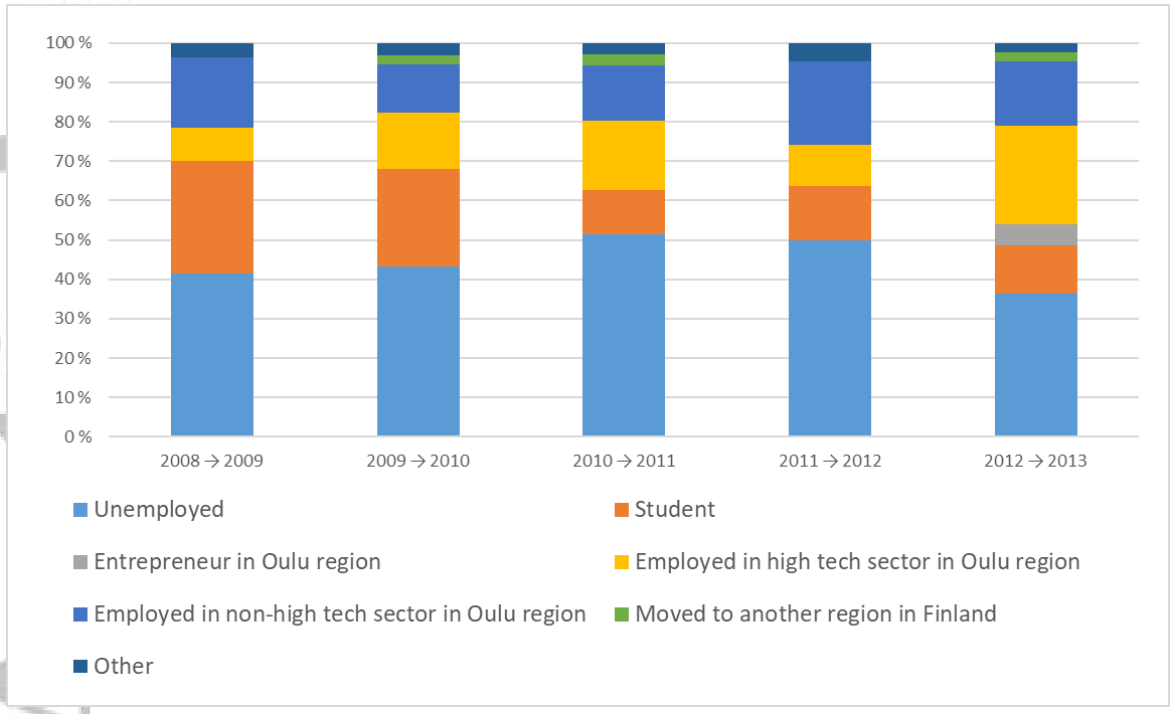


**Figure 6.** Status of the redundant employees (who lost their job in the electronics industry in 2008 - 2013 in Oulu) after one year. (Reference: FLEED database)

