

WHO BUILDS “SCIENCE CITIES” AND “KNOWLEDGE PARKS”?

HIGH TECHNOLOGY FIRMS MOBILISING HETEROGENEOUS COMMERCIALISATION NETWORKS

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“Met grote ogen keek Anton over haar heen. De hagedissen... Was zoiets mogelijk? Kwam het door de hagedissen? Waren de hagedissen uiteindelijk schuldigen? ‘Je bedoelt’, zei hij, ‘zonder die hagedissen was het niet gebeurd?’ ”

Harry Mulisch, De Aanslag, 1982

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INTRODUCTION

The recent failure to deliver the Lisbon agenda has led to much soul-searching within Europe (*cf.* The Sapir Group, 2005). This failure has enlarged the gulf between the limited number of successful knowledge regions, and those regions for whom globalisation has brought further anxiety, job losses and economic restructuring. More recent Lisbon-inspired policies have therefore attempted to build linkages between successful ‘knowledge islands’ and other, outlying and peripheral places so all can exploit concentrations of European knowledge and innovativeness.

Öresund in Denmark & Sweden, the Eindhoven-Leuven-Aachen triangle in the Rhine-Maas Euregio, and the South Ostrobothnia virtual university all attempt to provide ‘less successful regions’ with access to resources for knowledge-based economic development (Maskell & Törnqvist, 1999; Sotarauta & Kosonen, 2004; Hospers, 2005). Alongside this there has been an increased emphasis on the physical development for the new knowledge economy, creating spaces for these high-technology developments, with science cities, knowledge parks and innovation centres springing up once more across Europe (Hospers, 2005).

This knowledge-based development model begins from the concept that global knowledge flows can be diverted from pools of success into such high-technology spaces in less successful regions. Previous waves of science parks failed to address the core/ periphery gap, booming in the totemic sites of the new economy, and becoming drab office developments elsewhere (Massey *et al.*, 1992). However, new theories of economic development emphasise connecting ‘global knowledge flows’ with local activities, creating a ‘local buzz’ which can stimulate new and innovative high-technology combinations that promote economic growth (Chapman *et al.*, 2004; Hospers, 2004; Bathelt & Boggs, 2005).

There is a need for local innovative capacity to absorb these global resources, and clearly, high-technology small firms (HTSFs) can provide a means to create this ‘local buzz’. In this paper, we consider the way that university spin-off companies

mobilise networks and communities which occupy this physical infrastructure, science parks, learning regions and knowledge cities, and capture and locate ‘global resources’ in these less successful places. Drawing on work undertaken in the old industrial regions of North East of England and Twente, the Netherlands, in this paper I highlight the diverse ways in which HTSFs can place such regions in the global knowledge economy. A dynamic model of community-building is elucidated, and used to reflect on the relationship between HTSFs and knowledge based growth to extend the debate concerning the value of inter-regional knowledge sharing for economic development.

GLOBAL PIPELINES, LOCAL BUZZ? A REVIEW OF THE LITERATURE

There is an increasing acknowledgement that knowledge is increasingly important to the production process. A series of macro-economic studies demonstrates that productivity growth has become increasingly dependent on investments in intangible forms of capital (i.e. not land, labour or machinery), and that ‘knowledge capital’ has increasing returns to scale (Romer, 1994; Solow, 1994; Temple, 1998). Increasing returns to scale suggests that knowledge capital investments will increasingly be concentrated in places with competitive advantages in knowledge production, and the rise of a limited number of mega-cities has been linked to this phenomenon (Smith, 2003).

Although the implicit regional consequences of the knowledge economy are increasing geographical differentiation and competition through innovation, there is some unease that straightforward knowledge capital narratives are unhelpful for understanding ‘ordinary places’ (Armstrong, 2001; Moulaert & Sekia, 2003). Moulaert & Nussbaum (2005) argue that knowledge capital encompasses resources without ‘economic value’, and that other types of capital – human, institutional and ecological can also promote territorial development.

Such capitals can help to bring new financial investment into those regions, which produce local benefits in what Bathelt *et al.* term “global pipelines, local buzz” It is not merely the investment which is important, but that the investment allows local actors have some control over its expenditure, and sufficient time is allowed for the benefits to diffuse regionally (Asheim & Herstad, 2005). Cooke & Piccaluga (2005) describe a “regional knowledge laboratory” as various actors bringing external investment into a region which creates unique assets that are of value to their external partners.

