A Knowledge-based Strategy for Renewing a Declining Industrial City: The Norrköping Way

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Abstract

Norrköping, a small urban area formerly dependent upon old labour-intensive industries, has developed a knowledge-based renewal strategy inspired by ideas emanating from its superseded local economy. Using a longitudinal case study, this paper explicates the dynamics of change amongst a triple helix of university, industry, and government actors that involved building consensus within the city and with its neighbour city of Linköping. The keys to success have been cross-institutional entrepreneurship, aggregating regional and national resources to realise a unique, locally generated strategy rather than adopting the usual list of such hot high-tech topics as information technology, biotechnology, or alternative energy, and striking a balance between intra-regional competition and collaboration in order to achieve common objectives and avoid any stasis arising from hyper-competitiveness. This paper utilizes a Triple Helix "spaces" framework and makes comparisons with other relevant cases to develop a theoretical model of regional renewal through the hybridisation of old and new industrial and knowledge elements.

Keywords: Regional development, triple helix, institutional entrepreneurship, collaboration and competition among city regions

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1. Introduction

The life-and-death question of the future for older industrial cities is to find new ways of development. Can de-industrialising municipalities take feasible steps to identify and develop new sources of growth to support themselves or must they inevitably shrink to the limits of their smaller economic base, cutting public services or even reducing physical size and razing depopulated neighbourhoods as Flint Michigan did?

Researchers, policy makers, and ordinary citizens alike want to find a renewal strategy to avoid these consequences. The first approach is usually to search the industrial landscape for a firm to relocate or establish a branch plant in return for subsidies; the next may be to develop a new economic base centred on advanced research. The president of Stanford University reports that visitors, who come to Silicon Valley from all over the world to learn how to replicate it, ask him about the roles of university, industry, and government in knowledge-based economic development (Hennessey, 2009).

Beyond these two basic approaches, a third renewal strategy may be discerned: a hybrid approach of recombining old and new technologies to serve existing as well as new markets. It may incorporate elements of the exogenous, foreign direct investment strategy of inducing firms to relocate and take advantage of lower costs. It may draw upon the endogenous entrepreneurial strategy of creating start-ups by commercialising advanced research or developing new business models in emerging fields. Building on its previous industrial platform Norrköping, an old Swedish industrial city, provides a case study for considering the viability of a hybrid strategy. Norrköping has a long and complex history of industrial development based on both indigenous and foreign resources. Its previous manufacturing and technology eras provided clues for teasing out a new strategy that applied some of the knowledge from the past in a new context, but it needed to develop new knowledge, which was the missing element in the municipal infrastructure. Pittsburgh, Pennsylvania in the US and Shenyang in China also provide related instances of renewal based on a dual strategy of reinventing old steel and metalworking industries by infusing them with new technological capabilities, whilst at the same time building new industries from advanced academic research in medical devices in Pittsburgh and software in Shenyang (Etzkowitz & Zhou, 2009).

Norrköping is a declining urban brownfield environment that had to change

strategy in order to stop the economic downfall. Although still at a relatively early stage of development, it presents some key features of a hybrid model of knowledge-based economic growth with broad potential applicability. This paper examines how local actors combined Norrköping's existing assets with a new knowledge base to construct a unique niche rather than entirely abandoning the old economy for a fresh start. It identifies local contingent factors that Norrköping utilised to its advantage together with assistance from national policy initiatives. In contrast to major urban conurbations that revised their strategies before finding a viable pathway, small de-industrialising urban areas may only have sufficient resources to pursue a single one-shot strategy and therefore must choose wisely and well the first time. The Norrköping Way illustrates the precarious path and pitfalls a relatively small city region faces in its struggle for renewal and survival.

2. Knowledge-based Regional Renewal

Regional development strategies increasingly supersede national strategies as intervention points. Those deciding economic growth policies in the years immediately after the Second World War regarded them mainly as national processes, although their outcomes had differential regional impacts. For example, the location of Heathrow airport adjacent to London focused development on the south of England at the expense of the North as an unintended consequence of transportation policy. Despite their powerful effects, those deciding national development policies did so without much explicit consideration of the concept of regions having spatial dimensions or of where economic activity takes place and why (Krugman, 1992; Fujita et al., 1999).

The concepts of technology and region gradually replaced this predominant model as the principal constructs for understanding economic growth (Krugman, 1992; Romer, 1990). In recent decades regions, whether officially or unofficially, have been the sites of policy activities designed to improve economies (Cooke & Leydesdorff, 2006). Moreover, regional policy has gradually undergone a transition from poaching or capturing each other's resources to one of creating new resources, typically based upon some knowledge advantage.

The phenomenon of regional development attracted much attention and many different research streams emerged in the last decades of the 20th century. Some examples of the research streams are neo-industrial districts (Saxenian, 1994), clusters

(Porter, 1998), regional innovation systems (Cooke et al., 2000), the triple helix concept (Etzkowitz & Leydesdorff, 1997), and spin-offs as the prime driver for regional growth (Klepper, 2009). Consequently, entrepreneurial and institutional regional innovations systems were proposed as terms to categorize the streams (c.f. Ylinenpää, 2009). Ylinenpää finds that the triple helix approach looks at the individual actors and their interaction and is therefore placed in the entrepreneurial category.

Knowledge-based regional redevelopment builds upon and supersedes previous conceptions of regions as natural, cultural, and administrative entities. Knowledge-based regions may be created on the basis of such pre-existing frameworks or as new identities, as with Sophia Antipolis, Öresund, and Brainport, whose leaders reconstructed them from both elements that were already in place and ones they imagined and then created (Quere & Coutures, 2002). Such projects are, moreover, typically joint entrepreneurial endeavours resulting from collaboration amongst business, government, and academic actors (Johannisson, 1998).