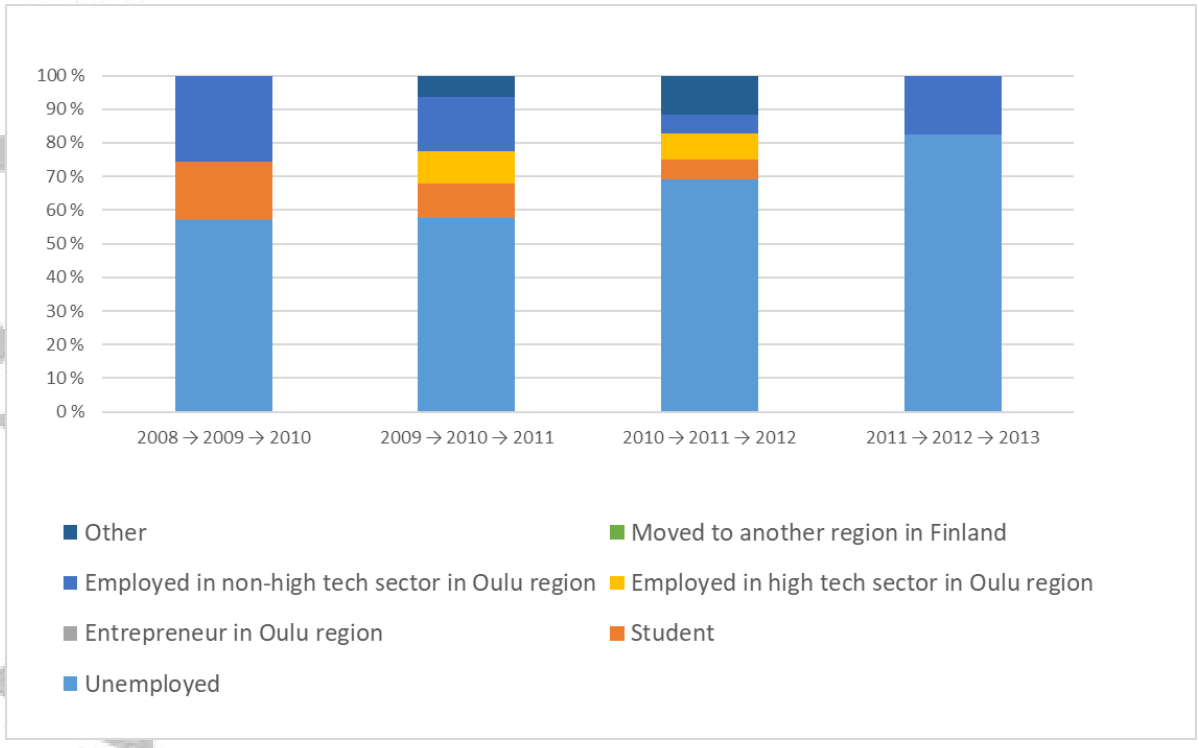


**Figure 7.** Status of the redundant employees (who lost their job in the electronics industry in 2008 - 2013 in Oulu and were without a job after one year) after two years. (Reference: FLEED database)

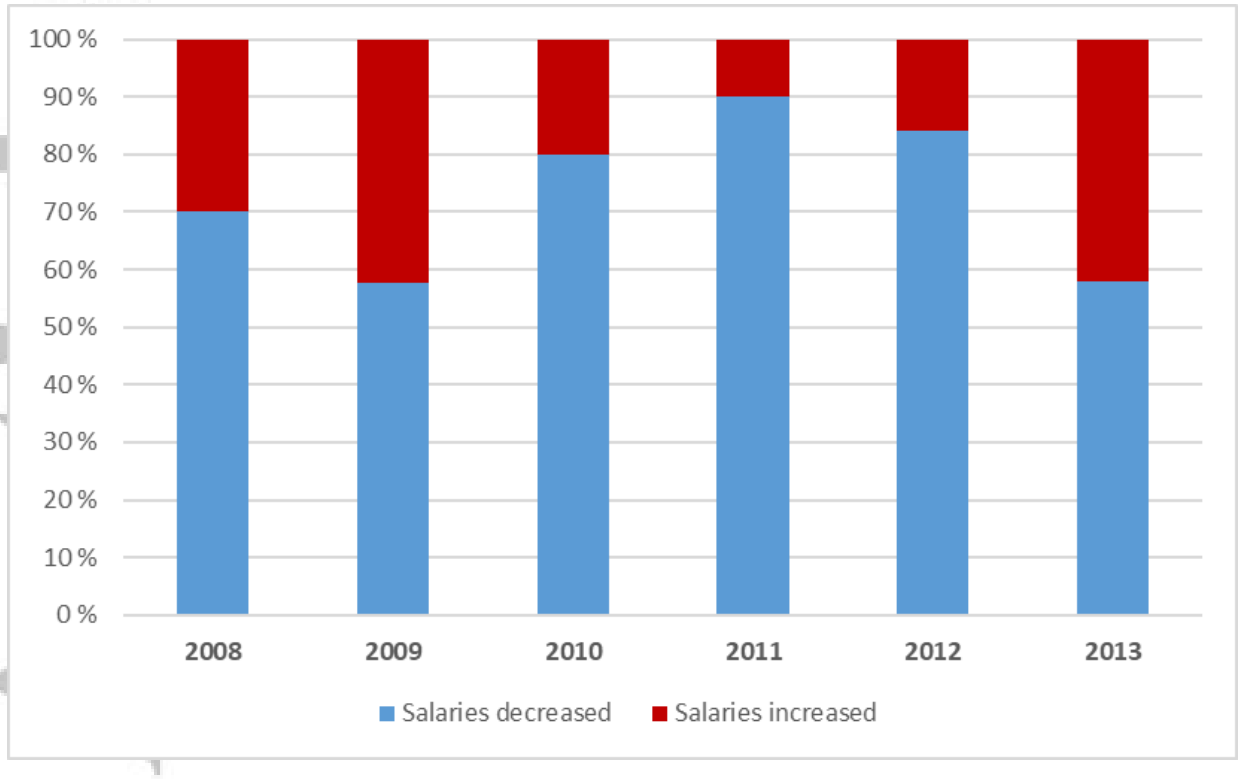


**Figure 8.** Labour outflows from the electronics industry and changes in wages in 2008-2013. (Reference: FLEED database)

