Constructing Regional Resilience in times of Knowledge Economy Crisis

The case of the Nokia-led ICT Industry

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1. Introduction

Tampere may be Finland's second largest city-region (after Helsinki) but from a European perspective it is at most a middle-sized city located far in north. This makes it intriguing that Tampere was a key site for the Nokia corporation's tremendous expansion via mobile telephony.Tampere became part of this success story, because of its strong educational and research basis and ability to grow in tandem with Nokia's expansion, with local and national economic and innovation policies being tailored to support this development. However, the era of dominance ended when Microsoft acquired and finally closed Nokia's whole mobile business. This caused thousands of redundancies and lay-offs in Tampere, fundamentally restructuring the city's entire ICT industry landscape.

Tampere is now at a point where a new ICT industry is emerging, and local development policies appear to have some purchase on research and education to stimulate this reindustrialisation. This paper seeks to explore the extent to which the Tampere cluster, and particularly its universities, contributed to building a resilience which outlived Nokia. The paper seeks to examine how the different development phases of the local ICT industry are connected to the evolution of its resilience capacity. Exploration of the ways resilience was constructed in Tampere allows specific scrutiny of the universities' roles through industrial development. Drawing on a case study based on local statistics, an analysis of local newspapers, interviews and focus groups[1], this chapter argues that resilience is not a predefined character of a city, but it can be developed through strategic, collaborative measures actively involving universities. Universities can play a positive role in these developments, but only if they are able to ensure that the pursuit of engagement activities does not

lead to an excessive short-termism, so that they can contribute effectively to path-breaking and not to the extension of lock-in activities.

2. Path creation, extension, branching and exhaustion

In this chapter, we are concerned with the issue of regional economic resilience, which according to Martin (2012: 12) consists of regions ability to resist recessionary shocks, its ability to recover, ability to renew growth path and ability re-orientate. David (2001: 26-27) suggests that sometimes when endogenous development ceases an external shock is required to shake the region out of its lock-in. Martin and Sunley (2006: 406) see this as an overly radical interpretation and it is true that such a shock is not always needed – resilience turns a shock into a shift of economic trajectory. In this chapter, as with Chapter 8, we draw on Lester's (2007: 17-18) typology of industrial transformation process distinguishing four different ways of transformation: 1) indigenous creation (new technologies and competences) 2) transplantation from elsewhere (technologies and competences new to the region 3) diversification into technologically related industries (new functions of technology and competences) and 4) upgrading of existing industries (incremental adjustments in technologies and competences). In all these cases, regions that are locked into old industries facing path exhaustion are able to create new pathways and/or extend existing pathways. Resilience therefore depends on a region's capacity to perform path creation, extension and branching, and ensure that lock-in does not lead to path exhaustion.

Hassink (2010b) describes **path exhaustion** as a state where the innovation potential of local firms has been reduced or innovations are restricted to a certain technological path. A regional industry has a low adaptability with regard to technological and market changes. Martin and Sunley (2006: 415) describe lock-in as a situation where a technology, industry or regional economy has become stuck in a particular trajectory or path that has become inefficient in some way. Martin and Sunley (2006: 400) summarise the views of path dependency that can emerge from the ossification of these structures: 1) technological lock-in, 2) dynamic increasing returns where positive feedback reinforces existing paths, and 3) institutional hysteresis where formal and informal institutions, social arrangements and cultural forms self-reproduce themselves.

Path creation can be described as "establishment of new firms in new sectors for the region or firms that have different variants of products, employ new techniques, organize differently, etc. than what

hitherto have dominated in the region" (Isaksen 2015: 588). These industries can be either new to the region or totally new industries (Tödtling and Trippl 2013). Path creation usually has two main streams: it may be caused by inward investments and/or sectoral diversification of existing firms through path branching or it can be research driven focusing on commercialisation of research results (Henning et al., 2013: 1353). Path creation may also require building of new knowledge organisations and institutional change (Tödling and Trippl, 2013).

There is a bridge here from path creation into **path extension**, "in which increasing returns and positive externalities reinforce local industrial dynamism" (Martin and Sunley 2006: 415). In path extension success is based on incremental innovations in existing industry (Hassink 2010a). Established ways of doing things started to emerge, with logics of "increasing returns" and "positive lock-in" where current circumstances receive positive feedback and seem productive, creating a self-reinforcing circle. (Arthur 1989: 127; Martin & Sunley 2006: 401-402). **Path branching** refers to existing local firms and industries shifting to different, but related sectors (Boschma and Frenken 2011). Regions usually branch into industries that are technologically related to the pre-existing industries in the regions (Neffke et al. 2011: 237). Path branching is often seen as industry driven (Neffke et al., 2011: 237).

