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Economic institutionalization in practice: Development and the "third role" of universities*

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Normative prescriptions for the Third Role of universities assume specific agency and goal orientation. However, this process of institutionalisation is not context-free. To understand what determines if the university behaves as an economic institution, we ask what persuades it to (a) collaborate with industry and (b) engage with regional development. We develop a conceptual framework for "*task-oriented" institutionalisation* and the role of *individual versus institutional action.* We do this by analysing the local universities in the biotechnology concentration in Turku, Finland and find that resource constraints rather than a consistent strategy have driven universities' to collaborate with industry. Implications for institutional theory and economic policy are discussed.

Keywords: Universities, Innovation, Industry, Technology policy, Economic development, Finland

JEL: I20, R11, O38, L65

INTRODUCTION

Universities are certainly social, cultural and political institutions, but are they economic development institutions? The "Third Role" being discussed in Europe, indeed worldwide, refers to pressures on universities to take on (regional) economic development mandates in addition to their existing roles in education and research. This has also been the case in Finland, where the third role of universities has been given increasing attention in both Higher Education and Science & Technology policies. From a regional perspective, universities appear to be increasingly viewed as an economic asset especially because unlike firms, they are relatively permanent institutions and therefore safer for development policy measures.

In general, university-industry interactions seem to have been subsumed into broader analytical as well as normative policy debates for both technological innovation as well as the local and regional development (for example, GIBBONS *et al.,* 1994; ETZKOWITZ and LEYDERSDORFF, 2000; HARLOE and PERRY, 2004; CHATTERTON & GODDARD, 2001). History shows that the role of the university has been contested by State and citizens alike. It faces numerous tensions - education, research, training, technology transfer or assisting in broader economic development. While there has been an external pressure for universities to take a more active role in terms of the society and economy, most studies do not enquire into *how and why* universities begin the process of engagement or respond to these measures. Most studies have focused on technology transfer dynamics from university to firm without asking *why* universities choose to interact in the first place, which could affect the dynamics of transfer significantly. In this we attempt to answer (a) what persuades universities and industry to work together (b) what persuades universities to become involved with a regional development mandate to flesh out the idea of *'task-oriented' institutionalisation*. Normatively, universities perhaps 'should' interact with firms, but why, when and how do they? Who begins the interaction or is this a proverbial chicken-and-egg problem in institutionally 'underdeveloped' regions, with reluctance on both sides? These questions are important for many reasons. Even if relatively successful interactions take place between university and industry, it is often unclear whether the university might have strategic intent in shaping the interaction, whether universities could do more to fulfil a 'third role' of regional development and whether and how public policy has influenced it. The issues of intent and autonomy take on particular significance when State influence still holds sway in science and technology policy, especially when attempting to make publicly available all outputs of publicly funded research. Asking these questions allows an investigation of the normative elements of institutional development contrasted with real-world processes.

We take as a starting point that engagement of universities in the economy is the archetype of a process of institutional change and these emergent institutions arising from complex processes. As such, their compatibility with local economic needs (the Third Role) is a negotiated process, not necessarily having (or even being able to have) foresight and predictability (SOTARAUTA and SRINIVAS 2006). While some economic institutional frameworks view institutions as rules of the game structuring incentives for human exchange and economic performance (NORTH, 1990), we question the very origins of strategy and goal orientation as responses to these 'rules'. While institutions reflect continuity and change in society, they are affected by individual actors (SCOTT, 2001). Yet, the timescale on which institutional change occurs is much longer relative to individuals as units of analysis (e.g. HODGSON, 1988).

A particular challenge is that goal-orientation at institutional-level is difficult to understand without some insight into individual goals and actions, i.e. a discussion of holism and individualism (see, for example, RUTHERFORD, 1994). While both "old" and "new" economic institutionalists vary in their respective schools of thought on the extent to which individual action plays a role in social change, AGASSI (1960, 1975) may come closest to describing a middle path in how individual action while shaping institutions, is itself circumscribed by institutional factors. Agassi's contribution is "that it highlights the impossibility of endogenizing all institutions within a theory that takes as given only the physical environment and the psychological states of individuals. In any theory that attempts to explain the development or change of some institution(s), some other institution(s) will have to be taken as exogenous…(..)". (RUTHERFORD, 1994). Thus, a normative or rational actor, goal-oriented explanation of university engagement, however desirable as an *outcome*, appears to be insufficient an explanation of *processes* on the ground, but the two types of analysis can nevertheless be linked in an analytical discourse as we show (TOOLE, 1979).

To develop insights into institutional change such as university engagement in regional development and collaboration with firms, and individuals' influence and the timescales of change, we suggest that theorizing about such institutions cannot be complete unless it can draw upon systematic inductive studies of economic institutionalization as occurs in practice. Turku's story of how the universities became (to the degree they are now) institutions for economic development, thus can be seen as a way to disentangle the institutional and individual strands to the story as firms and the universities interacted over time.