A problem for less successful regions is a lack of globally-connected actors able to bring in investments; in such regions, large firms tend to be disinvesting and downsizing. In this paper, we look focus on universities, important components of regional innovation systems, and much more uniformly distributed than either firms or government research laboratories. Drawing this knowledge laboratory concept, LFRs lack strong knowledge exploitation sectors which convert global academic prestige and research grants into premium products and export income. We consider two cases of universities which have attempted to produce their own knowledge exploitation sector by promoting university spin-out companies.

BACKGROUND TO THE STUDY AND METHODOLOGY

In this paper we present two case studies characterised by regionally engaged universities with regional development strategies attempting to exploit those

universities' capacities. In the North East of England, a partnership of Newcastle City Council, Newcastle University and the Regional Development Agency (RDA) have jointly purchased a central former brewery site for £30m (€45m) on which to develop a new science campus, "Science Central". In Twente, in the east of the Netherlands, the RDA, the University of Twente, its host municipality of Enschede, and a number of other regional bodies have announced support for a 120ha science park adjacent to the campus, *Kennispark*. In both cases, the national government has provided moral support without necessarily providing funding or compulsion for the schemes. In both cases, the schemes are currently under development.

In both cases, regional partnerships are attempting to promote university-based high technology growth at a scale not previously achieved. In both cases, a number of relatively small scale successes in university commercialisation have been achieved. These various elements have been combined discursively by regional political actors (including each university) to argue that success is possible on a far greater scale. In this paper, we trace these narratives, to explore whether the elements are likely to combine together at the expected scale. We begin with looking at the novel regional capacities produced by commercialisation, particularly in terms of regional networks of high-technology small firms which have mobilised around each university.

University of Newcastle, North East of England

The North East of England underwent industrialisation from the late 18th century, and has experienced a century of industrial decline in which it became dominated by mature mass production businesses with little indigenous entrepreneurship. Newcastle University was formally created in 1963 from King's College Durham itself formed in 1937 from a specialist marine engineering and agriculture college and schools of Medicine and Dentistry (Loebl, 2001). Agriculture, medicine and engineering were all applied subjects, and King's College reflected this disciplinary mix in its ethos as "a place of useful knowledge" (Potts, 1998). Despite a prevailing isolationist academic norm and successive UK governments discouraging university/regional engagement from the 1940s to the late 1970s, Newcastle-based academics maintained industrial contacts throughout this period (Potts, 1998).

After 1979, the new European Regional Development Fund 'non-quota' (i.e. community-wide) policies were based upon mobilising indigenous business assets for innovation. With few private or governmental R&D organisations active in the North East, the Department of Trade and Industry and local authorities demanded the universities become actively involved in regional engagement (Benneworth, 2002). This initiated a stream of activities as Newcastle University expanded its regional engagement, including a Micro-Electronics Applications Research Institute (MARI, 1983), an City Technology Centre (1984), a seed capital fund (NUVentures, 1987), a regional development office (1995) and finally, a Business Development Directorate (2003). By 2004, regional engagement had become central in two key institutional documents, the Business Plan and the Estates Masterplan.

University of Twente, the Netherlands.

The Twente region industrialised in textiles and supporting machinery after 1830, and after WWII entered a period of secular decline, which by the 1970s had become a crisis. The Technical Polytechnic of Twente (THT¹) was created in 1961 to increase technical graduate numbers, promote regional textiles renewal and support the Dutch transformation into an advanced manufacturing economy. However, as the 1970s

textiles crisis unfolded, the Government seriously debated closing THT and refocusing scarce public resources on more successful regions and industries (Groeneman, 1991).

Under the leadership of Harry van der Kroonenberg², the university reinvented itself, changing its name to the *University of Twente* (UT) and rebranding itself as “the entrepreneurial university” in 1985. In parallel, UT pioneered a series of institutional innovations, including a technology transfer office (1979), an incubator unit (1982), student entrepreneurship schemes³ (1985), knowledge circles (1990), regional venture funds (1996), an open innovation centre (1997) and a “technology accelerator” (2003). These resources made UT a central partner of the provincial government and regional development agency, who now seek to extend and generalise the last quarter century of high-technology growth.

Study Methodology

Each regional case study involved two elements, a review of regional information sources and a set of key respondent interviews. A wide range of documents were reviewed, including historical and contemporary reports about both universities and their regional contexts, along with contemporary policy documents and strategic plans from the university, regional partners and the national government⁴. 75 face-to-face interviews were undertaken in the two study regions, 32 in Newcastle and 43 in Twente⁵ undertaken through a snowball approach (*cf.* Yin, 1994)⁶. These interviews included 16 spin-offs in Newcastle and 24 firms in Twente, with the remainder a mix of university management, academic and commercialisation staff, and key regional stakeholders including regional development agencies, networking organisations and representatives organisations. The study took place within the framework of an ESRC project “Bringing Cambridge to Consett?”.