By linking the concept of resilience to the conceptual framework provided by path dependency we might be able to add analytical leverage in the efforts to understand how regions may escape their past and open new paths. Drawing upon Garud et al. (2010), we want to emphasise the power of reflexive agency and cumulative processes of gradual change as forces in path creation, and thus also in resilience. As Garud and Karnøe (2001) highlight, initial conditions are not given, as assumed in path dependency studies, but are constructed by actors. Therefore, various incidents shaping paths ought not to be approached as exogenous and manifesting something unpredictable, non-purposive and random but as emergent and serving as embedded contexts for agency. Garud and Karnøe's framework stress the role of entrepreneurs but, as Djelick and Quack (2007) maintain, path creation is also political by nature, and new paths may emerge due entrepreneurial efforts of science and policy actors despite the lack of business entrepreneurs (Sotarauta and Mustikkamäki, 2015; Sotarauta and Suvinen, 2018). As Bristow and Healy (2014: 97-98) point out, networked and polycentric nature of governance and policy is critical in resilience.

This brings us to the issue of universities, long an important resource in innovation policy but perhaps they even have a greater role as long-term competence builders from this framework. Universities' role in building human capital for the region in general cannot be underestimated. For example Crescenzi, Luca and Milio (2015) have stated that human capital, especially tertiary educational attainment, is a strong predictor of regional growth, innovation and also resilience. It is this issue that this chapter specifically addresses, asking the question of whether universities can positively contribute specifically to path creation, extension and branching activities, countering path exhaustion in old industrial regions and therefore contributing to this territorial resilience.

3. An introduction to the case study[2]

This case presents a study of Tampere, founded in 1779, Finland's second largest city-region with a population of 380,000. It was one of the first Finnish regions to industrialise, driven by cotton mills and paper factories, and later expending include textiles and mechanical engineering (see Haapala 2005). These industries drove economic development until the 1970's, when textile industry began to disappear, and the 1990s, when Finland was hit by a deep recession, which drove deep changes in industrial structure and policy strategies, towards developing new high-tech industries. Within a decade Finland moved from being one of the least ICT – specialised countries to one of the most specialised ones in terms of exports, production and R&D (Boschma and Sotarauta 2007). Finland's rapid shift to a knowledge economy involved many coincidental factors and good timing; a strong industrial structure began to emerge already in the 20th century with the presence of foreign companies like Ericsson and Siemens (Boschma and Sotarauta 2007). Demanding customers (network operators), standardisation (Nordic Mobile Telephone Standard) and a culture open to new technologies contributed significantly to the evolution of the ICT cluster. Business and policy worked together well (Boschma and Sotarauta 2007: 169) to position Tampere as one of Finland's three ICT hotspots with Oulu and Helsinki. From the early 1990s, the ICT agglomeration grew very rapidly in Tampere, in 1996, there were 170 companies employing 5,200 staff and with €770m turnover. By 2000 turnover had doubled to €1.5bn, a growth driven forward by Nokia and attracting interest from local (business) development, innovation and higher education policy in Tampere City-Region. (Kolehmainen 2003)

The strong science and technology base and the educational institutions has been one of the major strengths of ICT cluster in Tampere, with the Tampere University of Technology, the University of

Tampere and Tampere University of Applied Sciences. *Tampere University of Technology* (TUT) has traditionally had very close relationships with local businesses both in terms of research and education. *The University of Tampere* (UTA) has its roots in social sciences, but today it is a diversified university with long traditions in computer science and other ICT related fields of education and research as well, starting the first ever Nordic computer science degree in 1965 (Kolehmainen 2003). Tampere University of Applied Sciences (TAMK) is the smallest of the three HEIs, oriented towards working life and RDI collaboration, one of Finland's most popular universities of applied sciences, and strongly international with its teaching supporting many regional ICT companies.