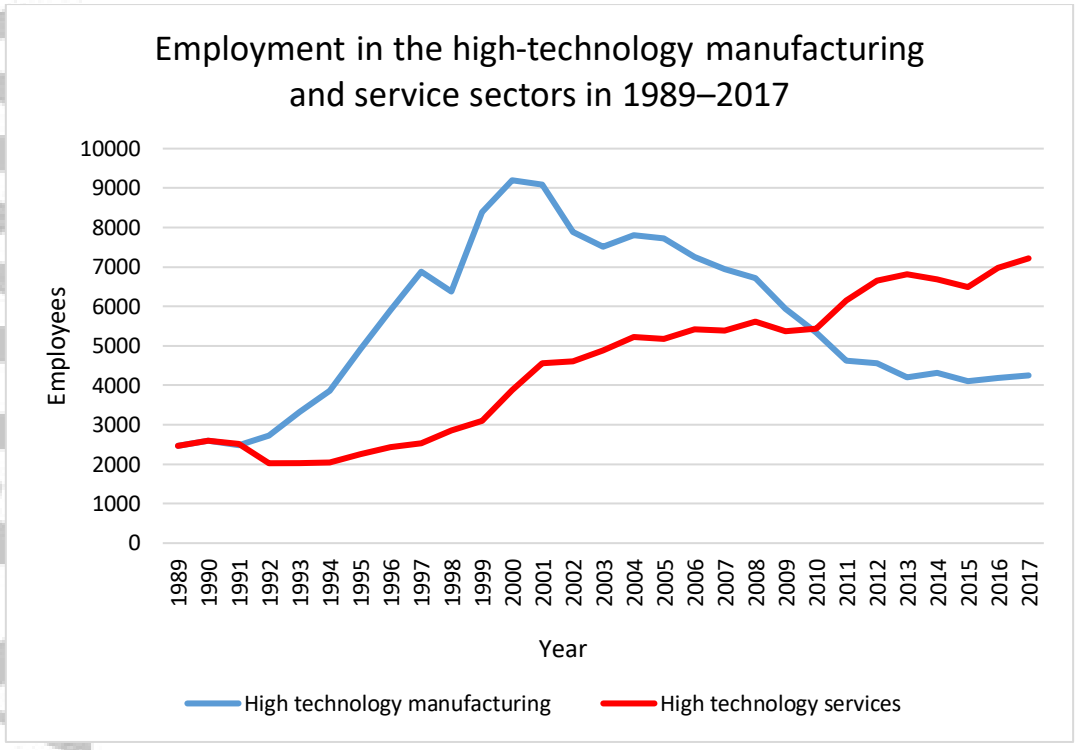


**Figure 9**. Employment in the high-technology manufacturing and service sectors in 1989–2017 (Source: FLEED database)

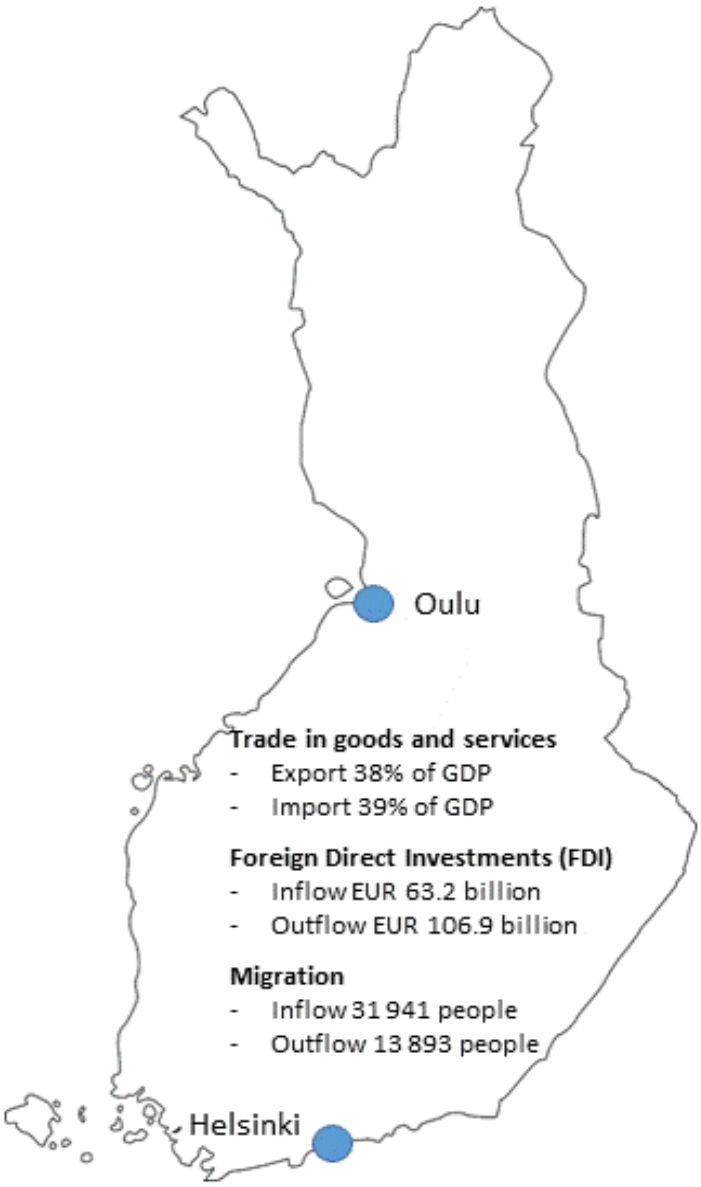


**Figure A1.** The location of Oulu, Finland and international flows related to trade, FDI and migration in 2013. (Reference: https://data.oecd.org/finland.htm and www.stat.fi)