We use the case study method, studying the development of a biotechnology concentration in Turku, Finland. Turku is the third city-region in Finland and is the country's oldest city dating back to the 13th century and the capital until the 18th century. It is a major port with an illustrious history in academia, culture and government. Today, Turku is the second biggest concentration of biotechnology activities in Finland after Helsinki. According to ISPE (2003), Turku is one of the three centres in the Nordic countries to have above-average levels of biotechnology research and commercialisation in Europe.

While some recent studies on Turku have mentioned the role of the university (e.g. HÖYSSÄ *et al.,* 2003, BRUUN, 2002, ORAVA *et al.,* 2001, SCHIENSTOCK and TULKKI, 2001) we hope to provide a theoretical framework to Turku's development (and dilemmas) by explaining the precise circumstances of economic institutionalisation of the Third Role. The end points appear to receive more attention than those critical processes in between. The paper is divided in four parts. In the next section we describe regional biotechnology concentration in Turku and its dominant actors. Section three examines the history of collaboration between private firms and the university in Turku detailing the specific chronology of institutionalisation. Finally, we return to the concept of 'task-oriented' institutionalisation and the "Third Role" approach to policy and planning, raising both theoretical and practical issues

THE CASE STUDY ON THE BIOTECHNOLOGY CONCENTRATION IN TURKU

The research focused in particular on the role of two specific universities and their involvement in the creation of "BioTurku", the city's high-tech concentration. The primary data consisted of detailed interviews and analysis of industry statistics and policy documents, in addition to previous studies about the development of industrial activities in Turku. A total of 36 detailed structured, open-ended interviews were conducted over an intermittent 6 month period in2002, with academics (scientists), policy makers at various levels, CEOs or R&D heads of companies and actors working in intermediary organisations. For reasons of confidentiality agreed to in the Local Innovation Systems (LIS) project, we use anonymous quotes here.

Today, there are approximately 60 companies related to biotechnology activities in Turku and around 3,000 jobs in the biotechnology related companies (2004 statistics).The most important branches were diagnostics (23% of the companies), biopharmaceuticals (18%), biomaterials (7%) and functional foods (7%). The rest (45%) consisted of different services (TURKU BIOTECHNOLOGY STRATEGY, 2004). A notable part of innovations in the smaller biotechnology companies are based on university discoveries and even the bigger companies are actively collaborating with local university research groups.Finland's first university was established in Turku in 1640. It was moved to Helsinki in 1827 and became Helsinki University, the only one in Finland at the time. A less than century later, in 1920, Turku got a new university. Today, there are two major universities in the city, the University of Turku (UTU) with 17,300 students and Åbo Akademi (ÅA) with 7,000 students. Turku University today graduates 1,069 Master's degree students a year and it also serves 117 Doctorates a year (2003) and offers a vast spectrum of departmental subjects. UTU has several areas of excellence with world-class research in biochemistry and molecular biology, including immunology and receptor biology (BIOTECHNOLOGY IN FINLAND, 2002).

Åbo Akademi (ÅA) predates UTU by 2 years and is a major university for the Swedish speaking minority in Finland. ÅA has a unique position in hosting the only engineering department in the Turku region, with the areas Chemical Engineering and Computer Engineering. Together these two universities form a substantial research community with an estimated size of 120 professors, around 50 different research groups and 600 researchers related to biotechnology activities with around 80 PhDs graduating every year (TURKU BIOTECHNOLOGY STRATEGY, 2004).

Overall, the level of scientific research in Turku's universities has been high with many research groups near the top of the world in their related fields. The combination of skills in engineering and chemistry within ÅA and the biological ones in UTU have allowed expertise across fields of basic investigations relevant to medical therapeutics, diagnostics and biomedical devices. In addition, ÅA's specialties in chemistry and biochemistry and food chemistry in UTU have obvious implications for the food industry. In addition, for research in biotechnology and informatics, close collaboration and university support goes towards individual institutions such as the Turku Centre for Biotechnology, the Computing Centre, the national PET-Centre and the Turku Centre for Computer Science. Importantly for the pharmaceutical industry, the University hospital continues to build up a formidable force in basic research as well as clinical study and testing services. It also provides an important source along with the medical faculty of the university, of validation of early drug target research in the private sector.

With this long academic and historical tradition, it is perhaps unsurprising, therefore, that in contrast to other Finnish cities, a long tradition existed within Turku's universities to emerge as national as opposed to purely regional-level institutions. For example, the Tampere University of Technology was designed to be "a university for industry" from its inception in

the 1960s and had a very strong regional focus. The same was true of many smaller universities in Finland that were established on regional policy grounds.

THE CHICKEN AND EGG PROBLEM: WHO BEGAN THE PROCESS OF INTERACTION?