To more fully develop the triple helix model of university, industry, and government, institutional spheres, it is necessary to add a set of "knowledge, consensus and innovation spaces" to the relationships amongst the triple helix actors, interacting and taking each others' roles (Etzkowitz, 2008). Policy measures to encourage knowledge spillovers from universities and other research providers are increasingly important for regional development (OECD, 1998). The expansion of economically relevant research and development (R&D) may be conceptualised as the development and growth of *knowledge spaces*.

In order to enhance the conditions of translating knowledge potential into economic development, regions in transition may create or utilize for new purposes an existing venue as a *consensus space* in which the triple helix actors can meet to agree upon strategic matters, to work as an information hub, and to provide a governance structure "to generate and gain support for new ideas promoting economic and social development" (Etzkowitz & Ranga, 2009, p.7). Of course, knowledge-based regional redevelopment efforts may take place without the creation of a fully functioning consensus space, but we hypothesise that such efforts are likely to be less effective in their ability to consider alternatives and mobilise resources.

The advantage of a triple-helix consensus space is that it opens a region to a broader vision and enhances the likelihood of engaging the fullest range of actors for

implementing a strategy for success. Indeed, The Swedish Agency for Innovation Systems, VINNOVA, charged with funding R&D, recognises the advantages of a consensus space existing among the helix actors, not only by making it a requirement for funding but also by helping regions to establish such spaces as part of their redevelopment processes (VINNOVA, n.d.).

This governance regime involves a process of cross-institutional entrepreneurship practised by organised actors with sufficient resources to contribute to the genesis of new institutions in which they see opportunities to realise interests that they value highly (Leca et al., 2008). The invention, adaptation, or both of such organisational mechanisms, commercialisation instruments, and such programmes designed to facilitate growth as venture capital, business incubators, and science parks constitute the *innovation space*.

The knowledge creation in the *knowledge space* is often exploited by actors socially close and therefore also spatially close. This implies the information having a high degree of stickiness to the space where it is created (Sorenson et al., 2006). For example, the formation of firms as a result of advanced research tends to occur in the vicinity of research sites, reinforcing the salience of a regional dimension to economic growth whilst also giving it a new meaning. This implies that any region's chief asset is its sets of relationships, which take a long time to develop and are difficult to imitate (Storper, 1997). These intangible assets represent a significant resource, albeit one that requires further investment and the construction of a viable strategy, ideally by engaging the full range of relevant actors for realising their potential.

Past practice has demonstrated that reaching a balance between renewing old industries, which involves selecting those with the potential for renewal and leaving those that lack clear potential to their fates, and investing in new industries, which involves choosing likely candidates for success and avoiding chimeras, is a difficult yet achievable task (Etzkowitz & Ranga, 2009; Schumpeter, 1942).

3. Research Questions and Scope

The regional development process has three levels of actors, which are the national, the regional or local, and the bottom-up. The national actors primarily supply funding and support developments by providing knowledge of development processes, the regional or local actors generally set the agenda, set the scene for the enrolment of actors, acquire resources, and develop know-how, and the bottom-up

actors attract external human and other capital, commercialise and develop new technology, facilitate knowledge and information sharing, or perform some combination of these activities (Etzkowitz & Klofsten, 2005).

Regional innovation organisers are individuals or organisations that cut across the three spaces of knowledge, innovation, and consensus to establish achievable objectives. They possess prestige and authority in their regions, which enables them to mobilise and attract resources and to initiate projects for their regions' benefit (Etzkowitz & Ranga, 2009). In Norrköping the national actors were the Department of Education and private national foundations. The regional and local actors were the top decision-making institutions and individuals at the university, the municipality, the research institute, and local industry. The bottom-up actors were the research groups, the science-park and business incubator, external entrepreneurs, and those industries attracted to the new technology developed during the process.

Cooperation amongst different types of actors within a regional context is significantly crucial for regeneration efforts (van de Ven, 1993; Storper, 1997). This paper devotes particular attention to measures local actors undertook for the restructuring of economic activities in their small urban area, or their institutional entrepreneurship (DiMaggio, 1988). It addresses the research questions of (a) who the main actors involved in the hybrid, knowledge-based regional redevelopment strategies were and in what ways they collaborated and (b) what the core activities of their early-stage, hybrid, knowledge-based regional redevelopment effort were. Furthermore, because of the interest in the actors and their activities this study is related to the entrepreneurial regional innovation system approaches. Ylinenpää (2009) found in entrepreneurial approaches that for example the strategies of the region was emergent and that entrepreneurial skills and venture capital were attributed much attention.

Etzkowitz and Klofsten (2005) found that the development of knowledge-intensive regions has the four stages of inception, implementation, consolidation, and renewal. Government and academia takes the initiative during the first stage, and the initiative later transfers to industrial actors who identify and exploit the new knowledge's opportunities. During this process knowledge input is a central aspect of regional development and stakeholders are active in constructing assets for knowledge production (Cooke & Leydesdorff, 2006; Cooke et al., 2007).

This paper's case study further examines the model's inception phase, with

particular focus on the Norrköping's triple-helix spaces strategy for regional renewal. The development of a spaces strategy has at least four stages or phases that occur in a usual but not necessary order; they may be viewed as a "flow chart" with decisive branch points. The typical first or "mobilisation phase" involves drawing together the relevant actors to attempt traditional methods of regional redevelopment. The process stops there if successful, at least temporarily. If the attracting of existing firms stalls or fails, however, other alternatives open up. The response to blockages may include recommitting to the failing strategy and continuing to pursue it in the face of discouragement, giving up the redevelopment effort, or turning to a new model. Recommitment follows a pattern that Festinger (1957) identified as cognitive dissonance, in which repeated failure impels the followers of a course of action to pursue it more vigorously rather than abandon it.