Tampere has many intermediary organisations that have been concerned with stimulating the emergence of a strong knowledge-based ICT sector with collaborations between HEIs and firms. Firstly, its local government is very strong, with a strong city government but also a regional council (general regional development authorities owned by regional cities/municipalities). Tampere Region council has become very active in innovation policy promoting e.g. innovation platforms and user driven innovation. The national state owns Centre for Economic Development, Transport and the Environment (ELY Centres) in Tampere offering a wide range of economic development activities, including business support and employment services (advisory, training and expert services and funding for investment and development projects etc.). ELY Centres also administer Tekes (the Finnish Funding Agency for Innovation) services in the region. The regional councils and ELY Centres will be amalgamated in 2020.
Cities and municipalities have also set up their own economic development organisations and networks. Tredea Ltd. or 'Business Tampere' (Tampere Region Economic Development Agency), was started in 2009 by the eight municipalities of Tampere city-region. It provides support to start-ups and potential inward investors and is active in the execution of international talent attraction activities. All the activities have been very important during the dramatic restructuring of the ICT industry. Hermia Group is more focused, established in 1986 as Tamlink, offering specific product development and innovation services through one of its two subsidiaries, being Finland's oldest technology transfer company linked to TUT both operationally and via ownership. The other subsidiary - Innovaatio Oy Uusi Tehdas Ltd - stems from the Tampere Technology Centre which was established in 1990 to develop the Technology Centre Hermia founded four years earlier (see Lehtimäki 2005).

4. Path creation and path extension in Tampere region

4.1 Path creation: roots grew into mature business

Tampere experienced path-creation in ICT in the 1990s around the rapidly growing ICT industry, and in this section we explain its evolution as innovations, the existing knowledge based and structures laid the foundations for a new mobile industry. Nokia was an existing company that enlarged its product scale and invested heavily in research, tightly integrating it into the local research ecosystem. Tampere University of Technology was important in experimental basic research, standardisation and innovations (e.g. digital signal processing). In response to these developments, TUT began rapid growth in the 1990s, developing post-experience courses for businesses alongside diverse master and post-graduate degrees. Several courses provided important networking forums for local ICT professionals (Kolehmainen 2003), supported by the establishment of Tamlink and later Hermia Group (qv) as examples of institutional capacity being built to support the emergent path. From the early 2000s, the ICT cluster's structure was maturing, largely dominated by the business units of multinational ICT companies, such as Nokia, TietoEnator, Sonera, and Fujitsu Invia. Nokia remained important, but these companies were all actively oriented towards R&D (Kolehmainen 2003). The dominant role of multinationals also brought negative consequences, such as undermining the entrepreneurial atmosphere, manifested in low numbers of fast-growing internationally-oriented start-ups. (cf. Autere 2000). In the context of the 'dot.com' bubble that hit Finland in the early 2000's, Tampere was relatively unscathed, but was bit by deep restructuring a decade later.

4.2 Path extension: from the ultimate boom to first worrying signs

Alongside this path-creation activity, there was also path extension, with Nokia's global success creating a virtuous growth circle in Tampere based on Nokia's mobile technology. From our interviews it was clear that strong patterns of practise were emerging that provided a structure to this innovation activity. Tampere University of Technology (TUT) created a special relationship with Nokia, involving strong graduate recruitment to Nokia, many thesis projects with the company, modifying syllabi to reflect Nokia's needs, project funding from Nokia, and of course strong personal connections between TUT and Nokia. Indeed some years almost entire cohorts of Electronics and

Communications Engineering graduates were recruited by Nokia. This special relationship was useful for TUT because Nokia funded research projects, and used its global connections to assist TUT's internationalisation process. However, this maturity brought the first sign of lock-in. TUT believed that "didn't need anyone else" and they were "looking at the world through blue Nokia glasses", and this close relationship to Nokia overshadowed TUT's relationship building with other local businesses.

This had effects on the wider setting; TUT became a follower for Nokia providing qualified labour resources, just as Nokia started to focus more into product development than the basic research which had originally been important in the university collaboration. Engineering students ignored entrepreneurship because Nokia offered attractive job opportunities. Yet Nokia was not strongly locally-embedded, with its own global Nokia community, networks and processes that involved closed traditional innovation processes. Nokia was positive but inactive towards regional development initiatives like the City Council's flagship information society initiative eTampere Programme, and most Nokia site managers in Tampere were not active in regional development networks despite Nokia's huge economic role in Tampere. As late as the early 2000s, this developing lock-in was not regarded as worrying because of the mutual (short-term) benefits to regional partners, ignoring the deteriorating resilience from an overdependence on a strong, but weakly-locally embedded partner.