Understanding how and when the university has come closer to industry today requires a closer look at the organisational and institutional landscape of the city in earlier times. We argue that there is no neat, normative answer to which agents built this concentration. It has arisen through a complex process of economic institutionalisation and with no clear strategy or goal orientation at the outset by policy makers or academics, universities or firms. Instead, we highlight the intertwined nature of 6 separate strands of institutional growth, selection and linkages, most of which were accompanied by resource constraints and pressures to collaborate

(a) older companies and their university-oriented push

(b) recession and crisis

(c) the state-driven model

(d) the rise of regional development initiatives

(e) individual mobilisation

(f) the reappearance of universities with a muffled regional mandate.

While the six strands capture the institutional process, there has been a process of economic selection ongoing as well. We argue that in Turku, selection on university response and firm capabilities has acted in three major ways: (a) through national economic recession affecting all Finnish cities, it has limited Turku's choices, further complicated by Finland's EU accession in 1994 and its impact on the pharmaceutical sector (b) through global mergers and acquisitions specific to the pharmaceutical industry, which has created significant

concentration in Turku, and (c) through international changes to the science of biotechnology which has shaped local paths of firms and university departments. Thus, for Turku, there were dominant pressures to form new coalitions and new collaborations spurred more by external economic forces than internal political ones. Thus, the process of institutionalisation of a new university role (the Third Role) has emerged for a different set of reasons than that which is normatively discussed. The transition to such institutionalization can be seen in terms of shifts in selection environments, each further pushing the universities to seek local alliances and resources. Turku is thus less "new" in terms of its emergence and more intentional through the creation of a "new" identity (see also SRINIVAS and VILJAMAA, 2003 and SOTARAUTA and SRINIVAS, 2006).

Older companies and their university oriented push

Aside from the universities, there is an established pharmaceutical industry base in the region. There are two large pharmaceutical companies present, Schering and Orion, both of which do R&D in Turku. There are also a few smaller drug discovery companies today like BioTie Therapies, Hormos Medical and Juvantia Pharma. Most of the smaller companies have appeared during the last ten years and the number of companies has increased rapidly. There are also several companies working in the field of diagnostics. The most notable is PerkinElmer-Wallac that produces measuring devices, software and reagents for the research and development of drugs and diagnostic systems. Many of the smaller diagnostic companies are either spin-offs from Wallac or related to it in some ways e.g. Arctic Diagnostics, whose founder was a long-time R&D manager in Wallac. There are also some small companies that are spin-offs from the university.

Turku's mid sized companies such as Leiras, Farmos and Wallac, established the tradition of co-operation to some university groups and departments during the time when it was not that

common in Finland. They also had a need for a steady supply of professional employees. It would be misleading to say that these companies were the sole drivers to create a biotech base in Turku, but it is evident that they were far more directly involved as organisations than the university as a whole. For them, the link to universities functioned well and served company purposes. PE-Wallac, in particular, seems to have institutionalised many of its interactions with university researchers, and this culture seems to have been copied or at least supported, by researchers within other companies. While the larger, older companies had some obvious gains by coming to the university, they have themselves contributed to the development of the university research and that of smaller firms and have thus been a valuable asset for the regional concentration to build on. The bigger companies (a) created specialised expertise in business and development activities now accumulated in the region, (b) contributed skilled labour: many key people in the smaller companies in Turku and even in the universities have worked in the bigger companies and (c) acted as a pool for new start-ups. Many ideas have been exported even by individual workers leaving the company but in some cases also by a dedicated spin-out strategy of the bigger company (d) acted as a minor source of special services.

In Turku there also seems to have been less resistance in the university to applied research and co-operation with companies and this was propelled by largely industry-initiated interactions. It is a widely shared view, that co-operation was already quite normal in Turku at a time when in universities elsewhere, and in the Ministry of Education (especially in the 1970s), co-operation with industry was viewed as not acceptable or actively harmful to the cause of the university. Stressing this dynamic linking of old pharmaceutical firms with the local universities, one respondent said,

"...key founders and key people in these pharmaceuticals whether on Board of Directors or in advisory capacities, have been professors. In the 1970s there was a

university backlash to make research "pure", but in Turku it never seemed to cut off the very significant ties to the three main companies. So in Turku there were hundreds of people in R&D, mainly in bio-sciences linking University with industry."

Even in Turku, despite patchiness in the relationship between university and industry, not all departments reacted the same way and some were less recalcitrant than others. For example, in food more than in medicine, there seems to have been less resistance overall to working with industry, since PhD students themselves in food chemistry are exposed to industry early on in apprenticing through their educational years. The oldest of the local expertise is in the food industry, where food processing (manufacturing) and food chemistry have worked closely together since early 70s.

If we had to pinpoint what the larger companies have contributed towards the local constellation of innovation, it has been as a source of people with ideas and past interactions with the university. While the interactions with academia may have been institutionalised to different degrees within the different companies, every company effectively passed on a tradition to the region for hiring in university researchers, or for having in-house corporate researchers with an open attitude to working with universities.

