Organising for the Commercialisation of Research

Two European Case Studies

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PREFACE

The Symbion case study is based on interview with the Director of Symbion A/S, Christina Hvid, and with the CEOs of two of Symbion's tenant companies: Jesper Kongstad (Astion) and Rasmus Neelund (Pipeline Biotech). Further, this case study has benefitted from recent research by Mette Mønsted (Copenhagen Business School), cf. her very recently published book, *Strategic Networking in Small High Tech Firms*.

The Newcastle case study draws upon two short-term study missions to the United Kingdom (Newcastle, Bristol and London) were a range of experts were interviewed:

John Barber (Director of Innovation, Economics, Statistics in Department of Trade & Industry, and Evaluation & Chairman of OECD Committee on Science and Technology Policy), Ian Harrison (Deputy Director of Key Business Technologies Directorate, Department of Trade & Industry) & Chris Henshall (Head of the Science and Engineering Group in Office for Science & Technology, Department of Trade & Industry); Adrian Hill (Director of Third Stream Funding, Higher Education Funding Council for England); Caroline Gladwell (Science & Industry Council Policy Manager, Regional Development Agency OneNorthEast) & Mark Pearson (Innovation & Integration Executive, Regional Development Agency OneNorthEast); and *from the University of Newcastle*: David Charles (Chair of Business Innovation and Director of Research), John Goddard (Deputy Vice-Chancellor), Ken Snowdon (Director of Research, INSAT), Douglas Robertson (Director of Business Development), Richard Carter (Business Manager of INEX), Dale Athey (Business Development Manager), Jeremy Lakey (Professor), Calum McNeil (Professor and Vice-Director of INSAT), Sean Gaylard (Operations Manager), Arun Harish (PhD student, INSAT), Malcolm Young (Dean of Faculty of Science, Agriculture and Engineering), Iain Nixon (Director of Centre for Academic Development), Paul Freeman (Senior Advisor in Centre for Academic Development), Cathryn Harvey (Director of Careers Service), John Dersley (Director of Regional Development Office).

On behalf of the Copenhagen Business School, I should like to warmly thank all of the above experts for their open and helpful attitude.

Jakob Vestergaard
Copenhagen Business School
30 June 2003

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INTRODUCTION TO THE CASE STUDIES

This case study report is part of a research project commissioned by the Development Agency of Greater Copenhagen (Hovedstadens Udviklingsråd). The other major output of this research project is a review of key literature on the performance of science parks in meeting their objectives of stimulating research-based new business development, thereby contributing to regional economic development (Hannson 2003). One of the key observations of this review was that two key questions remain largely unaddressed:

(1) Does degree of success in meeting overall objectives vary with *type* of science park?
(2) Does degree of success in meeting overall objectives vary with *type* of entrepreneur?

The absence of research on these questions reflects no doubt that the concept of the science park has for long been taken more or less for granted. This state-of-affairs is unlikely to continue, however. Last year the European Commission published a large research report on business incubation initiatives in all its member countries (EC 2002). As part of this research, a typology of different types of business incubators was developed, with business incubator models ranging from enterprise centres over traditional science parks to university innovation centres. There is, in other words, an increasing attention to different approaches to promoting new business development. Likewise in the present report. Rather than using a very narrow concept of science parks, we have chosen to investigate two rather different approaches to institutionalising efforts to commercialise scientific research. The first case study is Symbion, a 'traditional' science park located in the northern outskirts of Copenhagen, taking up the role of an intermediary institution between public research institutions and key industrial clusters in the region. The second case study is the University of Newcastle, which in recent years have undertaken an extensive restructuring of the organisation and profile of its research, its teaching, and its estate, in order to become itself a science park, with on-campus business incubation units, industry-targeted curriculum development, etc. By choosing these two case studies we hope to initiate an analysis and discussion of the relation between, on one hand, different types of science parks and different types of entrepreneurs and, on the other hand, success in meeting overall objectives (cf. the two questions above). A short-term research project as the present one cannot, of course, reach a definitive conclusion on these fundamental questions. What *can* be achieved, however, is an identification of key issues, and a first depiction of the comparative strenghts and weaknesses of the two approaches.