HIGH TECHNOLOGY SPIN-OFFS MOBILISING REGIONAL COMMUNITIES

It is widely acknowledged that high-technology entrepreneurship is heavily dependent on networks (e.g Groen & Jenniskens, 2003). It is unsurprising that spin-off company formation, a quintessentially high-technology form of entrepreneurship, involves assembling and drawing upon a range of networks proximate to the particular spin-off entrepreneur (Benneworth & Charles, 2005). However, *pace* Dahlstrand & Jakobsson (2003), in the two case studies, the spin-offs’ network activity did not decline after leaving the university. A number of university spin-off companies (USOs) contributed more to these networks post-formation than ante-formation. In this paper, I distinguish six regionally articulated networks. These networks involved universities, spin-offs and regional partners, and spanned between the university and the region.

1. Providing direct support for academics

The first networks were the connections the spin-offs provided back to the professors who formed the companies. In Newcastle, the dominant model of entrepreneurship meant that in many cases the professor was still actively involved with the spin-out. In Newcastle, a particular technology subsidy, worth around €100k allowed spin-offs to undertake novel research, and the instrument technicalities made it least risky for small companies to spend it with an academic collaborator; thus, spin-offs generated third-stream income for their professors, and those commercial problems dsid

stimulate innovative blue-skies research attractive to science funders⁷. In Twente, although a similar instrument has been introduced now in the Netherlands, at the time of the research it had not, and so the main discovered form of interaction was spin-offs as users of science projects. For a 10% contribution to a project, the firms were involved with a user committee; because STW grants are evaluated partly on their dissemination plans USO involvement helped win projects and bring funds to the university.

Other spin-off/ academic linkages existed; in both regions, spin-offs employed post-graduates and post-docs; in cases in both institutions, a post-doc moved to work for a USO but maintained an academic relationship with the professor. In one case, a spin-off found his professor a useful source of graduates; when the professor retired, he mobilised a community of employers who funded the university (c. €50k annually) to maintain this employee source. In some cases, students worked alongside spin-offs on student research projects; many USOs were exploiting inventions which emerged within such projects. One research group had a practice of contacting key firms (including 'their' USOs) when they found potentially commercialisable things peripheral to their main research; they described as "throwing [the ideas] over the fence" to them. There were also informal connections; in every single USO, there was some active link back to the university.

2. Mobilising soft networks

A second set of activities was where USOs helped to develop soft networks whose presence helped other spin-offs and high technology small firms to succeed. UT had a number of excellent examples of where USOs themselves had come together and mobilised; a number of companies interviewed had been involved with TIMP.

- TIMP was a group of HTSFs funded by a local development agency on collaborative innovation projects in medical technology (Klein Woolthuis, 1999). This organisation succeeded, and a number of other projects emerged including the sector being designated a strategic thematic area in the regional science council (the Innovation Platform).
- Twente Technology Circle was launched by UT itself to help its spin-offs sell to large regional companies, but evolved over the years into an networking and mentoring organisation, under a steering group at the time of the research comprised entirely of TOP companies and a university representative.
- Technology Exchange Cell: a virtual product development laboratory at the university, stimulated by a large regional firm but whose realisation and rapid prototype capacities were provided by spin-offs from the university.

By contrast, in the case of Newcastle, there were much fewer academic entrepreneurs who were involved in stimulating networking activities in the region. Although a biosciences network was established (Bio²NET) by someone who subsequently established a USO, the region seemed somewhat behind Twente in terms of establishing supportive networks. There were key *individuals* who provided access to one-off advice/ guidance, and the university began to systematically engage with these key advice providers. The Alchemists was an organisation created by three retiring business service professionals to try to stimulate entrepreneurs to grow through using professional advice more effectively. Newcastle University approached their chief executive to sit on their Equity Committee which oversaw the formal

technology transfer process for university IP being spun-out. Other key regional entrepreneurs with their own networks were recruited to sit on key university committees including the Advisory Board for the Business School and committees dealing with other aspects of regional engagement.

3. Stimulating financial resources

The third area set of networks where USOs in both regions were active was in stimulating the creation of regional venture funds. Both institutions in the early 1990s had invested in a few companies, and some of those investments had proven successful. On that basis of that experience, universities in both regions had engaged with regional development agencies to help them create regional venture funds to meet USOs' needs. Those funds' creation was in turn justified by those previous successes and ongoing university commitment to spin-off creation.