But these companies are unlikely to have forged such strong local identities over time without the impact of economic adversity. As described next, Turku developed somewhat luckily, as a base for Leiras (of the Schering-Plough group), and Farmos (later fused with Finnish pharmaceutical company Orion), both in drug development, while Wallac was acquired by PerkinElmer to become PE Wallac for the diagnostics industry. Thus, Turku went from a city with an early concentration of therapeutics and diagnostics to one explicitly driven by the dynamics of two multinationals and one large domestic company.

Recession and crisis: the national and regional development process

The background of the biotechnology industry in Turku and in Finland can be traced to the development of the domestic pharmaceutical industry, born in the late 19th century. The exercise of autonomy, the acts of strategy, and the coalition-building of many local actors (but not the university) needs to be understood against this backdrop of older capabilities and the impact of the late 20th century economic recession. What the data shows is that there was nothing "natural" about today's relationship between university and industry. As a city under considerable economic pressure Turku was forced to face up to an uncertain future. The first important turning point for the city occurred in the 1940s, when the first pharmaceutical companies Farmos and Leiras, started research and development bases in Turku. One of the companies had a founder from the region that was familiar with advances in research communities of the universities; another situated itself there primarily to exploit a relationship with the universities. In both cases, it appears that companies sought out the university and tapped local capabilities.

Table 1 below shows the chronology of the development pressures that Turku faced. The local landscape remained relatively uneventful until the 1970s heralded the advent of more global relations and increased trade with other countries. However, the same global relations also created instability. With the fall of the Soviet Union and the lucrative soviet markets, Finland and Turku, in particular, faced significant hardship and economic recession. The period from 1990 to 1999 proved to be decisive for Turku. Unemployment in the city rose from 4.2% in 1990 to 22.1% in 1994. The food processing industry alone lost 21% of its labour force. Despite its best efforts through combined public and private strategies, Turku unemployment in 1999 was still 17.4% compared with the Finnish average of 10.2% in the same year. However, Turku stood to gain by some unexpected outcomes of other global changes.

Table 1. Turning points for the Turku pharmaceutical industry (Source: SRINIVAS and VILJAMAA, 2003)

1889-1925	Start of Finnish pharma industry, Generics manufacturing, mass production
1940s	Farmos and Leiras start bases in Turku
1925-1980s	Companies mostly acquiring foreign licenses to sell domestically.
1970s	Move to greater trade. More R&D investments but greater generics sales to USSR
Late 1980s	Product patents adopted in many other countries. Anticipation of EU membership
1989-1994	Recession, loss of USSR generics markets, M&A in pharma in global pharmaceutical industry, joining EU, shift to EU product patent regime, Turku starts BioCity
1994-2002	EU entry, further focus on R&D, consolidation of drug development R&D projects in Turku firms, layoffs, biotech start-ups and spin-offs arise, Turku pushes to develop a nationally recognises biotech base.
2002-	Financial pressures and mergers in smaller companies, institutionalisation of Bio Turku

Significant global mergers and acquisitions in the pharmaceutical industry created a series of conditions wherein Turku was left with Finland's highest concentration of therapeutic and diagnostic firms and two new multinational companies, along with a residual sizeable, but vulnerable, food industry[1]. The pharmaceutical sector in particular lost large markets in the fall of the Soviet Union and then global mergers and acquisitions wrought major changes. Further global integration and the 1995 Finnish accession to the European Union, created both gains and setbacks for the rapidly shifting intellectual property regime facing homogenisation and the need to move into newer areas of R&D.

The role of cities in re-engineering their futures took on greater urgency as the State battled recession on multiple fronts. However, compared with other cities in Finland like Oulu and Tampere, Turku thus became active in proactive local economic development policy quite late. This was partly a consequence of the local industrial structure; Turku did not face

industrial crises as severe as those confronted by Tampere for example. But in the 1990's the national recession and fiercer global competition resulted in a slow decline in its economic base. Traditional industry sectors such as ship building, machinery and the food industry were slow or even stagnant in their growth compared with sectors directly built on information and communication technologies. In the absence of large ICT-sector, attention in Turku turned to emerging biotechnology cluster. Indeed, its lack of an ICT base allowed it to find a new identity in a "high-technology" arena by merging various sub-fields of R&D using biotechnology such as food, materials and pharmaceuticals.