CASE STUDY I Symbion

1.1 Introduction

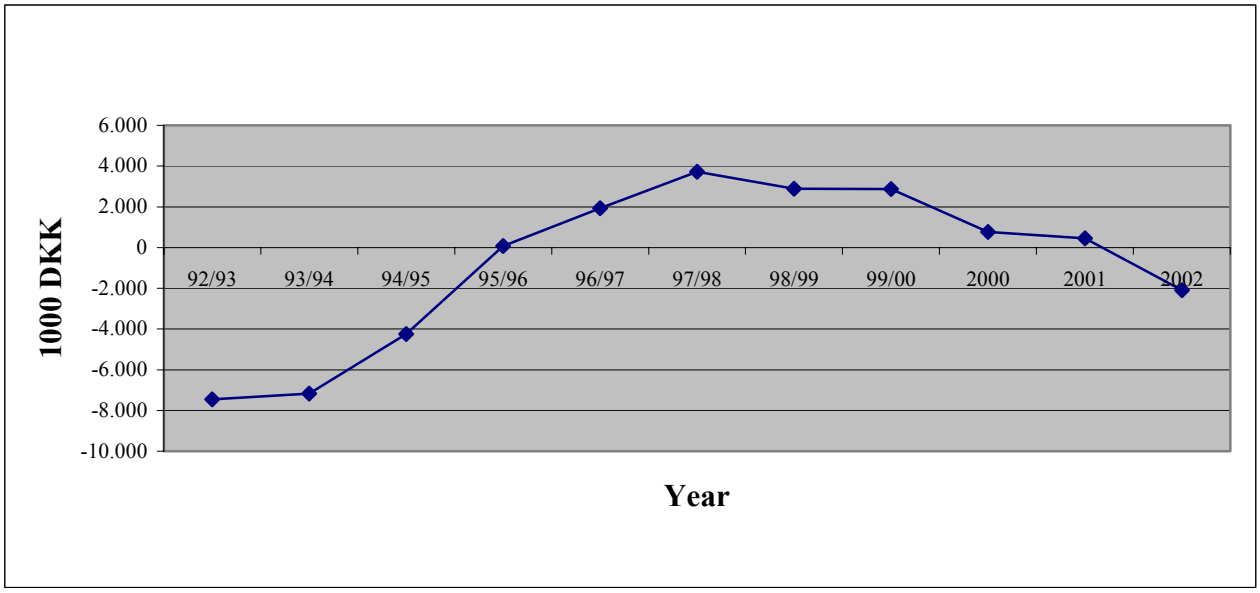
The Symbion science park initiative originated from a group of researchers at the University of Copenhagen.[1] Inspired by a visit to an overseas science park in 1983, a small group of natural science researchers decided to work for the establishment of a similar institution in the Copenhagen region. The group consisted of six scientists working in different fields of research: Microbiology, mathematics, physics, chemistry, geography and astronomy. By 1986, this small group of scientists had gathered approximately one hundred researchers, who all paid 500 Danish crowns into a fund, the KFI Fund. In its first years, Symbion operated from rented premises near the Natural Sciences, Medical and Pharmaceutical Faculties of Copenhagen University. In 1992, however, Symbion acquired its own facilities in the northern part of Central Copenhagen, where the science park still resides today. The Copenhagen municipality, the county, the state, the university and private investors financed the rebuilding of these new facilities.

> However, when the [new facilities were] ready, an industrial crisis affected the market, and industrial housing was suddenly abundant in the Greater Copenhagen area where prices dropped. This implied that the rental fees were high compared to other options, and not very tempting for many high tech firms (Mønssted 2003: 164).

Symbion suddenly was far less attractive as a site for new business development, and it proved difficult to rent the premises in adequate scale. In the first years, therefore, the main tenants were a number of university institutions[2] and a set of R&D projects from a large Danish pharmaceutical. By the late 1990s, however, Symbion had become more succesfull in attracting smaller high tech companies. The premises in Symbion came to be seen as quite attractive, and until the recent downturn in the biotech venture capital market there even was a waiting list of IT and biotech companies wishing to locate at Symbion.

[1] This section draws upon Mønsted 2003 and Hvid 2003.
[2] Including a chemistry department, a project group of philosophers, and the Centre for Innovation and Entrepreneurship at the Copenhagen Business School

Figure 1 Symbion revenues 1992-2002



Source: Symbion 2003d.

At current, opinions diverge as to whether Symbion is faced with an economic crisis or not. The influx of new biotech and IT companies has, at least temporarily, halted as a consequence of the macroeconomic situation in general and as a consequence of the downturn in the venture capital market for biotech in particular (75 pct of Symbions premises is at present rented to biotech companies). Some observers contend that the combination of the present market conditions, and the fact that Symbions's rental rate for tenant companies is somewhat above market prices for rent of office and laboratory premises, is likely to result in a severe economic crisis within 6 to 12 months from now (Kongstad 2003).[3] Symbion remains confident, however, that its ongoing efforts to improve its financial standing by negotiating its loans, and by negotiating with the City of Copenhagen its right of escheat over the Symbion premises, will loosen the financial strain sufficiently to take Symbion safely through the present downturn in the IT and biotech markets (Hvid 2003).

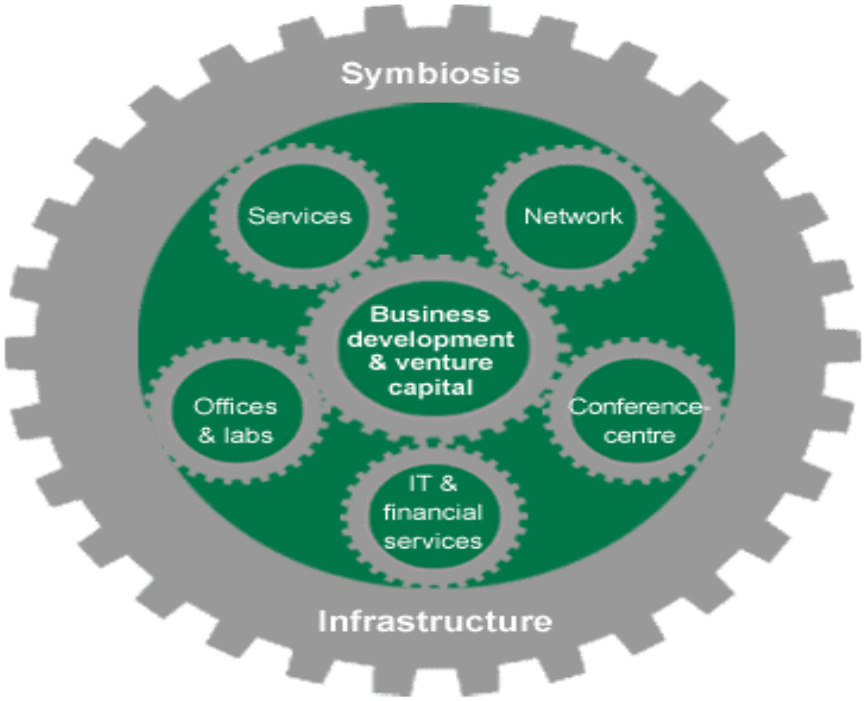
[3] Symbion stresses that the rental rate for a company at Symbion includes a unique package of facilities and services, that makes it incomparable to market prices for rental of office and laboratory premises (Hvid 2003).