Newcastle University had created a specific fund in the early 1990s to invest in spin-off firms, but this had largely disappeared without significant impact (Potts, 1998). What was significant was that one pharmaceutical USO had granted the university a share; the company was sold in 2002, and the university received a £6m (€9m) 'windfall'. Immediately previously, the university had failed to invest in a computer security company which had been sold for \$14m (€12m) and so *failed* to receive a windfall. The university in 2002 produced 6 spin-out companies and at the time the RDA were creating a high-technology regional venture fund. Newcastle University used these various facts to persuade the RDA to create a special instrument, the proof of concept fund, which was tailored to the needs of USOs.

In Twente, by the mid 1990s, the TOP scheme had been functioning effectively for a decade, and demonstrated that the university could produce companies which would grow near to the university. The regional development agency, UT and the nearby Polytechnic together created and capitalised Innofonds, a regional venture capital fund. This raised €11m which was invested in two tranches in around 30 companies, and although it became caught up in the bubble economy and some investments failed, it was a reasonable success; when the RDA merged with a nearby organisation, they created a joint holding company with the apparent intention of raising more funds and investing in high-technology ventures in the east of the Netherlands.

4. Making commercialisation supportable

The fourth area where USOs built a community was in contributing to making commercialisation a core university function. Although both universities liked the idea of getting additional so-called third-stream funds, in both places there was ongoing resistance to spending core university funds on central activities such as technology transfer offices which supported those activities. USOs in both regions became an important part of persuading universities that commercialisation was worth investing seriously in. It was not just that they helped academics win more research funding or that academics were lured by the financial rewards from selling off successful businesses. USOs also became involved with the core missions themselves and showed that commercialisation could help both universities achieve their teaching and research missions.

One key example of this was that USOs became involved in larger infrastructure developments which supported core university research and levered in external funds. There were a number of examples of these large multi-million euro projects, which

won large subsidies partly on the basis of scientific excellence, and partly on the basis of expertise in commercialising that expertise. USOs were been involved in a variety of ways, but critically helped to demonstrate that UT and Newcastle were good at commercialisation. Both governments increasingly emphasised science commercialisation, so positioning both universities to win large grants, which have in turn funded core academic research facilities.

- International Centre for Life (ICfL): a life-sciences campus based on a £50m lottery award and a £10m science infrastructure fund award, integrating university genetics research (medical and sociological) with hospital genetics services, and commercial genetics companies including USOs.
- Institute for Nanotechnology Exploitation (INEX, Newcastle): originally a professor funded out of university funds to integrate existing research strands; won RDA start-up funding; then won a £7m DTI grant followed by another £10m of infrastructure funding for nanotechnology.
- MESA+ (Twente): nanotechnology was a field where the university had produced some early spin-offs; a joint academic/ commercial laboratory facility was developed for nanotechnology including consultancy activities (now spun-off); in first ten years of life, has produced 30 spin-offs and has own small development fund; co-ordinates the Nanoned Science Exploitation Programme (€50m).

5. Producing new growth sequences

A fifth area where the USOs contributed to new regional networks was a number of the entrepreneurs involved in USOs subsequently becoming serial entrepreneurs and founded other companies producing sequences of growth. In Twente, four of the interviewed entrepreneurs were involving in diversification through setting up network businesses and joint ventures within an overall holding company structure; there were around 250 jobs in this four company originating sequence. In Newcastle, the very successful pharmaceutical spin-off spawned three daughter companies on the basis of the cash produced from the sale of the company. One medical spin-off had set up a number of subsidiaries as a means of testing new markets whilst minimising risk. The design team of an engineering USO left and set up their own business, and they both grew to employ over 50 people by the time of the research. This suggests that the networks formed from USOs had a degree of vitality and dynamism, and were not just self-employed academics anchored around the university.

Perhaps more interesting is the role of USOs in helping traditional companies in mature sectors to reinvigorate themselves and become more engaged in high technology sectors. In both life sciences and nanotechnology, there were a number of North Eastern mature chemicals companies working with Newcastle USOs as part of successful attempts to move into new markets; one company spun off from its parent and now employs over 60 staff, and there are around 200 employed in science-intensive biotechnology jobs in formerly mature chemicals businesses. In Twente, there were a number of branch-plants in the region whose survival within the corporate structure was dependent on maintaining unique knowledges that other parts of the business could not copy. A number of those branch plants had working relationships with spin-offs as well as the university to try to sustain their unique corporate capacities (*cf.* Technology Exchange Cell).

6. Stimulating regional technology policies

The final area where spin-offs mobilised networks was around emerging regional science and technology policies. Benneworth & Charles (2005) identified that spin-offs have a role to play in working with regional science and innovation policy-makers, improving business support's quality and relevance. In both regions, RDAs were apparently sensitive to spin-offs' needs, creating new programmes such as the high-technology venture funds. However, there was some evidence that much of the needs sensitivity was passive i.e. RDAs looked at spin-outs and decided what 'they needed' rather than working interactively with them.