5. Path exhaustion: Considerable structural changes

5.1 Mobile phone business by Nokia and Microsoft hit the wall

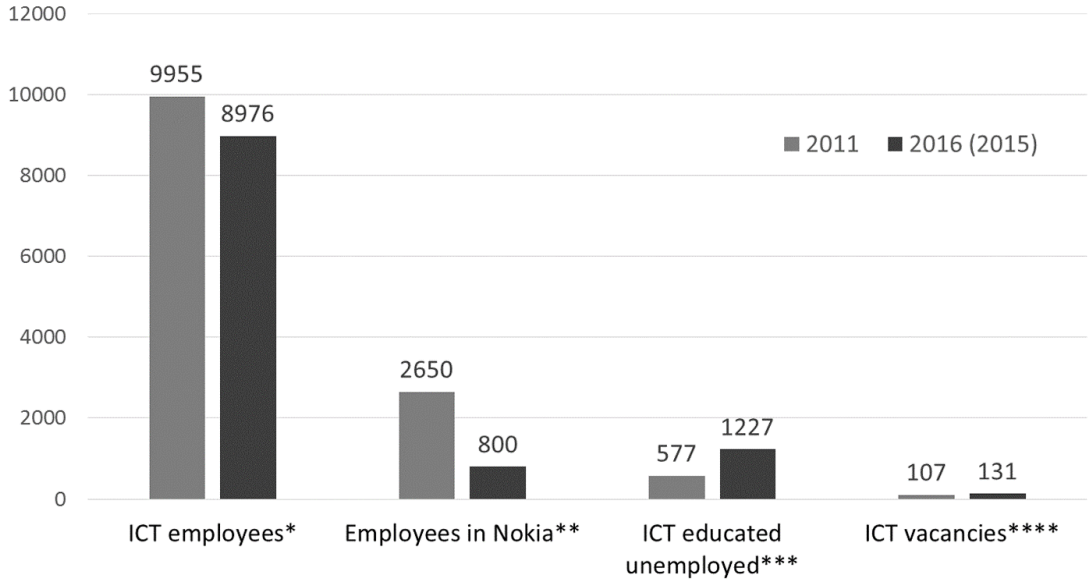
The path exhaustion came through problems with Nokia: a firm that once held a 40% share of the world's mobile phone market, and accounted for 4% Finnish GDP in 2000, 1/3 of R&D expenditure and 20% of exports in its heyday. From 2007, Nokia began shrinking, with negative effects on the Finnish economy, employment, and exports, particularly concentrated on cities where Nokia had its facilities (Ali-Yrkkö 2010; Ali-Yrkkö, Seppälä and Mattila 2016). The decline of ICT can be dated to the global economic crisis, with numbers of open ICT vacancies decreasing. In 2009 Nokia started to reduce employee numbers offering "voluntary separation packages", the first signs of the deep trouble facing its mobile business; many of its more senior and knowledgeable staff realised the extent

of the problems, and the outflow grew, with Nokia laying-off several hundred staff over the next two years.

In 2011, Nokia's new CEO Stephen Elop began strategic changes, choosing a new technological platform, the Microsoft Windows Phone to compete with Apple and Android, abandoning other technologies. This platform shift can be seen as a turning point, as thet new Windows phones flopped worldwide as a whole mobile ecosystem. Over the next four years Nokia and Nokia Siemens Networks ran several redundancy rounds, also outsourcing people to other companies, in total affecting several thousand employees in Tampere, and highlighting the risks of over-dependence on a single technology giant. Finally in 2014, after three year struggle, Nokia announced the sale of the mobile business to Microsoft, with their mobile phone development transferred to Microsoft. Following two more struggling years, in 2016 Microsoft announced they were ending Windows phone production, the final strike for Tampere's mobile phone industry, with another 500 ICT jobs disappeared in Tampere.

5.2 Structural changes in the ICT sector of Tampere

Tampere's city and region unemployment rates had been above the national average since 2007 (Statistics Finland 2016), with Tampere City having highest unemployment rates among Finland's six largest cities (City of Tampere 2016). As late as in 2009 Tampere hosted close to 4000 employees in Nokia Ltd and Nokia Siemens Networks, making them the region's biggest employers (City of Tampere 2011). This number fell to 2650 people by 2011 and to 800 people by 2016 (Figure 1). ICT accounted for 8.7% of all Tampere's employment in 2009 (Finland 6.3%) falling to 7.0% by 2015 (Finland 5.6%) This loss of ICT jobs had indirect employment effects in other sectors provided services for ICT businesses.