1.2 Organising for commercialisation

1.2.1 Overview

Symbion states as its overall objective "to foster a symbiosis between start-up companies, the world of research, universities and established businesses" (Symbion 2003a). This is sought achieved by a dual strategy of providing a physical framework and a set of advisory services to tenant companies. The following figure illustrates what is at Symbion perceived to be the essential components of achieving this mission:

Figure 2 The essential components of symbiosis



Source: Symbion 2003b

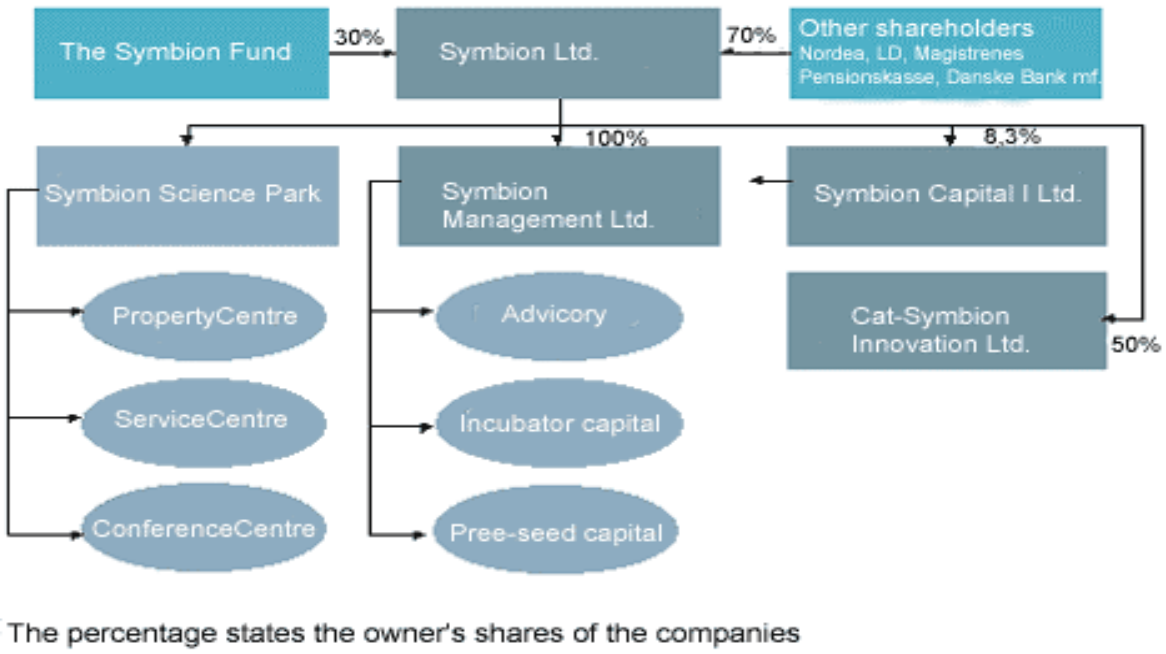
Symbion has specialised in assisting new established companies working with knowledge intensive, high-tech or innovation products within the areas of IT, biotechnology or medico. In attracting this type of companies, Symbion offers offices, rooms and laboratories on a rental basis. Symbion is a modern, three-storey science park located in the northern part of Copenhagen, with a total of 20.000m2:

- Offices: 7.200m2
- Labs: 2.400m2
- Conference and meeting facilities: 1.000m2
- Common areas, restaurant and canteen, service areas, cellar etc: 10.400m2

In addition to facilities, Symbion offers a range of services and advice, focusing particular on business plan development and capital infusion. At present, Symbion hosts around 75 innovative start-up companies.