The State-driven model: alive and well

The development of the biotechnology industry in Turku has, in many ways, been connected to changes in the national policy environment. Compared with some major biotechnology concentrations in the USA and the UK, the Finnish national policy push is highly integrated but remarkably state-visible (e.g. COOKE, 2002). There has even been a discussion of making biotechnology the 'fourth pillar' of the Finnish industry in the future (see SCHIENSTOCK and TULKKI, 2001) and as an indication of this strategy, biotechnology has been one of the key areas of public funding and institutional support during the past decade. Most of the financing for the universities and the companies come from public sources and there are several dedicated programs at the national level to support biotechnology. In 2001, the government funding for biotechnology research was €142 million and the biosciences cover roughly 40% in the national R&D budget. The biggest sources of funding were the Ministry of Education (36%), The National Technology Agency TEKES (28%) and the Academy of Finland (28%). Ministry of Social Affairs and Health and the Ministry of Trade and Industry also participated in funding (HERMANS and TAHVANAINEN, 2002). The national technology agency TEKES has invested some $90 million in biotechnology, which

accounts for 27% of the total investments. The Ministry Education, on the other hand, has set new Centres of Excellence (university units with extra competitive funding) to universities and in 2000, 9 of the 26 top units were in the field of Biotechnology.

Three national level public organisations, the Academy of Finland, TEKES and Sitra stand out. The Academy of Finland and TEKES are influential supporters of research and education. Sitra has been crucial in providing financing for the new start-ups in the absence of private venture capital companies and is still the most important source of venture capital for smaller biotech companies in Turku. There are also national programs like Centres of Expertise co-ordinating and focusing resources in key industries in many cities, one of which is in Turku. One of the key areas in the Turku Centre of Expertise programme 2000-2006 is related to biotechnology.

The strong role of the state is visible locally as well in the two main research universities, even if its influence on Åbo Akademi emerged later. Universities gain their funding from three primary sources: budget funding, earmarked funding, and competitive funding. The budget funding by the Ministry of Education for biotechnology research in 2001 was 3.94 M€ million for the University of Turku and 1.22 M€ for Åbo Akademi. In addition, the Ministry of Education and Academy of Finland provided 39 M€ of biotech funding to research, researcher posts, researcher training, Centres of Excellence and international activities in Finland in 2001. This money goes to a great extent to various biotech centres like BioCity Turku. Moreover, TEKES provides 22.6 M€ of competitive funding to Universities and Biocentres nationwide. (BIOTECHNOLOGY IN FINLAND, 2002). Table 2 below represents the division of the Academy of Finland and TEKES funding for Biotechnology in 2001.

Table 2. Academy of Finland and TEKES financing to biotechnology 2001 (Source: Biotechnology in Finland, 2002)

	Academy of Finland	*%*	*TEKES*	*%*
Turku	7804	20,1	9626	42,6
-BioCity Turku	*5879*	*15,1*	*5188*	*22,9*
-University of Turku	*1176*	*3,0*	*4094*	*18,1*
-Åbo Akademi	*749*	*1,9*	*344*	*1,5*
Helsinki	19642	50,6	8133	36,0
Other regions	11368	29,3	4852	21,5
Total (Universities and Biocentres)	38814	100,0	22611	100,0

Important tools for biotechnologies are the nationally-supported graduate schools, Centre of Excellence funding and the Academy professor posts. In 2001 there were for example 20 Graduate Schools nation-wide with 280 student positions schools in areas connected with cell and molecular biology and biotechnology in Finland. Seven of these schools were co-ordinated by the UTU or ÅA. Of twelve biotechnology related academy professors, two are working in Turku (in BioCity). In biotechnology, there are 18 different labs or departments that were granted a Centre of Excellence (CoE) status. Two of them are in BioCity (BIOTECHNOLOGY IN FINLAND, 2002).

Reacting to the Centre: the rise of regional development initiatives

The impact of the changes in the national science and technology policy has been very remarkable in Turku. The amount of public funding both for the universities and the companies has increased significantly especially during the 1990s.. However, this change cannot be seen only as a result of the changes in the national innovation policy but also partly a consequence of local initiatives, which have arisen gradually with involvement from the city council.

An external factor of considerable importance in the inspiration and evolution of Turku biotech seems to have been comparisons made by locals, and by national policy makers, of the differences of Turku with Helsinki. The delayed local introduction of State Research Centre (VTT) is a case in point. Turku remained quite invisible (compared with Helsinki for example) until the late 1980's. During that time (1987) the Ministry of Education launched a new research programme on biotechnology. In the first drafts were very Helsinki centred despite the fact that Turku was not much smaller in terms of biotechnology related activities. This 'injustice' raised local activity among the research community (BRUUN *et al.,* 2001). Some local researchers in both corporate and university circles seem to think it was a deliberate attempt by Helsinki and Oulu to keep the VTT centre away from Turku. This situation leading to local informal initiatives to increase the visibility of Turku in terms of biotech activities can be seen as one of the turning points in recognising the opportunities to develop a local concentration of biotechnology.

The first deliberate steps in recognising the new opportunities can be found from the mid-'80s when the first dedicated project for improving biotechnology research (the South-West Finland Biotechnology project) started. In addition to scientific results, this can be seen as the first time when biotechnology was introduced as potential growth area. Approximately at the same time (1986) a Foundation of New Technology (FNT) was established. This was an informal organisation, consisting of around 30 key people mainly from industry and academia and originally intended to discuss about plans to establish first technology park idea the Data-City (BRUUN *et al.,* 2001). This was the first bigger forum where key people could be brought in to the development process.