At this key point either stasis sets in or movement to the second phase of consensus-space development and "reconceptualisation" begins, as old leadership changes its thinking or new leadership comes forth to propose an alternative strategy. In the case of 1930s New England this occurred when the president of the Massachusetts Institute of Technology (MIT) set forth a research-based firm-formation strategy. This stage involves the realisation that a previous strategy is not working and that a need exists for developing a new one. Discussion then focuses on how to develop this new approach, taking into account a region's strengths and weaknesses. Branch points appear at each phase in the potential development and institutionalisation of a consensus space, as in a questionnaire, in which either development moves forward or the process comes to a halt, at least temporarily.

The third phase is operational based on "institution-formation," taking an action orientation as in the first phase but is focused on developing appropriate organizational formats, an "innovation space," to implement the new approach. The actors involved in the discussion assess their various resources and draw upon them to implement the new strategy. For example, in the New England case, in which the chosen project for implementing the new strategy was the creation of a venture firm model, they drew upon the complementary resources of the two universities, MIT and Harvard, for technical and business expertise, sought the resources of financial institutions to fund the project, and engaged political actors in a successful lobbying effort to change the investment rules for financial institutions to allow them to invest in more risky ventures through the intermediary of the new model. Institutional

spheres also played interchangeable roles, as when MIT and other technical universities became lead investors in the venture capital firm along with traditional financial institutions. Resource aggregation, with each participant contributing unique resources in a complementary fashion, is an essential part of the mobilisation process that arises from consensus space discussions.

Of course, it is also possible for discussion in the "consensus space" in the second phase to remain discussion and fail to result in action and movement into the third phase of the innovation space. The actors involved may not be able to agree on a viable project, the representatives of the participating institutions may have insufficient power to commit the necessary resources, as in New York City in the mid-1990s, or both, resulting in a loss of momentum and a blocked effort. This outcome may be temporary, with the project revived later, as in the New York case, or the region may have had just the one window of opportunity.

In the fourth phase, the beginning of an eco-system of interconnected innovation actors appears, including business angels, incubators, specialised law and accounting firms etc. The consensus space of informal meetings, may undergo a transition into a formal organisation with discussions among the triple helix actors continuing through board meetings, as in Porto Digital in Recife, Brazil and Joint Venture Silicon Valley in San Jose, California, or lapse, as in the New England case. Revival, however, is likely should a region face another crisis and the need for joint action reappears. The ideal outcome, of course, is movement into the latter stages of the knowledge-based regional innovation model with a dynamic innovation eco-system and a self-organizing renewal process (Etzkowitz and Dzisah, 2008). The Norrköping case only showed the glimmer of a fourth phase "take-off" to date.

The main objectives of the research are described in table 1.

Table 1. The main objectives of the research

Research questions
Who the main actors involved in the hybrid, knowledge-based regional redevelopment strategies were and in what ways they collaborated?
What were the core activities of their early-stage, hybrid, knowledge-based regional redevelopment effort?

4. Methodology

This paper's qualitative research presents a detailed case study of a de-industrialising Swedish urban area and its redevelopment actors, including its university, regional industry, research institute, entrepreneurs, and governmental agencies, amongst whom we conducted more than 20 semi-structured, in-depth interviews in 2008 and 2009. These included 45-minute to two-hour face-to-face and telephone interviews. We tape-recorded and transcribed them and the interviewees checked their texts for factual mistakes (see Table 1). We supported the interview data with an extensive secondary data collection of research applications, applications for funds, and voluminous meeting notes in order to increase the data's validity (Yin, 2003) (see Table 2).

We conducted this study's research in phases, beginning with an introductory meeting with the participants from the Norrköping municipality and science park. We interviewed the head of a cluster initiative at length and participated in cluster meetings in a technological field that the regional university and research institute had established at its new campus. We then interviewed the current and former municipal commissioners as representatives of the political leadership, followed by people from industry, academia, and the research institutes (see Table 1).

We then collated the data, presented it to the key actors, and used their feedback to improve the in-depth interviews with other key actors, who were those who had been part of the establishment of the regional university's key new campus from the outset. After triangulating the interview data with the secondary data we presented the written material to three key informants who checked for factual mistakes, ambiguous meanings, and the need for additional data. We therefore consider the construct validity of the empirical data to be high (Yin, 2003, p.35).

We had parts of the final document printed as an empirical working paper and distributed it to key informants (Svensson, 2009). We mapped patterns in the material in order to delineate causal mechanisms, utilising process tracing to account for equifinality, or the alternative paths through which the outcome could have occurred, supplemented by a typological comparison with other relevant cases (George & Bennett, 2005).

5. The Norrköping Way

Norrköping had experienced successive economic shocks since the 1960s. The

city had flourished from the nineteenth century until the 1960s due to its successful textile manufacturing industry, but this industry collapsed due to fierce international competition and reduced demand for wool products. Norrköping had also suffered from a decline in the pulp and paper industry and experienced a crisis in the late 1990s when Ericsson shut down most of its production there. It still had the advantage of being strategically situated between the conurbations of Stockholm and Malmö, with modern road, railway, and communication systems and an international airport. It has a population of approximately 100,000, making it the tenth largest city in Sweden, although it was the fourth most populous 40 years ago (Svensson, 2009).

The river running through the city has been a source of power for industrial production since the Middle Ages. First it served the mills, then in the seventeenth century it produced power for the production of brass for the weapons industry and, especially, for new textile-production methods imported from the Netherlands. In the late nineteenth century it was the biggest textile-manufacturing centre in Sweden, with more than 70% of all production, and was Sweden's second largest urban centre. In the nineteenth century the city also turned to paper production, and in the 1930s the world's two largest newsprint machines were installed in its industrial centre.