After a major legal restructuring in 2001, Symbion today consists of four legally distinct units: The Symbion Fund, Symbion Ltd, Symbion Management Ltd. and Symbion Capital I Ltd. How the constituent elements of the Symbin group relate to one another can be illustrated as follows:

Figure 3 The Organisation of Symbion



Source: Symbion 2003c

The key units of the Symbion group can be briefly depicted as follows (Symbion 2003a):

- *Symbion Ltd* manages the science park. Symbion Ltd has 31 shareholders, including two of the largest Danish banking companies (Nordea and Danske Bank), three large Danish pension funds, and the Symbion Fund.
- *Symbion Management Ltd* is a 100% owned subsidiary providing consulting services and investing capital in research and knowledge based start-ups. On behalf of Symbion Capital I Ltd and CAT-Symbion Innovation Ltd, SymbionManagement Ltd invests pre-seed capital and project capital in new companies.
- *Symbion Capital I Ltd* is a venture fund where Symbion Ltd holds 8.32% of the owner's shares. Symbion Capital invests in research and innovative start-ups primarily within the IT and biotechnology areas.
- *CAT-Symbion Innovation Ltd* is jointly owned by Symbion Ltd and the science park CAT in Roskilde, each with 50% of the owner's shares. The company forms the basis for the two science parks' shared innovation incubators.
- *Symbion Science Park* consists of four independent profit centres each having their own function in the science park: The Property Centre, the Service Centre, the Conference Centre and the Accounting Centre (more detail on each of these below).

1.2.2 Service Centres

As mentioned above, Symbion Science Park consists of four independent profit centres. A brief description of each of these:

- The Property Centre rents the science park's office and laboratory facilities to research and knowledge based companies and makes sure that these function optimally. The Property Centre assists and provides advice in connection with renovation and interior fitting of laboratories and arranges washing of laboratory equipment etc.
- The Service Centre operates the switchboard and reception and offers a number of services and makes agreements with suppliers benefiting all the companies in Symbion.
- The Conference Centre rents meeting and conference rooms, assists with the arrangement of conferences, meetings, seminars, symposia, courses, fairs etc. The Conference Centre manages the contract with the tenant of Symbion's canteen and restaurant. The Conference

Centre is responsible for the practical details in connection with arrangements for start-ups, established companies and the scientific community.

- The Accounting Centre is responsible for financial tasks within the areas of budgeting, bookkeeping and advice.

Until recently, there was a fifth Centre: the Consulting Centre. In 2001, however, this Centre became a 100% owned subsidiary – *Symbion Management Ltd*. That same year, Symbion Capital Ltd was founded. In the following, we shall describe briefly these two units: Symbion Management and Symbion Capital.

1.2.3 Symbion Management

Symbion Management specializes in giving advice on how to establish and develop research based and knowledgeable companies within the following two areas:

(1) IT & telecommunication

(2) Biotech, pharma and medico.

Symbion Management stresses the importance of providing advice that builds on an in-depth knowledge of the involved technologies and markets. The most important competence, perhaps, that the Symbion Management consulting team can offer new companies, is the experience of having gone through the process of consulting business start-ups many times before (Hvid 2003).[4]

Table 1 below gives an overview of the consulting services profile of Symbion Management.[5] By European standards, Symbion Management have a very good coverage of In House consulting services.[6] This is no doubt a reflection of the concerted effort over the past three to four years to further upgrade and professionalise the consulting services dimension of Symbion's activities. The creation of Symbion Management as a separate legal unit in 2001 was a key aspect of this process.

[4] So far, approx. 300 companies have gone through the Symbion system of new business development (Hvid 2003).
[5] The list is based on an interview with Christina Hvid, the Director of Symbion Management.
[6] Compare the recent EC benchmarking study on European Business Incubators (EC 2002).

Table 1 Consulting profile of Symbion

	In House	External
(1) Pre-incubation services	X	
(2) Business planning and forming a company	X	
(3) Training to develop business skills		X
(4) Accounting, legal and other related services	X	
(5) Market research, sales and marketing	X	X
(6) Help with exporting and/or partner search abroad	X	X
(7) Help with e-business and other aspects of ICT		X
(8) Advice on development of new products and services	X	
(9) Help with raising bank finance, grants, seed and venture capital	X	
(10) Incubator seed/venture capital fund, business angel network	X	
(11) Advice on recruitment of staff and personnel management	X	
(12) Networking, e.g. with other entrepreneurs, potential customers	X	
(13) Mentors, board members and other senior advisers	X	
14) IPR and patenting	X	

Source: Hvid 2003

In addition to giving advice on a wide range of management and business development issues, Symbion Management assist tenant companies in pursuing financing for the further development of their businesses. Symbion Management not only gives advice on achieving capital infusion, however. In some cases Symbion Management actually invests in a company on behalf of Symbion Capital. To achieve financing from Symbion Capital there is, however, a number of criteria that must be met, and it is the role of Symbion Management to evaluate whether a company does in fact meet these requirements:

- The company must be research-based and/or knowledge-intensive
- It must be cutting edge, i.e. have no direct or indirect competitors nationally or internationally
- There must be a profitable market for the product
- The product should be liable to patenting

- The company team should be qualified to realise the business development plan

Symbion Management emphasises the importance of *networks* for the successful development of new businesses, and therefore takes an active role in promoting company participation in existing networks as well as in the formation of new networks (Hvid 2003). For instance, Symbion Management initiates a number of different "educational networks" among the companies, with consultants from Symbion Management attached to each of these network groups. In addition to these educational networks, a tenant company at Symbion has access to two general networks:

- A unique company network including all companies that have resided in Symbion
- A network with national and international universities and other research facilities

Symbion has a close co-operation with Nordic Technology Forum and Biotech Denmark. Their events are often held at Symbion. Furthermore, CONNECT Denmark resides in Symbion, working to encourage new high-tech business ideas by creating contacts among e.g. entrepreneurs and investors. Finally, Symbion's Goodwill Ambassador Corps consists of 141 prominent business people and scientists that companies can drawn upon through the mediation of Symbion Management.