The technology centre that started to take shape in the late 1980s was the physical forum for building a cluster. Technology centre BioCity from 1989 onwards was the second stage of the local technology park concept. Earlier positive experiences in starting an ICT related activity

in the form of DataCity gave the actors more confidence for pursuing same kind of activities related to biotechnology. The universities saw that co-operation between them could work and the local decision makers were more aware of the new opportunities. The recession in Finland and in Turku in the early 90s activated more local actors and also the city government to look for new future industries to concentrate on. One interesting factor was the role played by real estate business, which was actively involved in developing the BioCity concept from the very beginning.

BioCity was not only a building for companies to operate but also a bigger concept. The idea was to provide links between industry and academia by gathering a critical mass of researchers in different fields along with technical resources and possible company partners (BRUUN *et al.,* 2001). This was accomplished by establishing new facilities, particularly laboratories that were jointly administrated by the University of Turku and Åbo Akademi. From the universities point of view, however, our data shows that this new kind of organisational innovation came not so much from a shared vision but from *lack of resources*, which made the administration look for new ways of co-operation. As a result of the cutbacks in public expenditures during the recession the universities faced a 16% decrease in budget funding in 1993- 1994. Even after that the increase in budget funding has been modest at most while at the same time more responsibilities have been assigned to the universities and the number of students has increased rapidly (NIEMINEN and KAUKONEN, 2001). At the same time, (1991-2001) external financing for the universities tripled from €200 million to €600 million. As interviewees noted:

> *"Some of these departments are very expensive, so they have linked up with the University of Turku for the Centre for Biotechnology by necessity"*

and

"Universities are part of the broad privatization push and in general keeping with changes in Europe, therefore must get outside funds."

Local authorities, alongside other actors, have also been active in supporting the national Centre of Expertise programme. Local actors have been active in using the opportunities provided by national science and technology and regional policies. One element that shouldn't be underestimated has also been the use of biotechnology as a spearhead branch in "city marketing".

Individuals versus institutions, or institutions driven by individuals?

While the initiative to link up with industry may not have existed formally within the university, it has existed strongly on the parts of individual researchers, who have been important players in galvanising academia, industry and policy makers alike, into recognising the importance of biotechnology for Turku. This is recognised even within the university system. As one university interviewee put it: *"The university was not the prime driver, but scientists were"* However, even with individuals in the university making a push to support biotechnology research and collaboration, the spectre of resource constraints does not disappear:

"A few people at university were interested, but more in their own self-interest to get research funding".

A fairly small but active network of individuals appears to have had a big effect not only on improving the competitiveness of new pharmaceutical companies but also on mobilising new policy activities to support the local cluster's development. For example, the diagnostics business and especially PE-Wallac were certainly important factors in this internal culture driving later industry-university links in Turku and were often driven by the initiative of motivated individuals within PE-Wallac. Individuals with histories in big pharmaceuticals as

well as other leading firms have pushed the boundaries of university links. These people have been as likely to be institutional drivers in the early years as have organisations.[2]

In the best instances of individual linkages, researchers and company executives know each other personally and there is "no need to reinvent the wheel", as one company interviewee said. For a long time, the mobilising of local resources and the attempts to influence national S&T policy have mainly been a result of an interaction between individuals working in both the industry and in the universities rather than a general strategy of the universities or the local government. For example the whole BioCity concept has originally started from this kind of a voluntary interaction. At the same time universities as organisations were lacking a conscious strategy concerning the development of biotechnology. A local policy maker summarised the views of many others in the profession: "*The university doesn't have any clear idea of what to do with biotech*". From a spatial standpoint as well, the universities seem to have been followers, not leaders. University-based individuals galvanised the initiative, but the institutionalisation of this initiative has been slow to occur. The city government of Turku was not the initiator in starting a technology park as was the case in many other Finnish cities. Instead, the main initiators for new initiatives were individual actors from academia and different business.

> *"It always starts with individuals, then somebody develops infrastructure etc. On the organisational agenda as well, biotechnology has been less visible. For example the universities have not been very active in pushing a dedicated strategy about how to develop biotechnology."*

Nevertheless, while informality of interaction initiated by some individuals has some obvious advantages, there has been concern expressed by a variety of interviewees that the local network of active individuals is too small and that too much of the burden is laid on few key individuals. As one company CEO said:

"At the early stage it is useful to network and later on becomes cumbersome and begins to be inefficient for many. There are too many competing interests on time for organizations. It may still be useful for the University, but for firms there is competition to prove results, so they are overworked and frustrated."