There were more interactive approaches; in Twente, the RDA Technostartners programme drew very heavily on the experiences and academic knowledge built up through the TOP programme. The TOP concept was diffused and extended into other contexts including a remote rural area and a college of middle professional education. In the North East, the RDA allowed the regional universities to administer their proof-of-concept fund, acknowledging that their commercialisation expertise was as effective as anything they could assemble.

There are some examples of how USOs did become directly involved with reconfiguring policy in support of spin-offs. In Twente, one USO entrepreneur was appointed to the Regional Innovation Platform, albeit as a successful entrepreneur rather than as a USO representative. One 1980s spin-off entrepreneur ran a state-funded seedcore fund to the south of Enschede. In the early 00s, the RDA encouraged micro-clusters of high technology businesses to come to them, funding several collaborative partnerships, many involving USOs in leading capacities.

There was less apparent involvement in the North East of Newcastle USOs shaping the regional environment. The national Industry ministry (DTI) became aware of a problem with tax rules which was to stop spin-outs for 18 months because a non-executive from a North Eastern USO (not from Newcastle) informed them of the problem. Although the North East did build a somewhat Byzantine regional science policy apparatus, the so-called "Strategy for Success", USOs were only ever peripheral to the structure.

TOWARDS A COMMUNITY BUILDING MODEL: USOS AND POPULATED SCIENCE PARK CONCEPTS

But how do these various contributions and communities come together to mobilise the idea that a 'science park' policy is of regional significance? This can be considered as a process of stabilisation over a long-term period:-

- high-technology spin-offs demonstrate that high-technology entrepreneurship can be made to work in a place,
- this shows universities have further potential which can be exploited, and
- the growth trajectory of USOs shows that a 'science park' arrangement is the appropriate way to manage knowledge exploitation.

This is the basis of the community building model: something experimental, small scale and indeterminate becomes common practise, large scale and precise. This makes external partners willing to support and invest in the 'science park' concept. It is possible to highlight four stages in this translation process, with at each stage, the

contributions made by USOs playing a role in the outcome, whether the next stage can be progressed to and what the impacts of those changes are.

Experiments in entrepreneurship

The first stage in the model is when the university begins with its experiments in entrepreneurship, and the first USOs emerge from the university. This may be as a consequence of the university launching a scheme such as the TOP programme, or announcing, as Newcastle University did around 1990, that entrepreneurship was something that professors should be doing and providing a service for interested academics. The key determinant in successfully progressing to the next stage is whether producing spin-offs appears to have unrealised potential which could further be exploited. The runaway success of TOP and external interest in Newcastle University's spin-offs both suggested that there were further capacities for action.

If the scheme is a failure in its own terms, then it is likely that the university will abandon the scheme once funding for the programme expires. However, there is also a scenario where the scheme might succeed in its own terms, creating businesses, jobs and other outputs, and yet fail to lead to progress to the next stage; in both institutions, when schemes failed to demonstrate a clear potential to link to core teaching and research missions, then such schemes were either periodically abandoned or became the preserve of isolated individuals with little institutional mandate to continue the projects. Facing such institutional apathy, it is hard for individual projects to survive.

However, if spin-offs are dramatically successful, then it is possible that they will offer the university an opportunity to produce core teaching and research benefits from them; both universities saw USOs had a potential to bring in external resources which could be invested in core scientific infrastructure. At that point, both universities became interested in finding more generic structures making spinning-off companies more institutionally rooted.

Institutionalising academic entrepreneurship

A common strategy for embedding spin-offs more firmly within each institution was creating specific hybrid institutes where spin-offs, research groups and other commercial partners could interact around a shared set of facilities. Such institutions allowed spin- to benefit from the presence of academic infrastructure, and academics to benefit from the presence of a commercial-quality infrastructure. Cost-sharing between academics and companies, for example, could be used to underwrite investment in large capital facilities which increased the scope of work potentially undertaken by particular research groups.

Building such facilities required demonstrating two key points, firstly that there were clear academic benefits in investing core resources in such facilities, and secondly, that there was a steady stream of spin-out companies emerging which would continue to lever in additional resources to support ongoing academic research programmes. Again, USOs' previous collaborations with university research groups and their demonstration that university spin-out activities were successful helped to justify the creation of 'hybrid institutions' such as MESA+, ICfL, the BTC and INEX.

Those hybrid institutes were not always successful. There were examples of 'institutes' in both institutions that did not succeed either in terms of their commercial mission or their academic mission, and obviously, such failures tended to be rapidly closed down or 'merged' into more successful organisations. Some institutes were

successful in terms of the commercial mission, but did not contribute to core academic missions; those activities tended to be spun-off or privatised, because of the difficulties that higher-level teaching and research institutions have managing other types of activity⁸.