Data sources:

* Statistics Finland (2016), Statistics Finland (2013)

** 2011: Tampere Chamber of Commerce (2012:2), 2016: Aamulehti (2016)

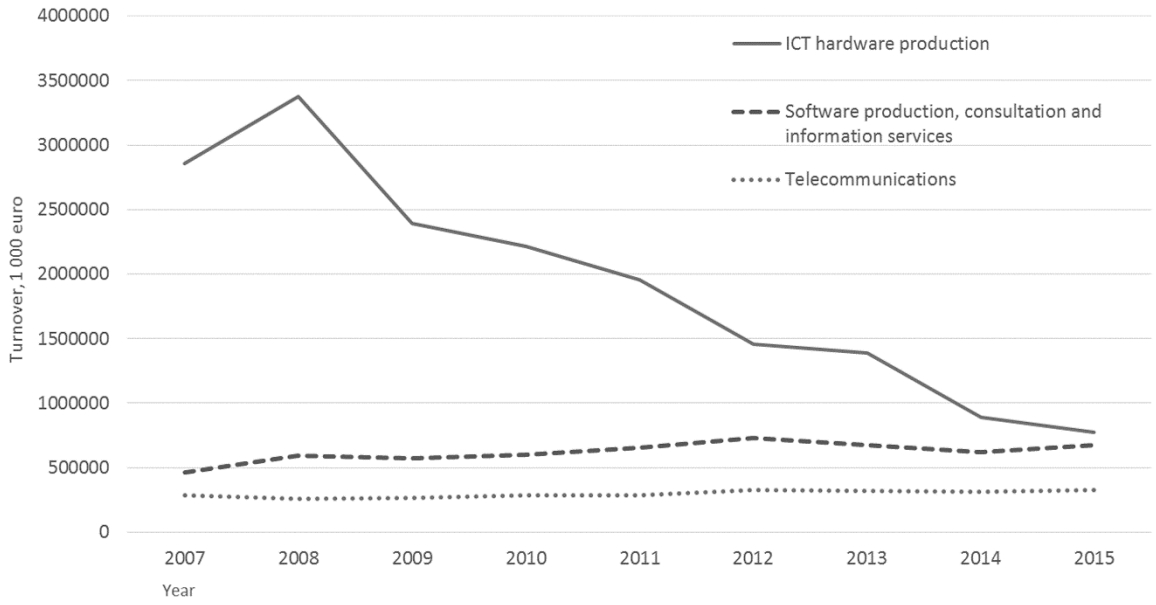
*** 2011 May and 2016 September by Neittaanmäki & Kinnunen (2016:9)

**** Ministry of Employment and the Economy, Sector Online (2016)

Figure 1. Some aspects in ICT employment changes in Tampere Region.

In 2011 the ICT sector employed nearly 10,000 people. Five years later 3,000 jobs had been restructured. About 40% were employed relatively quickly, and 40% undertook subsidized activities (coaching, re-training, entrepreneurship courses). 20% were in danger of long-term unemployment. (Salkoaho & Ikonen 2015: 8). The 2/3 of unemployed ICT workers had only secondary level vocational education with new vacancies requiring high level technology competences. Another risk group being middle managers, employed in great numbers in Nokia (Neittaanmäki & Kinnunen 2016: 21). Alongside redundancies, a new wave of software SMEs and a few larger actors have emerged. ICT specialists were also employed by more traditional industrial sectors as they adopt smart technologies. Both local ICT firms and externally-owned multisite ICT enterprises were continually recruiting during the recession, particularly software developers, sales and technical staff. Fast growing SMEs along with international enterprises were able to exploit this rapid restructuring, either by recruiting staff or establishing new sites in Tampere (e.g. Intel, Huawei).

The overall picture was of ICT industry transformation towards technologically-intensive software, with a persistence of high unemployment in the region alongside unfilled ICT vacancies: in 2016, ICT companies were estimated to have recruited recruit 700 new staff. The business structure of the ICT industry in Tampere Region has also changed. There are more SMEs and focus has moved from hardware production (mobile phones) towards software development. The number of ICT companies or their local units has grown from 720 to 859 from 2007 to 2015 (Statistics Finland 2016). Exports have fallen dramatically and are only rather slowly recovering. New ICT businesses are diverse, with firms active in the games industry, web applications, cloud solutions, cyber safety, health technology, location based services and digitalisation of all kinds of services and traditional industry. In comparison to the Nokia period, the overall production volume of current ICT companies (sum of turnovers) in the Tampere region remains low (Figure 2).