Symbion's degree of interaction with the higher education institutions of the Copenhagen region is not satisfactory, whether seen from the perspective of the tenant company or from the perspective of Symbion Management (Hvid 2003; Kongstad 2003). Symbion has often experienced either a lack of interest or a lack of professionalism when it has approached the universities of the Copenhagen region to discuss issues such as raising student awareness of entrepreneurship as a career option, and other key issues with regard to the agenda of promoting the commercialising scientific research. The general feeling at Symbion is that the universities have an extremely ambivalent attitude to commercialisation and interaction with industry, and that they are in fact not quite ready yet for this interaction. The University of Copenhagen, for instance, are still in the very early phases of establishing a technology transfer office, and of formulating strategies for commercialisation and interaction with industry (Hvid 2003).

1.2.4 Symbion Capital

Denmark is traditionally considered short of risk capital. This was the basis for the establishment of Symbion Capital. Symbion Capital was founded in 2001, and is at present the largest venture fund in Denmark in the pre-seed and seed segments. Symbion Capital invests risk capital at the very early stages of innovative start-up companies, provided that the company fulfils the above stated investment criteria. Symbion Capital invests risk capital in companies within IT, telecommunication, biotechnology, pharma or medico. Symbion Capital disposes of more than 300 million DKK. Symbion Capital typically can invest between 2 and 8 million DKK, but in certain exceptional cases more than 20 million DKK. This may be either as the sole investor or as one of a number of parties in a larger syndication.

All potential investments are subject to thorough screening. A typical screening lasts from two to six months and is supervised by two venture managers from Symbion Management. The screenings are based on the company's business plan. If the project lies within Symbion Capital's sphere of investment – and if a capital infusion is considered likely to help the company get quick access to key markets – an initial meeting is set up. After the first meeting, a detailed analysis with the purpose of revealing the risks related to the investment, is undertaken. The investment is presented to an internal evaluation board comprised of all venture managers in Symbion Management. Furthermore, Symbion's advisory boards composed of persons with business experience and in-depth knowledge of the biotech and IT industries are drawn upon. A study of markets and of potential national or international partners, patents and possibilities for trade sale of the company is undertaken. Concurrent with this screening process, an investment agreement is negotiated, including issues such as stipulating the key goals in the development process, getting other investors involved and distributing shares among founders and investors. When all risks have been thoroughly analysed and the contractual arrangements are in place, the Board of Symbion Capital decides if the investment will be made. Investments are paid in installments depending on the fulfilment of the stipulated organisational, technological and financial goals.

In table 2 below, a list is provided of the sixteen companies in which Symbion Capital have so far decided to invest risk capital:

Table 2 Companies with investment from Symbion Capital

3Dfacto	3Dfacto has developed and patented a software platform for the next generation of product configuration
Chempaq A/S	Chempaq develops a system for Point of Care blood cell counts
Curix ApS	Curix develops methods for modifications of peptide drugs to alter their pharmaceutical profiles in order to increase their stability considerably
Evolva A/S	Evolva develops technological platform for producing pharmaceutical molecules
Gamalocus ApS	Gamalocus develops community games on the Internet
Immediad ApS	Immediad develops technology for mobile, wireless advertising which will make the media production cheaper and easier to handle
Intelligent Inventory ApS	Intelligent Inventory develops an inventory management software
LukaOptoscope ApS	LukaOptoscope develops and manufactures a new generation of optical quality measuring systems
Medico Metrics ApS	Medico Metrics develops a technology platform for cancer diagnostics based on fluorescence measures
MEMSflow	MEMSflow develops a lazercontrolled micropump for the transportation of liquids in microfluidic systems
MOSketeer	MOSketeer develops manufacture and market software products within the area of Multiple Operating Systems for a PC
PSET ApS	PSET develops applications to secure e-commerce and e-banking
SYCS ApS	SYCS develops a new computer chip architecture
Unwired Factory A/S	Unwired Factory develops location based services to wireless applications
Wideboard	WideBoard is a communication system with a wide variety of applications, based on a scalable, virtual whiteboard
Wone Technologies	Wone Technologies develops digital TV card, using the computer power generated by 2nd generation game consoles to allow full access to digital channels for analogue subscribers

Source: Symbion 2003a

1.3 Key observations

A key strength of Symbion is its business networks in the IT and biotech clusters of the Greater Copenhagen Region. A key weakness, on the other hand, is the relatively low level of interaction with the higher education institutions of the region. This reflects, to some extent at least, an increased focus in Symbion A/S on business development and management consulting, at the expense of its institutional anchoring in the science-base of the region. The relatively low level of institutional interaction with the universities of the region may be part of the explanation why recruitment from the universities is rather low too. At present, as little as 20 pct of the people working in the tenant companies at Symbion hold a PhD degree, and only 6 pct come to Symbion directly from the university (Symbion 2003b: 6-8). Though an increased focus on professionalising its business development and management consulting may have been necessary, Symbion seems to have lost sight of its original mission of facilitating an increased interaction between the higher education institutions and the key industrial clusters of the region. Some have even argued that Symbion's increased emphasis on developing its management consulting services is more an expression of an 'identity crisis' vis-à-vis its original mission, than really a response to the actual needs of its tenant companies (Kongstad 2003). In a recent benchmarking report by the European Commission, a typology was developed that supports this contention. According to this typology, Symbion seem in fact to be closer to the notion of a Business Incubator than to that of a Science Park, cf. table 3 below. At Symbion, this transition in the direction of a business park is seen as a necessary aspect of Symbion's own institutional trajectory and as part of an overall international trend (Hvid 2003).