Those hybrid institutes which have been successful were those which helped to win external funding for academics; this was often translational R&D type funds which could be spent on fairly basic research. The funds were often justified because each university had successfully ‘applied’ basic research, demonstrated by the spin-off companies⁹. Because both universities had been able to make the institute-type model work on at least two quite different occasions, both universities attempted to rebuild themselves organisationally to improve their capacity to produce a stream of these hybrid institutes, and hence lever in significant external funds which underpin their core academic missions.

Building an entrepreneurial culture

The next stage of the process was building an entrepreneurial culture within the university, in the sense of a set of capacities to develop a stream of hybrid institutes. This institutional change involved reorganising research groupings to be more ‘marketable’ to external partners, forcing academic structures to accept commercial income targets and making looking for hybrid institutes a key part of the central and faculty business planning process. Both universities drew on their capacities and knowledges built up in spinning off companies to achieve a cultural change. These capacities and knowledges were arguably still held within a community still involving the spin-offs. Although this appears to be an issue of institutional management, in both cases USOs were involved in helping with this institutional change. Spin-off entrepreneurs were involved in a variety of ways in the technicalities of university cultural change, advising universities, bringing them good commercial opportunities, and implementing new structures.

Both institutions had taken some time to reach this position; much of the pioneering work of Harry van der Kroonenberg at UT was not driven forward by subsequent Rectors, and at Newcastle, previous Vice Chancellors had built entrepreneurial capacity within their executive offices without trying to coerce other academics to become entrepreneurial. What appeared to make the difference in the latest phase was the scope and the terms on which the university engaged with an external community, including USO entrepreneurs.

On those occasions where cultural change had been attempted but had not taken root, entrepreneurs and universities had ‘spoken at’ each other; this latest phase of engagement involved the two parties entering into each others’ confidence and working together towards a common goal, becoming an entrepreneurial university. This goal was clearly only for the direct benefit of the university, and so finding entrepreneurs to become trusted university partners was a difficult issue. USOs were a good source of trusted university partners because of their variety of personal, social and commercial linkages back into the universities.

Reconfiguring regional partners

The final stage of the process was that regional partners acknowledged that each university was entrepreneurial, with considerable untapped potential for further commercial exploitation, and was sufficiently well-managed with experience and

capacity in the particular area. In Newcastle, the regional development agency had proposed and invested heavily in a number of science projects which could not effectively be stabilised into a regional innovation system. Thus, the RDA engaged enthusiastically with the university's own regional science concept, rebuilding the campus as a set of hybrid institutes (Science Central). In Twente, a number of regional partners adopted the *Kennispark* concept in 2003/4 and implicit endorsement of the concept through the national spatial economic strategy ('*Pieken*') effectively made an extension to the science park an obligatory point of passage for Twente's regional science council (the Innovation Platform).

In each case, regional partnerships were mobilised which agreed in principle to fund large scale strategic investment projects, *Kennispark* in Twente and Science Central in Newcastle, with tens of millions of euros. The partnership funding idea recognised the regional value of a university able to produce a series of hybrid institutes. The regional value of these hybrid institutes was in accelerating the numbers of spin-offs; spin-offs had regional economic value because of their visible direct and network contributions. USOs were important both symbolically as 'claimed successes' by the university, but also 'trusted partners' (including USO entrepreneurs) were important in helping RDAs to believe the high-technology fantasies underpinning the strategic projects.

TOWARDS A MODEL FOR COMMUNITY BUILDING

In figure A below, we graphically represent this process as a flow chart. At each stage, USOs provide capacities which the key mobilising actor, in this case the university, draw upon in order to draw to the next stage. If there are not suitable sufficient capacities, then progress is not possible, and the developments which have been achieved either collapse or wither; unsuccessful projects are abandoned, peripheral institutes are privatised, or commercialisation targets withdrawn. I argue that in the two study regions, what has happened is that three sets of barriers have been overcome, making a sufficiently compelling case to enrol regionally investors in hybrid science parks.

[FIGURE A GOES ABOUT HERE]

In figure A, the USOs are only explicitly visible in the first phase, where they are the result of a commercialisation project whose success enables a series of subsequent developments. However, looking more closely at the two case studies, it is clear that USOs have been involved at *each stage*. USOs have helped universities address the problems at each stage, and to ensure that the institutional trajectory moves from the 'failing' or 'weak' trajectories to the 'strong' trajectory. This implies that USOs are indeed important in the process of progression from vulnerable entrepreneurship projects to a 'regional science park' concept. The contributions at each stage are as follows:-

- Firstly, the spin-offs help to make particular entrepreneurship projects succeed; individual entrepreneurs establish businesses, there is mentoring within and between cohorts and results are produced for the projects.
- Secondly, spin-offs help to make particular hybrid institutions attractive for other investors; on the one hand, they are a rationale for investing to create a critical mass, on the other they are interesting partners and sources of ideas and employees for other investors.