In this way the recently strengthened position of the City of Turku and new organisations like Bio Valley may help to further institutionalise the activities, which previously were more likely to have been sustained by individuals. Some interviewees did suggest however, that too much formality saps the inherent strengths of the interactions and places too much time-pressure on individuals with designated positions in the formal institutions.

The university (re)appears with a muffled regional mandate

In Turku, "older" biotech has merged with newer forms, and the strengths of the last 50 years still define current competencies and reputation. For instance, Åbo Akademi with its organic and inorganic chemistry expertise has allowed past expertise coming to bear fruit in a "newer", high-tech mode. These departments which had early-on established a reputation with industry by working on relatively mid-tech problems (by today's standards) with industry (such as in wood processing and pulp and fibre chemistry), now find themselves with new opportunities in a convergence of fields many of which have since gone "high-tech" in biomaterials, functional foods, diagnostics and therapeutics. Furthermore, a State-driven push through TEKES to initiate greater university-industry dialogues has resulted in more funds for resource-needy researchers to engage with industry, but resulting in a mixed picture in terms of outputs and institutionalisation of publicly-funded knowledge for regional development (SRINIVAS AND VILJAMAA, 2003; SRINIVAS *et al.,* forth.).

A further recent boost to industry has occurred in modern biotechnology with strong academic linkages to the US. When the molecular biology revolution occurred in the 1970s, many PhDs

and medical doctors from Turku did their postdoctoral research work in some of the best laboratories in the US. During they stay they witnessed firsthand the birth of commercialised biotechnology and the many pathways through which academics became involved in the business of medicinal biotech. A few lead researchers subsequently returned to Turku and became intricately involved in the setting up of both the Centre for Biotechnology, as well as a few promising start-ups and paved the way for a new approach to interacting with industry.

Today the landscape is considerably changed, with the universities linked to each other and to firms in a more explicit mandate for regional development. The Centre for Biotechnology (CBT) is a good example of this co-operation. It is a dedicated university research unit that was established in co-operation between both Universities. The Centre has three major functions: research, training and education and it provides technical expertise and coordinating services and equipment for academic and industrial projects. The Centre has also provided a forum for active interactions between academia and industry. In addition, a great deal of university research is conducted by organisations outside the universities, such as those under "BioCity Turku", an umbrella organisation for a research community that consists of over 50 research groups with over 500 people working mainly on cell and molecular biology and biotechnology (CBT sits in BioCity). The task given to BioCity Turku is to structure collaboration, resource sharing and infrastructure development in research and education in the area of life sciences.

Acknowledging the importance of spatial configurations, Turku Science Park is the hub of biotechnology innovation and is laid out in a small area abutting the city downtown area next to the campus areas of the two universities. The rabbit-warren architectural frame encompasses a dense setting of corporations, university laboratories, presence of public sector S&T, venture capital agencies as well as common restaurant and café facilities with low barriers between the industry and academia. The goal of the TSP, through organisations like

Turku Bio Valley, is to provide support for the entire innovation chain from invention to production through the "branded" concept, or shared vision of a "BioTurku", a new conceptualisation of a high-tech Turku region.

DISCUSSION: TASK-ORIENTED INSTITUTIONALISATION

We began the paper by asking (a) what persuades universities and industry to work together and (b) what persuades universities to become involved with a regional development mandate. Normative prescriptions for task orientation in economic development assume specific strategy and goal orientation. We find that universities' intent to collaborate in Turku has been driven mainly by resource constraints rather than a consistent strategy of local engagement. Fundamentally, Turku history shows that there were few obvious examples of university-initiated projects to work with industry that have not had as their basis a financial or technical resource constraint. It is true that the initiative to link up with industry has existed strongly on the parts of individual researchers, and in a small city like Turku, key individuals (despite the lack of strategic support from their own institution) have become important drivers in their own right for change. Nevertheless, the reality is that the universities were unlikely to be pioneers in venturing off-campus unless resources (financial or infrastructure) forced them to. The interaction has been primarily driven to varying degrees by large pharmaceutical and diagnostic companies in the past and by individuals within them. More recently this function has been taken over by start-ups and spin-offs generated by the consolidation of R&D within these companies. Moreover, the new active role as an economic actor slowly taken up by the university appears mainly a result of external influence by firms, national policy and local informal coalitions and not a result of conscious strategy by the university administration. This is an important finding that fundamentally challenges the way we normatively think of the universities' role, and when and how we anticipate 'task-oriented' institutionalisation to appear.