When the international electronics firm Phillips wanted to secure the Scandinavian market in the context of the emergence of the Nazi regime in Germany in the 1930s it chose Norrköping as its Scandinavian headquarters, where it produced radios, then television sets, and developed microwave ovens in the 1960s. During the 1960s textile crisis the telecom company Ericsson established a factory producing electric transmission equipment and later circuit boards, but most of the electronics manufacturing ended in the 1980s and 1990s. The Phillips plant closed down production of both audio products and colour TVs in the 1980s, and it was manufacturing only remote controls and microwave ovens when Whirlpool bought it in 1993. In 1997, Ericsson decided to outsource its Norrköping operations to its sub-suppliers. Two years later it ceased manufacturing circuit boards and broadband there and sold the circuit board division.

Linköping University (LiU) had been present in Norrköping on small scale since the 1970s, with approximately 1,000 students annually. In 1994 the Swedish government announced a national expansion of the higher education system, which was a labour-market policy response to increased unemployment resulting from Sweden's 1992 economic crisis. It was also a strategy to increase Sweden's

knowledge base to increase future national competitiveness. This gave LiU an opportunity to expand its Norrköping campus to what is now a high-profile one with 500 staff and approximately 5,000 students. It is also associated with such support organisations as a science park, a business incubator, technology transfer organisations, and an active municipality. The municipality's development plan has a strong emphasis on triple-helix-like collaboration, one of which has been evolving there in recent years.

5.1 Awareness of the Need for New Strategy Dawns

The hybrid alternative did not appear immediately. The helix actors only considered taking a more activist approach after a period of waiting for economic processes to take a putatively natural course of development. After a period during which nothing happened the municipal leadership began to come together to consider an alternative strategy based on the neighbouring city of Linköping's success in generating new firms from an academic base.

5.2. **Norrköping's Renewal: A New Practice**

Public-sector actors at high decision-making levels initiated the change process, the municipal commissioner in particular playing a key entrepreneurial role. During this initial process representatives from industry and such public-sector organisations as the Ministry of Education and LiU became involved in strategy formulation. The public sector has retained an important coordinating role, but entrepreneurial individuals from other types of environments began to take their own initiatives based on the shared vision.

Early in the 1990s the Norrköping municipality's board had actively sought a solution to their city's economic problems, its chairman, or commissioner, strongly promoting an increase in the city's knowledge base. They had observed that the labour market had shifted towards more highly skilled workers and therefore hypothesised that a greater number of skilled people in the municipality could make its labour market more dynamic. They were also aware of the successful development of Linköping, 35 km away, which had dealt with a similar situation successfully with such a strategic change. When a window of opportunity opened in the mid-1990s, through the national government's expansion of higher education they took steps to create a research-oriented campus.

Ever since the downward economic trend had started in the 1950s the municipality's leadership had tried to reinvigorate Norrköping by asking the national government in Stockholm to provide replacement jobs and incentives for industry to settle in the vicinity. That strategy, however, had failed every time to turn it into a place with an economy that was expanding rather than contracting, the one-time injections failing to generate more overall economic activity.

In the early 1960s Norrköping made an agreement with Linköping that it would not object to the national government placing a university there if it received part of the new university's operations. The Swedish parliament then voted in 1965 to establish a medical and technology institute in Linköping as an extension of Stockholm University. The Norrköping municipal board considered this to be a breach of a tacit agreement that the institute of technology would be located in Norrköping rather than the small-scale, non-research-oriented campus of LiU that it did receive.

In 1995 the university's vice chancellor strongly supported the expansion of the Norrköping campus based on the integration of the city's cultural and industrial assets with future research providing the project with credibility. A multifaceted local working committee consisting of the university's leadership, the municipality, the county administrative board, governmental agencies situated in Norrköping, and local industry representatives convened to prepare the application to the national government. The Swedish educational system had expanded by then and 2,300 places could be dedicated for the university's expansion, which had begun in 1994 when a newly elected Social Democratic national government had initiated a programme for higher education in Sweden in order to increase national competitiveness and to decrease its unemployment rate. The national education strategy's objective was for Sweden to continue to compete internationally with knowledge-intensive products and services rather than labour-intensive ones.

The university established an organising committee that included the provincial secretary, the municipal commissioner, the university vice chancellor, and a couple of local industrialists to coordinate the launch of new research for the campus. Their concept was that novel educational programmes, together with a closer relationship with industry, would position Norrköping as special relative to other municipalities with universities. They planned for their agenda to be ready and launched by the autumn of 1997.

During an early planning meeting the university vice chancellor stressed the importance of being innovative and not hesitating to develop new ideas in order to construct a unique profile that would be attractive to both students and university staff. He argued that the municipality would be unlikely to have another opportunity like the one they then had. The municipal commissioner expressed this sense of emergency by saying in 1997, "This committee must not decrease the speed of operations. We have to put in the resources needed in order to keep the high level of urgency up until the start of the new campus in the autumn of 1997" (translated from Swedish).

The capturing of an academic presence therefore became a key part of the municipality's regional renewal strategy, which has also been a commonplace development elsewhere. In Norrköping, however, academic development followed a particular trajectory that went well beyond the usual goals of retaining youth and generating spillovers from campus spending.

The helix actors put a carefully crafted academic strategy in place, one reminiscent but not apparently influenced directly by Stanford University's, which emphasised creating *steeples of excellence* by hiring a faculty with closely related research interests in fields with intertwined theoretical and commercial potential. A group called the Campus Council became the organisational successor to the organisational committee. The vice chancellor and the university's executive committee appointed its chairperson and 11 of 18 delegates who would meet three times per year, the other seven delegates being from such external stakeholders of the new campus as cultural organisations, the business sector, and public bodies. This effectively made it a consensus space broader than academia for mapping academic and industrial excellence and how these two could match. It became synonymous with the municipality's development strategy, with a mandate to facilitate the exchange of information, ideas, and experiences amongst the university, the new campus, and their external stakeholders.