Table 3 Business parks and science parks – key definitions

Business park/business incubator	Science park
Incubators nurture young firms, helping them to survive and grow during the start-up period when they are most vulnerable. Incubators provide hands-on management assistance, access to financing and orchestrated exposure to critical business or technical support services. They also offer entrepreneurial firms shared office services, access to equipment, flexible leases and expandable space — all under one roof.	A science park is characterised by the following three characteristics: (1) It has formal and operational links with centres of knowledge creation such as universities, higher education institutes and research organisations; (2) It provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit; and (3) It encourages and supports the start up, incubation and development of innovation led, high growth, knowledge based businesses.

Source: EC 2002

CASE STUDY II University of Newcastle

2.1 Introduction

The University of Newcastle was founded in 1963 when the Newcastle based colleges, founded in the 19th century, separated from the University of Durham.[7] Originally, the University saw as its mission to produce "capable and cultivated human beings" (John Stuart Mill 1867, cited in GHK 2002: 3). Recently, the perspective has been changing, emphaising more and more how universities are "a significant force in regional economies, as a source of income and employment, and in contributing to cultural life" (Dearing Report 1997). In accordance with these new expectations from UK policy-makers both at the national and the regional level, the University of Newcastle in 2002 reformulated its mission, which today is:

> To be a world class research led educational institution and to play a leading role in the economic, social and cultural development of the North East of England

This mission statement has then been the basis of developing at new vision for the University of Newcastle. In this vision, a successful university should be not only "a significant force" rather a "major driver" in the regional economy – in fact, a successful university should be a "defining characteristic" of a successful region. Underlying the Newcastle approach to this new agenda was the contention that in contemporary knowledge economies a successful regional economy depends crucially on the degree of 'interpenetration of the production and commercialisation of knowledge':

> This interpenetration often finds expression in clusters of economic activity that encompass strategic alliances between universities, centres of applied research, knowledge intensive businesses, and supporting business services. Working together in the cluster in vital for the success of the cluster. Universities, firms and the public sector need to align their aims and activities, and collectively marshal their resources… Successful economies in the world of today (and tomorrow) are characterised by a convergence of aims and activities and by mutual support given and received amongst the institutions that comprise the economic cluster in question (GHK 2002: 5-6).

In order to achieve its new mission, the University of Newcastle initiated a major institutional and managerial restructuring:

[7] The University at present has 14.600 full time students, and 1.600 part time students. The University of Newcastle employs 2000 academic and 2000 other staff. Its overall budget is 320 million euros, with 49 pct being competitive and external funding, i.e. non-block funding.

> In order to achieve these goals the University had to change; internally, by focusing on rationalising the faculties and enhancing the capacity and capability of the university to undertake leading-edge research and externally, by constructively engaging with its stakeholders, namely businesses, the community and government (GHK 2002: 3)

The key intermediate objectives of the institutional restructuring was the following:

1. A better coordination of operational and strategic management
2. A culture encouraging innovation at all levels (teaching, research, and reach-out)
3. Increased external income generation.

The restructuring plans recognised from the outset that increased external engagement would put new requirements on university management at all levels (Goddard 2003). It was further recognised that while a traditional university adopts administrative processes (controlling activity and ensuring procedures are followed), an entrepreneurial university should pursue management processes, which would seek out opportunities and make things happen. The key challenge was thus seen to alter management practices in several dimensions: financial management; personnel management, student management, research management and management of the information systems to support these processes. To achieve this, the following overall time-schedule was launched:

- New management team to be in place by January 2002
- Reviews of teaching, research and administration to be completed by March 2002
- New resource allocation methodology in place by June 2002
- New academic structures to be in place by August 2002

In parallel with these restructuring processes a set of new principles for interacting with business and community were being devised. Previously, research-based third mission activities focused exclusively on technology transfer, spin-off companies, and consultancies. Now, *students* came to the fore of third mission thinking.[8] Students were thought to be the main "carriers" of knowledge, and as the potentially most effective channel for employers to the global knowledge base. This will be furhter described below, particularly in section 2.2.8 and 2.2.9.

[8] The term 'third mission' refers to the agenda of promoting the utilisation of scientific knowledge (also called 'out-reach'), in addition to the two 'traditional' missions of universities: teaching and research.

2.2 Organising for commercialisation

2.2.1 Overview

A key aspect of the restructuring that has taken place at the University of Newcastle is a professionalization of its interface with business.[9] This is immediately apparent when one logs on to the university web site, connecting you at once with 'Services for Business':

> As one of the UK's leading universities, our reputation rests on the quality of our research, teaching and the services we provide to the business community. We will match your needs with our expertise and find the right solution for your company - whatever its size or location. For more information about our services please contact us and join the hundreds of companies who already benefit from collaborating with us.