In the conception of institutional change of newer economic institutionalists, the individual has an important role to play, while this is downplayed although certainly not absent, in "old institutionalist" perspectives. Here, while institutional change to new economic roles has certainly been influenced by individual response and intention, the reality is that the university's overall response has been a process of collective sense-making of changed circumstances of successive selection within the city. From an emergence standpoint of complexity, as discussed in SOTARAUTA and SRINIVAS (2006), BOSCHMA (2004), CURZIO and FORTIS (2002), economic systems and organizations co-evolve with each other and with their environment. Certain identifiable points (times) exist at which a transition occurs. Emergence underscores the idea that global economic structure has significant elements of local interaction**s** and **t**hus actors both *create* their environment and *adapt* to it. Universities thus cannot be seen to be central agents driving change, but as institutions that have benefited and evolved from broader changes emerging in Turku, i.e. they have co-evolved with development, but have been structured by specific selection transitions (SOTARAUTA and SRINIVAS, 2006). The influence of individual**s** may be less important and their time-scales of action short. Thus emergence provides an insight for economic development compatible with old institutional economic viewpoints which takes this into account. This is a far cry from an entirely rationalist, strategic frame since individual actors cannot fully analyze their own environment and thus design optimal strategy. In keeping with Axelrod's framework, actors in Turku reconcile their strategies to successful ones of the past and by observing what others are doing. However, this is no endless repetition of strategies as actors are forced to reconcile their actions with a changed selection environment of the three types that Turku has witnessed, and thus give rise to new forms of institutionalization. Indeed the process of economic institutionalisation as phenomena, we argue, must arise through

inductive studies of the sort we have conducted where the normative debates of the "Third Role" are linked to the positivist tradition (TOOLE, 1979).

Thus, Turku's evolution may be less a case of posing individual action against holism, but to suggest that more collective sense-making and economic action (e.g. commercialisation of R&D, acknowledgement of university contributions to the region) has emerged over time. In effect, holism rather than absent before, may have become more visible as the processes of economic institutionalisation of the university has taken hold and captured the imaginations of citizens. This has occurred because of dramatic exogenous shifts in the economic environment and changes in the technological make-up of local biotech-related capabilities, which have shaped individuals' (particularly those in universities) interpretations of local resources, institutions and their own engagement in creating a different future.

A newer role for the university may be emerging, with smaller firms having been cut off from large internal corporate R&D, opening up new channels of communication with the universities. Biotechnology SMEs are also often specialised in R&D rather than production and distribution, and face serious financial and product deadlines, less space for leisure. These infuse their collaborations with universities with some urgency. If local universities cannot provide this vision and some strategy that is useful to local firms, then the latter are likely to look elsewhere for such alliances.

Turku's universities have come to this economic development process later than other institutions such as city government, and as such have moved from an identity of a diffuse economic institution to a broader set of "task-oriented" institutional processes including regional economic development. This in turn has changed how national policy-makers and other actors view economic development in Turku and its universities. Universities as Turku's local institutions have structured a new, *and still negotiated*, set of rules for economic interaction. The institutionalisation is not new in terms of capabilities, nor is it exclusively

'high-tech'. Cognitively and operationally, this has meant a new language by many university actors to describe the emergence of a "new" high-tech cluster arising from the ruins of the recession signifying a transition to new forms of economic engagement. Turku's identity as "newly innovative" has thus been the result of collective re-interpretation and taking stock of existing resources (SRINIVAS and VILJAMAA, 2003). This alone is a significant developmental change and an emerging local strength.

Overall, Turku is a prescient case for broader changes sweeping Europe advocating a "Third Role" for universities. It shares many characteristics of other small to mid-size technology-intensive urban centres. Yet, its capabilities have developed over a long period, and nurtured by a variety of actors. State-induced interactions between companies and universities have also had mixed success (SRINIVAS AND VILJAMAA, 2003; SRINIVAS *et al.,* forth.). The study shows that generic "Third Role" prescriptions for university-industry collaboration are unhelpful; the specific dynamics of institutionalisation and the origins of strategy and goal-orientation need to be understood on a case-by-case basis. There is much more to regional development than technology transfer between universities and firms, and regional development policies need to be further clarified to distinguish them from those for these general R&D interactions. Universities cannot be expected to participate in technological innovation on the one hand and yet automatically or painlessly deliver on a broader regional mandate. The time-scale for such institutionalisation is slow, and its origins need further study.

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NOTES

[1] In therapeutics, in the 1980s, Orion Corporation and Huhtamäki Ltd. aggressively bought out most other companies, including Leiras subsumed into the Huhtamäki Pharmaceuticals Company in 1986. A further consolidation took place with Farmos and Orion being merged in 1990, and separation in 1992, with Leiras emerging as a separate legal entity once again, but being subsequently acquired by the global company Schering. In diagnostics, the Finnish firm Wallac, with a long history research and university involvement in Turku, was acquired by US-based Perkin Elmer Inc.

[2] For instance, researchers like Professor Erkki Soini, formerly a long-time senior researcher in PE-Wallac, always kept links to university research, having come from there himself. During his 20-30 year tenure at PE Wallac, he actively coordinated with university departments because he had a vision of what joint research could accomplish, and believed this at a time when few others had such a vision. He then returned to the university as a full professor, having decided that he could pursue some types of research more effectively in the university, and began his own company. (From communication with Prof. Soini and with other interviewees.)

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