Data source: Statistics Finland 2016

Figure 2. Turnover development of the ICT sector in Tampere Region.

These changes had clear effects on Tampere's universities, with far fewer students interested in studying Electronics and Communications Engineering in TUT, whilst electrical energy engineering grew in popularity. TUT faced a dramatic reduction in external funding because of Nokia's prior dominance as a research partner; these projects dried up over a two year period, and TUT began competing more intensively for funds, actively seeking new project partners and collaborators. The

new software firms have proven highly interested in working with the universities to access student potential as innovation resources.

5.3 Dimensions of Tampere's regional lock-in

Laamanen et al. (2016: 13-17) identified that Nokia mobile phone division's decline after its huge success could be ascribed to four causes, including poor strategic choices (e.g. technology, timing, leadership); a lack of capabilities to face new challenge; organisational problems (particularly inflexibility, where structures prevented efficient R&D); alongside general environment factors (market changes and an economic downturn). Faced with dominant iPhone competition, Nokia's organisation became too massive, bureaucratic and slow, had a traditional innovation process and finally there were globally difficult economic situation. Interviewees argued that the *"time of the dinosaurs was over"*, *"it was time for new and more agile companies"* and *"creative destruction"* were involved. This organisational failure drove path exhaustion, and as Nokia faltered, Tampere was unable to help them address the challenges despite the massive consequences this had for the regional economy.

The regional lock-in manifested itself in many ways. Interviewees argued that it was not just the failure of Nokia in the global market, but the excessive specialisation in the regional labour market with a failure to develop broader competencies and encourage entrepreneurship. Nokia was a highly attractive partner for many regional actors in the ICT sector, with the result that there was a very strong central node, and only limited interactions between the other partners. However, Tampere was not leaning only on ICT, but has been actively developing also other industries, such as machine building industry and heatlth technology. In any case, the structre of the local ICT industry undermined the regional resilience, something that became clear with the crisis and Nokia's rapid downfall with its highly disruptive effects as Tampere was forced to de-lock itself. After the event, one municipality development manager even described that *"Nokia and Microsoft downsizing and shutdowns were the best things that have happened to Tampere after all."* The argument was that as that path had ended, it had at least created a space for the emergence of new software businesses and the revitalisation of the machine building industry.

6. Path branching by deepening open collaboration

Not all the actions to reshape Tampere's industrial scene were reactive responses to the immediate crisis, particularly by the universities to promote innovation and entrepreneurship, with some work undertaken to promote innovation and SMEs beginning from 2008. Innovaatio Oy Uusi Tehdas Ltd. launched the "New Factory", a business incubator and an innovation platform that aims to *"connect entrepreneurs, students, researchers, mentors, investors and experts from various fields into value co-creation."* In this respect, the concept called Demola has become quite prominent. Demola is a student innovation project platform on which multidisciplinary and often multinational student teams solve real-world challenges provided by companies and other organisations. Quite recently, TUT, UTA, TAMK and City of Tampere became the owners of Demola activities. New Factory also created the Promoto concept to facilitate the birth of start-ups by linking students and highly-skilled unemployed people in anticipation of a coming crisis. In total there are more than 160 established start-ups and 1600 jobs created and €35m funding raised by firms in Tampere's New Factory.

From 2011, as the depths of the Nokia crisis became evident, Tampere's universities also were active in working with development organisations and other regional actors to try to create new economic development paths for the region. Existing loose cooperation network made it relatively easy to mobilise a core group of actors; the City & Regional councils, Tekes, the ELY centre, Hermia, the Region Economic Development Agency, the Chamber of Commerce, the two universities and at that time also Nokia. Operating through unofficial breakfast meetings, this core group sought to develop collaboration between public and private bodies amidst the ongoing structural changes. (Salkoaho and Ikonen 2015: 9)The group built on its mutual trust and common will to functioned solutions, and Nokia passed confidential redundancy information to employment agencies to help with their planning. The group was called together by Tredea and despite the lack of formal leadership it was able to play a significant role in crisis management and coordination. One tangible outcome was the RecruIT event, started in 2011 to promote employment, but has since established its position as a meeting point for the ICT-sector companies and professionals.