The university also expected its broad scientific centres to encourage the participation of such external actors as governmental agencies and private companies. Each educational centre had a steering committee consisting of members of the faculty and external actors from both outside the university and other faculties. The realisation of the plan went more quickly than expected, and 400 new students were recruited for the new programmes in the spring of 1997 for a total of 1,800 students

and more than 150 faculty members. By 2002 it had 5,000 students and 500 employees and three engineering and three masters programmes covering such areas as media technology, electronic design, and transportation and communication technology. These areas were in alignment with the current economic base of Norrköping; which were paper companies (media technology), electronic companies (electronic design), and logistic companies (transportation).

The path to regional renewal through academic development was not entirely smooth, however. In the absence of a formal agreement between the university and the national government in regard to research resources the government failed to deliver them. Both the university and the municipality announced that the campus would be unsustainable if the educational programmes were not backed up by research in the specific fields. In other instances renewal has been based upon redirecting existing academic resources. In Uppsala the departure of Pharmacia left behind a network of relationships between former firm managers and academics that became the basis for a wave of biotech start-ups, the resources for which they had to create from scratch (Waluszewski, 2004).

A new local foundation, in association with the major paper company and established with money donated by a local industrialist, financed a professorship in digital picture and media technology that has resulted in novel, high-quality education in such subjects as graphic design, virtual reality, and scientific visualisation. A Swedish telecommunications company financed a professorship in communications electronics despite cutting back most their activities in the municipality. Then another local foundation, established with money from a major local paper company, sponsored a professorship in printed electronics. The university also provided resources for research in the new fields. The municipality learned from the vice chancellor that a major research institute needed new premises. In a combined effort to attract the institute the municipality injected resources from its newly established foundation, as did a major private foundation and VINNOVA. The university situated the research institute next to the science and technology institute so they could share facilities and resources for commercialisation.

5.3 Resource Aggregation to Implement the New Strategy

The discussions in the consensus space generated an alternative implementation strategy based upon local resources. The municipality sold its

publicly owned energy company to an international firm and established a municipality-governed local foundation. The statute establishing the foundation mandated knowledge exchanges and cooperation between the university and industry in order to create the innovation of novel products and increased productivity and technological levels in regional companies. The municipal commissioner became heavily involved in the negotiations with the buyer.

The fund has acted as a seed financier for research-based ideas emanating from the university campus. Its first grant was to the newly established research institute and science and technology department, creating a centre for the support of technology transfers and the coordination of international and national research in organic electronics. The centre has actively coordinated several relationships with multinational corporations and international research groups and has also obtained external funding from national research financiers. Governmental rules limit what the public sector can do to assist business activities, so the funding of cutting-edge technology research has been an ingenious way to increase the region's competitiveness.

A council delegate representing a local bank suggested a local fundraising campaign when he realised both the importance of research for the expanded campus and the national government's refusal to provide any resources for it. A local entrepreneur who was also a council delegate added his extensive network and credibility to a fundraising campaign that managed to raise SEK60 million (approximately €6 million) for research. In order to induce a bandwagon effect and give the campaign credibility the municipality and university both made large donations amounting to one-third of the final total. The council then launched a second fundraising campaign managed by a small council working committee consisting of the local entrepreneur, the local banker, a university leader, and a student representative. This committee employed a professional manager.

Other cross-organisational working committees within the council include one promoting students as a local resource and one concentrating on marketing the new campus. The new campus's faculty prefects have been responsible for finding such social innovations for the university as new and improved ways of operating. The municipality has also dedicated money for research positions within the university's administration. The university began admitting PhD students and some have finalised their dissertations in organisational studies and municipality-related issues. The

overall objective of all this activity is for clusters of research and business to develop involving technological knowledge, making the municipality's industrial structure more differentiated and the region consequently less vulnerable.

The municipality has sponsored a science park governed by a foundation run by representatives from the university and local industry. It intends to engage in entrepreneurial activities that complement the research. The research groups soon became self-sustaining by securing external means for their research, and are often able to obtain matching funds from national funding organisations in relation to the local money they raise. Entrepreneurs and several multinational corporations have established relationships with the research institute in order to exploit the new technology emerging from it and the university, producing new applications that they test in Norrköping in joint facilities in the science park, business incubator, research institute, and university.

During the first years after the establishment of the new campus a microelectronic research institute in Linköping was searching for larger facilities. The university's vice chancellor, together with the municipality's board, arranged for the research institute to move to the new campus. The transfer and upgrade of facilities received grants from the municipality and from VINNOVA. The research institute moved into the same building as the electronic design department and shared its microelectronic laboratory and the two organisations started to work together with the new technology. The newly founded municipality fund sponsored several projects for the researchers in regard to their market relationships.

5.4 The Embryo of the Future Norrköping

Norrköping renewed its efforts to obtain national funding on the basis of the newly created bottom-up platform. In 2005 the managers of the local science park, the research institute, and the microelectronic department developed a joint application for a major contribution from VINNOVA. The municipality fund and the research institute, and later VINNOVA, supported this consortium financially. The strategy was to use the various local actors' attributes synergistically and for each of the founding partners to continue to work as usual, only toward a joint goal.

When the Campus Council's eight-year mandate ended in 2005 LiU decided that it would continue to work for the new campus's further development by continuing the activities that started with the fundraising campaign to expand the

academy's presence in the municipality, be a university hub for the surrounding society, market the campus, and be a platform for new campus activities and projects in research and education. The argument was that a need existed for a meeting place and a hub for LiU and its external partners. The proposition emphasised such aspects of the council's systematic approach as its organisation of the new campus's marketing collaboratively with other local actors. Its objectives include stimulating the activities of the science park, the joint umbrella organisation for the promotion of new technology, the research institute, and a centre for demonstrating and developing new technology.

The Norrköping urban area has received positive effects from the establishment of the new LiU campus; e.g. university employees and students. The educational level of its citizens has increased and the number of high-school students continuing to tertiary education has risen significantly from 30% before 1997 to more than 40% in 2005.