- Thirdly, spin-offs become involved in helping universities develop the structures necessary for entrepreneurship, including running investment instruments, developing incubator activities and facilitating reorganisation.
- Fourthly, spin-offs help to enrol external regional partners by telling them of the value of commercialisation undertaken at the university and its ongoing capacities to exploit its wider knowledge base.

There is therefore a process of co-evolution between the universities and the spin-off communities in the two examples presented. On one side, the spin-offs are evolving from small standalone companies into significant regional actors; on the other, the universities have evolved from institutions spilling knowledge into their localities into institutions with strategic plans for commercially disseminating their knowledge locally. The result of the coalition is that other local actors create a place where those two activities can take place in parallel, that spin-offs can be actively stimulated, namely the science park.

The consequence of this is that in each case the science park is much more than a piece of real estate. The 'science parks' (Science Central and *Kennispark* respectively) are a series of relatively stable and certain activities and capacities (spin-out, incubation, mentoring, venture finance, urban regeneration) which are being combined together in an innovative and plausible way. It is by no means certain that the projects will succeed, but the two concepts being developed in the two regions appear to have a considerable advantage with respect to the failed 'high technology fantasies' of the 1980s, in that they are not beginning *de novo* – the science park in each region is a natural extension of tendencies and capacities already proven and demonstrated.

Of course, such science parks are neither regional knowledge laboratories nor are they fully fledged regional innovation systems. The fact that both universities have worked for twenty years promoting innovation emphasises the difficulties in promoting new regional innovation systems. However, these new science parks are interactive, hybrid spaces where a range of capitals come together, and could conceivably provide an arena where local buzz could be created and spread out across the region.

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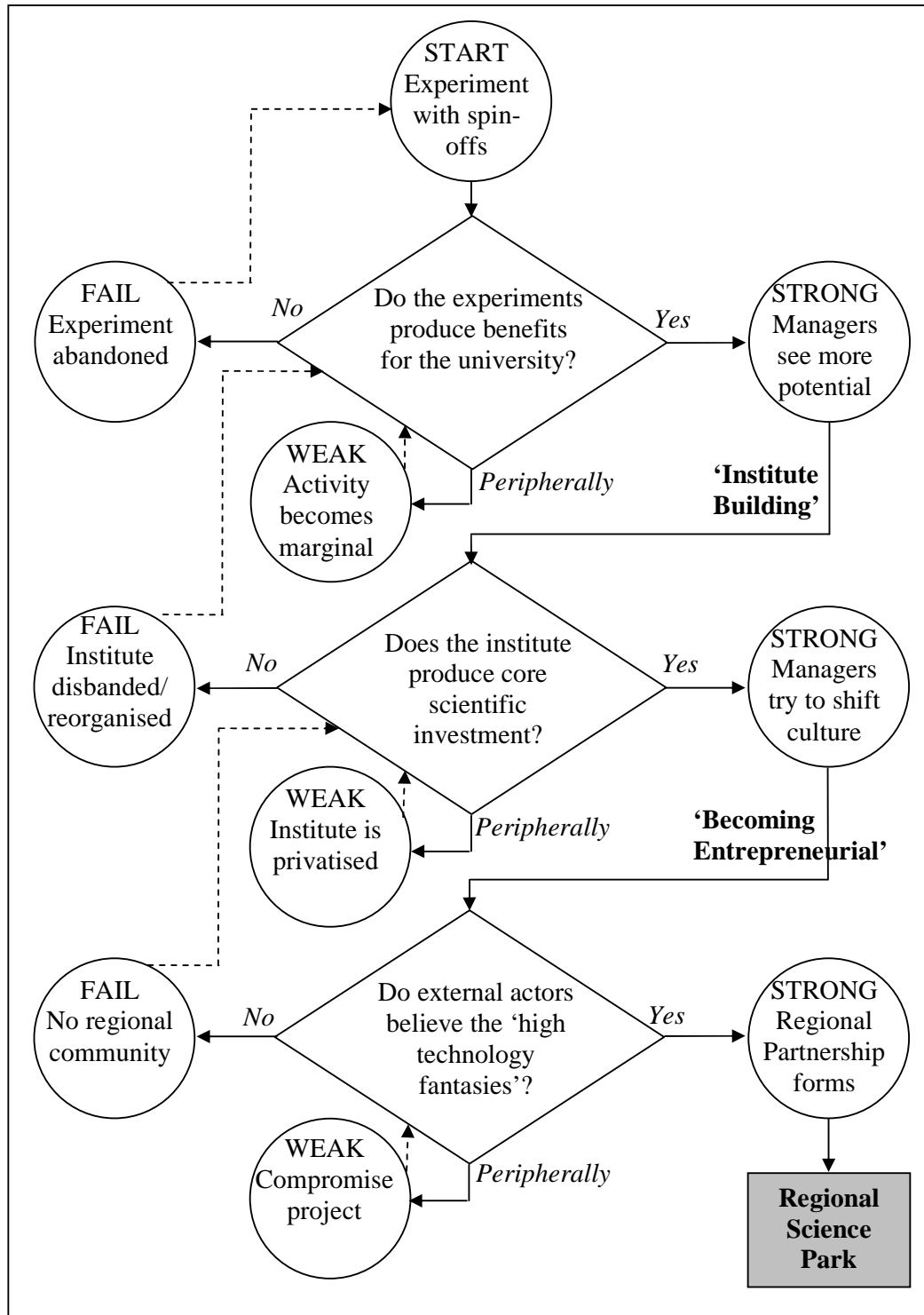
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Figure 1 A model of community building with high-technology small firms and universities