We point to two activities that facilitated the emergence of new firms. The ELY Centre launched an upgrading programme "Spirit – ICT Future in the Tampere Region". Approximately 2,000 people and twenty companies participated in the Spirit retraining and qualification upgrading activities (Salkoaho and Ikonen 2015: 8). This programme was the public counterpart of the Nokia Bridge programme, in which Nokia sought to avoid the damaging PR that had accompanied its Bochum

factory closure. The Bridge programme offered five different paths, redeployment within Nokia, outplacement to another company, new companies foundation, retraining, and career coaching. The entrepreneurial path provided funded start-ups with grants of €10-25,000 and technology licenses, with 100 businesses, employing 550 people with only 40% of firms in ICT (Kiuru, Handelberg & Rannikko 2013; Eskelinen 2015: 24-25). Microsoft also adopted a similar programme, Polku ("Path") for their redundancies, which was also positively received.

The City of Tampere and Tredea worked on an industrial development policy, with their "Invest-in Tampere" programme, seeking to create new employment by supporting start ups, providing growth services and promoting Tampere as an attractive site for global and national ICT companies, based upon qualified labour, high-quality physical infrastructure and research institutions. Some companies recruited whole development teams and located to Tampere, although some firms were not to stay permanently.

The path branching emerged as new companies were established from the ashes of Nokia and Microsoft pursuing strategies based on lack of hierarchical structures, openness and transparency, continuous learning, crowdsourcing, ethical and meaningful assignments (Kärki 2015: 16). The new ICT sector was more versatile than previously, covering the games industry, cloud solutions, cyber safety, health technology and digitalisation of traditional industry. Nokia did not entirely disappear but lost its dominant position in Finland's economy (Ali-Yrkkö, Seppälä and Mattila 2016: 3-4) nevertheless recovering to being the highest value added Finnish company with its network systems and patent portfolio. Nokia recently re-entered the mobile phone business, licensing the Nokia brand for phones and tablets to HMD Global Ltd, a low risk, but potentially profitable strategy.

The universities contributed to these path branching activities, most notably being active in Nokia's Bridge Programme and Spirit programme, and this stimulated new collaborative thinking amongst the universities. Tampere University of Technology, University of Tampere and Tampere University of Applied Sciences co-operated closely to coordinate their post-experience education offer, and also to compete against private providers for this training. The informal network was here important in helping the employment authorities to persuade the universities to participate in these shorter-term activities, despite the universities' general preferences for teaching larger and more general upgrading courses. Universities, especially TUT, needed to find new research partners to fill out the gap that Nokia had left. The issue of short-termism here was also a problem, and both university and regional

firms devoted a lot of effort to building relationships which in some cases failed before a reasonably strong university-business network formed over recent years.

The path branching concept is useful to understand the restructuring of ICT in Tampere as the mobile phone industry diversified into other ICT sectors and also merged into traditional industries as smart technologies. It is easy to see that Tampere can be located into two latter categories of Lester's typology, namely diversification and upgrading. The university's resilience building role through university became evident with the employment rates of highly educated ICT employees were considerably higher than secondary level educated (Neittaanmäki & Kinnunen 2016: 21). In the regional management group, universities also contributed to the development of new approaches of collaboration and openness, away from supporting clusters towards driving processes of digitalisation. The universities have been active in reshaping the regional talent attraction policy to increase the human diversity and global linkages.

Looking to the future, this shared leadership contributed to the development of a new Smart Tampere program (2017-2021) to produce a more transversal set of solutions to the cities' open big, digitalization-related challenges. Innovative 'smart' solutions are provided by companies, universities and citizens, around seven themes that are health, education and know-how, industry, building, infrastructure, mobility and government and citizen. The City made the project funding contingent on this new way of working, and the universities have been willing to participate not only for projects in their own right, but in working with others to orient those projects and their other activities to the big, local challenges. Part of this programme seeks to develop new kinds of open innovation platforms, using existing infrastructures, such as the universities and larger businesses, to empower smaller groups, digitalising city life and promoting an agile approach which can later be upscaled to involve large companies, research institutions and the public sector (cf. Raunio et al. 2016,5). The universities have been actively engaged with these platforms, drawing on their resources, competencies and highly skilled individuals. At the time of writing, the three regional universities had agreed to merge in 2019, intended to create a university with more than 35,000 students, and with new, modern procedures for the research, education and societal engagement.