The 'Services for Business' website then leads in a number of directions: Collaborative Research and Consultancy; Professional Development and Training; Graduate Recruitment; Conferences and Corporate Hospitality; Business News; and Feedback. In the following, a brief description will be given of the most important bodies of expertise and services provided in the areas of Collaborative research and consultancy and Graduate recruitment (section 2.2.2 – 2.2.8).

In addition to these university-wide initiatives, there were a number of initiatives at the level of individual faculties (for instance, 'Technology Village', cf. section 2.2.10) as well as at the level of individual research institutes. One example of the latter was the University Innovation Centre for Nanotechnology, and its commercial arm, INEX. This section will include a detailed description of INEX (section 2.2.9), since INEX may be seen as a paradigmatic case of what the University of Newcastle have been restructuring itself to become.

2.2.2 Knowledge House

In 1996, the Higher Education Support for Industry in the North (HESIN)[10] set up the Knowledge House to provide an interface connecting the universities and industry in the North East. Its task is to encourage local SMEs to take advantage of the combined resources located within the six North Eastern universities. The Knowledge House functions as a centrally co-ordinated enquiry and response service providing local industry with a single point of contact for advice, guidance and

[9] The following extracted from the University of Newcastle website, www.newcastle.ac.uk, from interviews with key personnel involved in Services for Business, and from EC 2001.

[10] HESIN was formed in 1983 as a local industry-academic consortium. HESIN's constituent bodies were five Higher Education Institutions in the Northern region: the University of Newcastle upon Tyne, the University of Durham, the former polytechnics of Newcastle, Sunderland and Teesside together with the Northern regional office of The Open University.

support on a range of technology and management-related issues. The Regional Technology Centre (RTC North) acts as the central co-ordinator of the Knowledge House, with additional managers based at each of the universities. The central aims of the Knowledge House in terms of providing research services to local firms are to: (i) provide a rapid and confidential response services, (ii) offer a free initial search and diagnosis package, (iii) "source" local assistance wherever possible, (iv) arrange initial introduction between the firm's staff and the university personnel, and (v) monitor the progress of the delivery of the service once specified.

Contact by firms can be made either through the Central Co-ordinator at RTC North, or to individual Knowledge House managers which operate at each of the six universities. Where necessary, assistance is provided by defining the exact nature of the enquiry; often an important issue for SMEs who are not used to using external research or technical assistance. This service is provided free of charge by the Knowledge House team. The enquiry is then confidentially circulated throughout the Knowledge House network and sources of assistance and expertise are identified. In order to achieve a high and even standard of service, once a proposal and a contract is agreed, the Knowledge House team closely monitors the progress of the project.

The Knowledge House has received several accolades in the UK. It also has been commended and promoted in the UK National Inquiry into Higher Education. Its initial enquiry and revenue targets have been exceeded and SME repeat business has been achieved.

2.2.3 Research and Innovation Services

The purpose of Research and Innovation Services (RIS) is to help promote and support research within the University of Newcastle, and promote its use for social and economic development. To achieve this, RIS provides a range of services. There are two main lines of activities. First, RIS works with individual researchers and research groups in identifying sources of research funding, preparing and negotiating research proposals, and secondly, RIS assists in developing commercialisation opportunities. RIS handles over 1200 research applications each year and processes over 1000 new awards with a value of more than £50million. Currently, the RIS database has more than 800 research sponsors. RIS prepares and negotiates around 100 collaboration agreements and sub-agreements each month, which brings it into contact with a large number of other research organisations that collaborate with the University. RIS supported 21 UK Patent and 14 PCT filings in 1999/2000. Researchers file around 20 new Invention Disclosure Records each year. RIS has excellent contacts within major research funding organisations as well as in commercial and government organisations. RIS is a member of AURIL (Association of University

and Industry Links), SRA (Society for Research Administrators) and AUTM (Association of University Technology Managers). Through these professional groups, RIS maintains and develops networks with professional colleagues in the UK and Internationally.

2.2.4 Technology Transfer Office

The team members of The Technology Transfer Office all have wide experience of academic research and commercial product development, together with knowledge of contractual, licensing and intellectual property issues. The Office aims to offer a range of services to University staff and industrial partners, to bridge the gap between academic research and commercialisation. Technology transfer consists of a number of stages where the researcher, the Technology Transfer Office and commercial partner(s), work together. The Technology Transfer Office thus gives advice and assists in a number of different matters, including: Identification of valuable ideas and expertise; Invention and intellectual property rights issues; Patents, copyright and trademark; Assessment of commercial potential; Contacting potential commercial partners; Confidential disclosure agreement; Negotiation of a commercial contract; Licenses and royalties; and Project management. The technology transfer team handles around 40 new enquiries per month and has a current project portfolio of 120 commercialisation projects.

2.2.5 Business Development Team

The primary role of the Business Development Team is to achieve a clearer and more comprehensive understanding of the needs of business with particular focus on those clusters identified as key in international, national and regional strategies. The team is responsible for matching those needs with expertise and capabilities available within the university. The Key Areas of Business Development at Newcastle University are the following:

- Bioscience & Pharmaceuticals
- Agricultural, Marine and Food Sciences
- Engineering and Offshore
- IT & Informatics

The Team operates internally within a network comprising academic Faculties, Research and Innovation Services, The Careers Service, The Teaching & Learning Support Unit, The Teaching Company Scheme and Knowledge House.