Source: authors' own design

¹ THT is the abbreviation derived from the Dutch name for the institution, Technische Hogeschool Twente. Although literally meaning Technical High School, the *Hogescholen* are now part of the higher education system as Universities of professional education alongside the Scientific Universities. However, despite the name, THT was created as a technical university rather than a university of professional education.

² The position broadly equates with the position in UK universities of Vice Chancellor; however, the governance arrangements in Dutch universities are somewhat different to UK universities. UK universities are traditionally governed by an academic body such as Senate, which appoints the senior managers drawn primarily from promoted professors. In the Netherlands, universities have a small executive board, which reports to (and is appointed by) a supervisory board of stakeholders, including academic representation, but also the government and the Ministry of Education. The Rector Magnificus is the senior academic representative on the executive board with responsibilities for teaching and research; the other positions will typically not be academics and have responsibilities for finance, estates, regional engagement and internationalisation. In practise, there has been a convergence of these two systems as both Dutch and UK universities come to terms with very similar external pressures.

³ The most famous of these, about which a great deal has already been written, is the so-called TOP programme, from the Dutch name, *Tijdelijke Ondernemers Programma* or Temporary Entrepreneurs' Scheme. The scheme is open to anyone with a business plan to exploit technologies and know-how in university research groups; in practise this restricts participation to recent graduates and people working in companies that have research collaborations to the university. This scheme has existed since 1985, although it has been tweaked in response to experience and the changing demands of funders.

⁴ Those documents directly cited in the paper are included in the bibliography; a full list of documents reviewed is included in Benneworth (2005).

⁵ More interviews were undertaken in Twente because I did not have a good understanding of the regional development context in Twente, whilst I had just completed a research project on regional science policy in the North East England which provided comparable contextual information for the North East.

⁶ I consulted with academics in each institution with a knowledge of spin-offs to identify a core of interviewees, and then the same was extended outwards approaching people recommended by the initial interviewees.

⁷ as one academic professor noted "The company will pose a question to me, as research director, 'that represents a 30% loss of productivity over the entire year, what can you do about it?' And the answer has turned out to be very, very interesting ... There are two things. Firstly, how can you devise solutions, and I tend to go to the DTI and say if we could devise a method ... this would increase productivity by 30%, increase profit, lead to growth, so many more people would be employed so we'll try and do that with them. Then you go to the scientific literature and you ask, is there any scientific or any knowledge or mechanisms for measuring [what controls productivity] ... you can then devise a programme of pure research to try and get at the mechanism".

⁸ In the mid-1980s, both universities had received significant government funding to establish micro-electronics consultancy centres to help local SMEs adopt new technologies; both centres grew very rapidly on the basis of local demand, but once the funding expired, in each case the university felt that it was employing people (and incurring risks) that added nothing to core teaching/ research missions, and so those institutes were privatised, and became spin-off companies.

⁹ Newcastle University received a £3m grant from the Department of Trade and Industry for the Nanotechnology Manufacturing Initiative which was explicitly justified in terms of Newcastle's success in producing spin-outs. Likewise, the position of UT as the centre of the Dutch Nanoned programme was a consequence of both the scientific excellence in MESA+ but also the fact that spin-outs from UT had been very important in the predecessor programme, Microned.