Indirect effects of the establishment of Norrköping's research campus include attraction of several knowledge and innovation-space organisations. For example, collaboration between a research institute, the science park, and LiU's Department of Science and Technology resulted in a major regional development project, financed by VINNOVA, for exploiting the emerging technology of printed electronics. In addition, the Norrköping campus's world-class digital visualization research programme received major grants to build up a public centre connected with its research. A direct effect of the research campus is the inflow of knowledge workers, with the Department of Science and Technology having 11 full professors and more than 40 PhD students.

The initiative had also established and fine-tuned an innovation space including a business incubator, science-park, and business plan competition. No increase in new companies based on new technologies has yet become evident, however. A few start-up firms based on the technology of the academic research have emerged, but it is too early to see any economic results. Norrköping's established companies' competitiveness has yet to increase due to new technology, but industry representatives are interested in the new technology and participate in information meetings about such technologies as printed electronics.

Insert Table 3 about here

6. Towards a Theory of Knowledge-based Regional Renewal: Some Analytical Perspectives

The case study shows how local actors' joint efforts changed the municipality of Norrköping's knowledge base over a 15-year period with a transformation process in which actors at different levels of decision-making cooperated. The actors have had different motivations for taking part in the joint activities, but an understanding of the vision and its potential benefits for themselves are cogent factors.

Actors from the public sector, academia, and local industry were essential for establishing the new knowledge base. The public sector encouraged the change in strategy, academia established learning resources and developed novel educational programmes, and local industry, critically, mobilised resources when a need existed for them and also provided input for such factors that its representatives considered important as what educational programmes would cater for its needs.

The municipality had been hit by recession and economic crises before and the natural reaction was to turn to the national government and request the relocation of jobs to the region. Early in the 1990s the municipal commissioner asked the national government to expand Norrköping's modest higher-education activities into being a full research university in order to be able to self-generate jobs, as Linköping had done, and to develop a workforce with increased flexibility. Linköping's success made the effort seem realistic. They were able to speed up the process of academic development by affiliating with this adjacent municipality that had a successful university.

The commissioner and his team changed the regional practice from external investment and dependence on a few industries to a policy based on the creation of unique knowledge capabilities, which might then attract external investment, increase existing industries' competitiveness, and create new ventures.

6.1 Actors, Core Activities, and Time

This study has focused on the actors and their the core activities as the key aspects of a knowledge-based regional redevelopment process. People sometimes took initiatives alone in their organisations or as individuals, but all those involved have responsible positions in their organisation that provided them with the

opportunity to participate in the combined development process. This paper has therefore generally attributed the core activities to organisations, but has recognised some individuals when that seemed accurate. As Andersson (2000, p.348) noted, "Things started to happen with the speed of lightning when the new Vice Chancellor took office."

Figure 1 illustrates the overall development process, divided into four time periods over 17 years. This division results from the observation of distinct new phases in the development process, which includes new consortiums consisting of collaborations amongst different actors establishing spaces for consensus building, knowledge creation, and innovation activities.

6.2 Critical Mass Alliance

Leadership was crucial to the success of the Norrköping project. In order to acquire knowledge-generating assets in the region a single individual, the municipal commissioner, initiated the strategy and was willing to take the economic and political risks. Institutional entrepreneurs need to have legitimacy from various constituencies and be willing to put their own legitimacy at risk because they use their own personal values and identities as symbols of the change process (Maguire et al., 2004; Wade-Benzoni et al., 2002). In order to realise the new strategy the commissioner formed an alliance with LiU, making the initiative more credible. This process exemplifies the requirements for institutional change, which are strategic alliances and access to experts (Boxenbaum & Battilana, 2005; Hwang & Powell, 2005; DiMaggio, 1988).

These principles apparently trickled down to the middle level of decision makers participating in the implementation of the university's expansion, partly because the renewal of the economic model's objectives coincided with the university's need for research activities and also because the upper-level decision makers were continuously close to the implementation process. As the Municipal Commissioner told one of this paper's authors:

> "What Norrköping did differently was to work together with the established LiU instead of building up a college from scratch. To be part of an established university is a great advantage in times of lower application rates and gave Norrköping the advantage of having a research university" (translated from Swedish).

It is evident that the cooperation between the two municipalities in the region led to many benefits, such as being able to share resources and having increased resources and faster operations. The cooperation also led to departments in both cities reaching critical mass instead of competing for resources. The entire region based its governing set of principles on the vision of establishing a new economic model for the municipality (Cooke & Leydesdorff, 2006). Norrköping was also able to tap into the capabilities of Linköping's innovation space, as Sweden's rightist coalition government had established seven foundations, called Technology Bridge Foundations, from 1991 through 1994 to build up early-stage capital and business development capacity in the regions around Sweden's seven major universities.

A critical mass of academic and governmental research in emerging areas of science and technology has been the basis for successful science cities. A local Dutch development initiative was extended into a regional cross-border collaboration, called the ELAT-Eindhoven, Leuven, and Aachen Triangle, to be able to achieve critical mass in research and development activities in proximity to the local initiative. This implies that collaboration might increase the benefits of knowledge spaces due to helping to achieve critical mass and synergetic effects (Brainport Eindhoven 2013, 2006).

6.3 Role Casting

The mid-1990s saw the first effects of Norrköping's institutional entrepreneurship, the strategic alliance between the two neighbouring towns, the experts being LiU's leadership. It also became clear that the driving actor had to show diverse social skills because of having to act in such different institutional contexts as national politics, the university, and local industry, and the municipal commissioner, the university vice-chancellor, and the Campus Council's chairman did need to mobilise diverse social skills in order to manage the institutional contexts they encountered (Perkmann & Spicer, 2007; Sundin & Tillmar, 2008).