7. Discussion: constructing regional resilience

This article has sought to look at the role of universities in the long-term development trajectory of a region and an industry at a time when it was dominated by a single company. In Tampere, the resilience capacity seemed to be rather high in the 1990's, when the ICT path was created and system was in a flexible and creative state after a severe recession of the early 1990's. By the end of the 1990's Nokia and mobile phones had reached a tremendous growth and established their role as an engine of economic development in Tampere Region. In the first years of the 21st century this appeared to continue, despite resilience deterioration through increasing dependence on one actor. As the crisis hit, the scale of lock-in became evident, with first problems in 2008 crisis, mass redundancies in 2011 and the closure of mobile telephony industry in Tampere in 2016. What has happened since 2008 were various attempts by regional actors to construct resilience in ways that would minimise the damage done to the region by the delocking process that hit as Nokia mobile telephony in Tampere entered its terminal decline. The universities have been important in that process, although unlike other chapters in this volume, one of the main issues the universities needed to address was solving their contribution to the lock-in problem, after an active role in earlier path creation.

Universities have had a significant role in different development phases of the ICT industry in Tampere. To begin with, we argue, the whole cluster would not have emerged without the initial efforts by both scientific universities. That is also the case concerning the rapid growth and the "glorious days" of Nokia and its mobile phone business. At that time both educational and research activities were of great importance. However, quite intense university-industry interaction between Nokia and TUT especially was not able to prevent the dramatic restructuration of the local industry. One could argue that the relationships were even too tight, or at least mental models were too homogenous. Later on, the universities were involved in the management of the acute crisis, but their role cannot be determined as crucial.

Consequently, the universities needed to relocate themselves to the new setting. For example, the "open innovation platform approach" provide universities with quite different position to more traditional university-industry interaction modes. More generally the role of universities in this case study appears to have reasserted itself, both as a means of attracting highly talented students but also in creating the channels to better embed them in the region. The adoption of an open innovation approach and the creation of new platforms was an attempt to facilitate that and to create an

environment where experimentation was encouraged and failure permitted, a very different kind of regional culture to that prevalent under conditions of a large employer.

So what are the wider lessons we can learn from this case study of the involvement of universities in an attempt by an old industrial region to reinvent itself for the 21st century? The Tampere region is a quite extreme example because of the sheer size of the boom and the bust the region experienced related to a single firm, and the effects that this had on a wider industrial sector, firstly as crowding out, and then providing potential productive assets for this. The most obvious example to this is the universities have acted to have an ameliorating role on the boom to bust conversion, ensuring that as many of the resources that were built up in the 'gold rush' years were retained and retrained as the crisis built up. The retraining and upgrading programmes from the universities are emblematical of this approach in explaining how universities can help to deal with these moments of evolutionary collapse.

But there is another more interesting story emerging from this case study again revealed by its extremity. Tampere's universities have been in recent years, as with other universities in this volume, under enormous pressure to succeed and compete in a range of national and international comparative frameworks. They have to compete for students, they have to produce highly-rated research by winning prestigious and lucrative research grants.When faced with a single firm that was able to help them deliver so many of these goals it is unsurprising that the university oriented a number of its activities towards that single firm. But at the same time, that orientation towards Nokia contributed to the sense of lock-in by reaffirming to other policy makers that the existing way of business was suitable. And the universities, and in particular TUT, had to find new ways to break that lock-in given these wider networks within which they were operating. Supporting new entrepreneurs with short courses and small research projects represented a very different way of working for TUT post-Nokia and required substantive learning activities within the university to realise the necessary internal changes to permit participation in the informal regional network.

And this we argue is the most interesting contribution to be made here, to place the role of the universities in the context of public organisations that nevertheless have strongly private interests, to compete and succeed in these wider knowledge networks. It is all too easy to assume that universities are able as 'ivory tower' actors to stand above the daily throng and take decisions with long-term perspectives at their heart. But these new global pressures drive universities towards the same short-

term rationales that are at the heart of the emergence of regional lock-in. We contend that in the context of evolutionary approaches and resilience, it is this issue that requires additional research and reflection, how can universities be granted the necessary space and time to contribute to resilience, and not themselves exacerbate lock-in, crisis and the regional economic problems that ultimately result.

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Notes

1. The case study uses various data sources including standard statistics (Statistics Finland), 73 daily paper articles (93 pages; Aamulehti, main local newspaper), six extensive, thematic face-to-face interviews and two thematic group interviews, alongside other materials as referenced elsewhere. We have compiled the milestones of Nokia related events from local daily newspaper Aamulehti news archives and from regional employment authorities report (Salkoaho 2015).
2. This section partly draws upon Kolehmainen (2003), but the description has been updated and revised.