Other explanatory factors for the project's success were opportunity recognition and the timing of the municipal effort, both of which Shane (2004) considered to be essential for entrepreneurs. Furthermore, in accordance with entrepreneurship theory it was the organisation owning the problem, the municipality, who searched for a solution and started the change process (von Hippel, 2005; Shane, 2000). This was identical to the change process in Malmö, which also had an

institutional entrepreneur from the municipality who had the openness to build alliances (Roijer, 2009).

The project's institutional entrepreneurs changed over time in a sort of baton-passing relay. However, the initiator and maintainer were the municipal commissioner and the university's leadership, who brought with them years of experience and established routines.

6.4 Collaboration by Do-It-Yourself

In the third time period of the late 1990s the differences in the contributions that depended on the backgrounds of the actors became evident when the Campus Council embedded local actors in the process of establishing a knowledge-based region. These actors acquired an understanding of the project's vision and problems. In several cases the embedded local actors found solutions to problems through their unique competencies and understandings of local practice. The Campus Council provided a consensus space that enabled the different actors to engage with the vision and use their abilities to change institutions.

The case of Malmö, developed in parallel to Norrköping's, confirmed the importance of consensus space and coordinated strategy and revealed that regional vision, strategy, and organisation affect the outcome. Norrköping's project emphasised the importance of a research orientation, especially in technological fields, early. In Malmö the university college established was part of a grand vision of a spatial redevelopment project that would open the town towards the sea whilst also increasing its knowledge levels (Roijer, 2009).

During the implementation phase it was obvious that mobilising such key embedded actors as local banks and real-estate owners opened up new paths for the strategy's realisation (Lawrence et al., 2002). These actors drew upon their unique experiences, knowledge, and information in regard to the local situation. Once they understood the strategy and the different requirements they found new opportunities and acted as institutional entrepreneurs through such activities as setting up a research fund. The Campus Council became a space for consensus building in which the key actors found a platform from which to work. The Chairman of the Campus Council (2009, n.p.) acknowledged that "the involvement of external people, who already have great credibility in the region, has been of utmost importance for the integration of LiU in Norrköping" (translated from Swedish).

Industry is a broad term involving such different types of actors as entrepreneurs, industrialists, and CEOs, and these actors generally act either from a sense of duty as citizens, from a desire to realise possible benefits for their businesses, or both. Furthermore, we found that in Norrköping municipality-based manufacturers, local banks, local real-estate firms, local entrepreneurs, and local foundations contributed the most, as Etzkowitz (2002) found to be the case in New England. What these have in common is that a general economic boost to Norrköping would be likely to benefit them in the end. Another benefit has been the local prestige of working for the university, which only local citizens can enjoy.

6.5 Bandwagon Effects

During the period of 2000 through 2008 we observed the entrance of such actors inhabiting the innovation space as the research institute, renewed science park, and business incubator. The entrance of these actors also attracted early-stage financiers and financial resources from VINNOVA. The established knowledge space attracted innovation-space actors, but the municipality's activities also led toward the integration of the knowledge space with the innovation space, with the objective of producing benefits for the local society.

Although the municipality and the university were still involved in the embryonic bottom-up processes of commercial entrepreneurship and innovation, these began to occur also via the science park, the research institute, the business incubator, the business-plan competition, university researchers, and entrepreneurs, all of whom have become core actors. Such companies as Facebook and Skype that started originally in Boston and Europe migrated to Silicon Valley for strategic reasons, and this behaviour is even more common for the attraction of human capital. These bandwagon effects, characteristic of knowledge-based regions, have begun to be noticed in Norrköping but have not yet realised their economic potential.

This case study supports Etzkowitz and Klofsten's (2005) finding that decision making in knowledge-based regional-development phenomena occurs at a high level during inception and then shifts to lower levels during the implementation stage. It is important to note that this case has yet to undergo all four stages of this particular cycle.

6.6 Collaborative Entrepreneurship

Knowledge-based regional development is a complex phenomenon similar to businesses' entrepreneurial processes. Entrepreneurship consists of the discovery and exploitation of opportunities, and this has clearly been an important factor in Norrköping's regional redevelopment (Shane, 2004). Johannisson (1998) found entrepreneurship to be a result of joint efforts between individuals with complementary skills. This is a vital consideration both when studying and promoting institutional entrepreneurship.

Dialogue and combined research benefit the research streams of both institutional and individual entrepreneurship (Leca et al., 2008). Having a significant level of information about a certain solution capability, its applications, its needs, or a combination of these in a market segment is the prime driver for opportunity recognition (Shane, 2000).

Insert Figure 1 about here

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7. Conclusion and Policy Implications

This study's special contribution has been to show the importance of creating a consensus space in which collaborations among the actors to develop plans and gain access to resources is crucial as the basis for renewal. We focused on a regional redevelopment initiative that started the process of transforming Norrköping, a small city in economic decline, into one with an enhanced knowledge base, building upon but less dependent on such traditional industries as pulp and paper and the manufacturing of electronic components. Through the combined efforts of actors representing its university, public sector bodies, and industries, in strategic alliances and working committees, it was able to allocate such new resources for creating economic activities as seed financing for innovative projects, research-oriented organisations for promoting the commercialisation of R&D, and networks for facilitating knowledge transfers between its university and industry.

To achieve regional redevelopment, regions without a knowledge base need to move one step back and take initiatives to fill the gap and create that base. A process of going through stages of academic development, starting with a teaching university, and launching firms based on existing knowledge, such as Stanford, California did in the late nineteenth century, and then creating a new research base and start-up firms

based on advanced knowledge may conceivably be undertaken simultaneously or even in reverse order (Etzkowitz, 2008; Ylinenpää, 2009).

Devising a redevelopment strategy centred on a university and an associated institute was the key to realising Norrköping's potential. During the 15-year-period up to the start to 2009, Norrköping's knowledge, innovation, and consensus spaces developed and affected each other. The municipality leadership's institutional entrepreneurship created the embryo of the consensus space when starting the developmental process, which transformed after the securing of the first knowledge assets in 1997 into the consensus space, which maintained the same characteristics throughout. By approximately 1999 the knowledge assets had begun to attract more knowledge assets and the actors within the consensus space had begun to assist in the mobilising of resources. The innovation space then began to emerge out of the possibilities in the knowledge space's assets. The "Norrköping Way" exemplifies the non-linear character of the triple helix spaces model, with a knowledge space inserted into a "brownfield" region as spur to hybridization rather than as a source of de-novo start-ups as in a "greenfield" locale. Thus, the same structure may serve a different function, depending upon context, in innovation strategy as well as societal development, more generally.

Norrköping lacked entrepreneurship education and a top-down firm-formation strategy, however. Both Norrköping and Linköping are the sites of such actors as the science park and campuses of the regional university, but most of the competence in these institutions is dedicated to objectives other than generating start-ups. This is obvious in the case of printed technology, for which several of the organisations in the knowledge and innovation space assigned a low priority in regard to entrepreneurship. The promotion of firm formation might be even more important in an institutional setting such as Sweden's, where national policies tend to be risk-averse, resulting in a low level of entrepreneurship. Also, in the cases of both Linköping and Lund, the first science-parks in Sweden, it has been the start-ups that have created most of the economic success, and firm formation strategies have been the essence of the MIT and Silicon Valley successes. Firm transformation is a more difficult and unusual strategy with relatively few success cases, like Nokia. It may be expected that in Norrköping that there will be a gap between the old paper firms and the emergence of new media technology firms, linked through the intermediary variables of triple helix innovation strategy, continuity of technological culture and financial capital

retained from the previous era.

Etzkowitz and Klofsten (2005) found that knowledge-based regional development could be divided into temporal stages. This study contributes theoretically to an increased understanding of the underlying processes of the incipient and implementation stages involving the establishment of a new economic base for a region, and has consequently found a different level of decision-making at each stage of development. The entire process has been characterised by collaboration resulting from consensus building based upon the actors' long-term commitment. This collaboration has included such multifaceted activities as knowledge sharing, fundraising, resource allocation, the recruitment of key individuals, and the attracting of complementary organisations.

Norrköping's experience is therefore an example of a relatively small urban area putting itself on the road to revival through a series of well-made choices. Had any one of them gone another way, such as deciding to go it alone rather than to cooperate with Linköping or to continue to rely on the national government for resources rather than to take steps to generate them locally, the project might have been stillborn. A complementary study of a city region whose choices were less perspicacious would therefore be helpful for understanding the factors affecting renewal better. Whilst successful renewal has many roots, publicity campaigns typically suppress or cover up failures by claiming success in the face of stasis, so such studies are likely to be much more difficult, but even more necessary, to conduct.

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Appendix

Table 1. Formal interviews for the study.

Position	Organisation	No. of interviews
Cluster coach	Norrköping Science Park	3
Director of industrial strategy	Municipality	2
Commissioner	Municipality	1
Former director	Municipality	1
Head	Norrköping Science Park	1
Head of R&D	Incumbent Industry	1
Founder	Technology start-up	1
Customer	Purchasing director	2
Chairman	Campus Council	2
Secretary	Campus Council	1
Managing director	Research Institute	2
Professor	Department of Science and Technology	1
Project manager	Research Institute	3
Project manager	Research Institute	3

Table 2. Archival records and documents.

Major archival sources	Organisation
Meeting protocols 1997-2004	Campus Council
Meeting protocols	Development foundation
Presentations	Research institute
Annual reports 1997-2008	Regional university
Internal documents	Cluster initiative
Applications for cluster initiative	National agency - VINNOVA
Evaluation of cluster initiative	National agency - VINNOVA
Statistics	Norrköping Municipality
Homepages	All involved actors

Table 3. Norrköping in brief

- Norrköping increased its population with 8,295 (6,9%) between 1970 and 2009. However, the main change in population has occurred since 1997, where the population increased with 6,205 (5%). In addition, Norrköping was the 2nd most populated city in Sweden in the late 19th century, and then fell to the 10th largest city in the 1980s and is currently the 8th on that ranking.
- Norrköping campus has approximately 500 in staff and 5,000 students.
- The number of high school students from Norrköping continuing to higher education has risen from the beginning of 1990s to 2008. From 70% compared to the Swedish average to the Swedish average.
- The innovation support system: Several organizations and resources have accompanied the university, or developed by the municipality and the university. E.g. the science park, the Linköping-Norrköping incubator, a regional early-stage venture capital fund, a research institute.
- Approximately 50 new spin-off firms have been started with background in the university as well other knowledge intensive organisations in Norrköping.

Figure 1. The renewal process of Norrköping.

Time-period	Main actor or actors involved	Core activities	Outcome of activity
Beginning of the 1990s	Norrköping Municipality Board (decision-making at a high level)	Responding to an economic recession, changing the redevelopment strategy	A new strategic document that opened up the municipality's renewal
Mid-1990s	Loosely coupled working groups representing the Norrköping municipality, regional university, national government, and local industry (decision-making at a high level)	Writing a strategic plan for a new campus, creating alliances and consensus with all triple helix actors, benefiting from the established regional university	Realising the strategic document and attracting the necessary resources
Late-1990s	Campus Council of people from the regional university, Norrköping municipality, and local industry (decision-making at a middle level)	Starting up the new campus within the regional university organisation, mobilising knowledge and resources to facilitate research activities	A profiled campus within the regional university that is anchored in the local community
2000-2008	Campus Council and such intermediaries as the science park, business incubator, and research institute (decision-making at middle and low levels)	Stimulating innovation and entrepreneurship through facilitating the commercialisation of academic research	High-level applied research, emergence of business opportunities, financing new ideas and cluster-initiatives