2.2.7 Regional Development Office

By working with colleagues throughout the University and with a wide range of regional and local organisations, the Regional Development Office (RDO) seeks to enhance the partnership at all levels between the University and its Regional Community. As a key element in these efforts, the Regional Development Office has formulated a Regional Development Strategy for the University. The Regional Development Strategy is intended to provide a framework within which the University can pursue its regional role, interests and activities. The overall aim of the Strategy is to:

> Achieve and develop a set of relationships with a range of regional companies, organisations, agencies and individuals that brings and maximises mutual benefits to the University and its regional partners and which improves the region's quality of life.

The University has three inter-dependent criteria which are used to prioritise various potential and actual regional activities, to evaluate whether to embark upon a particular regionally-focused activity: Academic benefit through teaching and research; Effective access to funding not otherwise available; and Enhanced reputation and influence.

The role of the Regional Development Office is to act as the focal point for the implementation of the Regional Development Strategy, for the monitoring of its outcomes, as well as for the continuous adaption of the Strategy to internal and external changes. The RDO thereby provides an overall focus on the University's regional opportunities, disseminating them and co-ordinating responses; encouraging Faculties and Departments in the identification and promotion of regional opportunities; playing a major role in relationship building with external partners; and ensuring that the University's potential and achievements are marketed and communicated as effectively as possible.

2.2.8 Careers Service

In line with the overall policies of the University, the Careers Service Unit takes a much broader approach to its mission than most similar units in other universities. Ultimately, the objective of a Careers Services Unit is to help graduates find jobs and to help companies find graduates. The approach taken in Newcastle emphasises the need to foster the employability of its students by encouraging the creation of an entrepreneurial culture within the university. The Careers Services has formulated a graduate enterprise policy and strategy, Progression into Entrepreneurship, and stresses the importance of the contents of the actual courses that students take as a key to create an entrepreneurial culture. The Careers Services Unit has therefore been involved in developing courses with a significant 'enterprise-element'. Find below one example of how this was done in the

case of a degree programme in Biosciences. Unfortunately, it is beyond the scope of the present report to describe the activities of the Careers Services Unit in any further detail.

Business for the Bioscientist is a new 10 credit module aimed at Stage 3 undergraduates on four of our degree programmes: Biochemistry with Biotechnology, Microbiology, Medical Microbiology, Medical Microbiology and Immunology. The course will run during the second semester of stage 3, starting January 2003 with around 60 students participating.

The aim of this module is to introduce students to enterprise and entrepreneurship in relation to the Biotechnology and Pharmaceutical industries. Small and start up enterprises will be examined alongside established 'blue chip' organisations.

Input will come from academic staff from the Schools of Biochemistry and Genetics, and Microbiology and Immunology as well as a number of external experts who have agreed to lead specialist workshop sessions.

Several workshops are already confirmed:

- Dr Andy Kelly, Vice president and co-founder of BioTecnol SA, a small biotech company producing therapeutic proteins: *Setting up a biotechnology company - from academia to entrepreneurship*
- Dr Dale Athey, Business Development Manager for Biosciences and Pharmaceuticals at the University of Newcastle: *Intellectual Property Aspects of Commercialising Research in Biotechnology*
- Dr Elli Oxtoby, University of Newcastle Research & Innovation Services: *Spinning out Technology - an innovative approach*
- Mr Duncan Lowery, Investment Executive, Northern Enterprise Ltd: *How business finances itself and the role of venture capital*

Further workshops will cover *Marketing*, *Ethics* and *Public Understanding of Science*.

A Biotechnology student isolating recombinant bacteria that express novel therapeutic proteins suitable for large scale production and commercial exploitation

The course will cover:

- The small Biotechnology Company: Priorities and objectives (BioTecnol SA. as an example)
- The international Pharmaceutical Company: Priorities and objectives (Astra Zeneca as an example)
- Exploiting a good science idea
- Intellectual Property Rights
- Finance and Planning
- Marketing
- Public Understanding of Science and Ethical Issues

Assessment will be continuous throughout the module consisting of a series of individual and teamwork tasks, presentations and reports. The tasks will be designed to establish that students have gained an understanding of some of the important issues, both scientific and commercial, faced by bioscientists in the biotechnology and pharmaceutical industries.

2.2.9 The University Innovation Centre for Nanotechnology

The UK Government, in its February 2001 enterprise, skills and innovation strategy document *'Opportunity for All in a Time of Change'* announced the establishment of the *University Innovation Centre for Nano-technology*, the core component of which is the Institute for Nanoscale Science and Technology (INSAT) and its commercial arm INEX – both situated at the University of Newcastle. Nanotechnology underpins innovation in most high-technology sectors, including the biotechnology, defence, communications, electronics and medical sectors.[11] Government and industry advisors worldwide view micro- and nano-technologies as keystones for economic and technological competitiveness. It is widely predicted that the nanotechnology era will lead to the next technological revolution. INSAT builds on top rank research in physical and biological sciences and medicine in the faculties of Medicine and Science, Engineering and Agriculture. Thanks to its commercial arm, INEX, the University Innovation Centre for Nanotechnology is not only a centre of research and training excellence of international repute, but also acts as a key cross-sector driver for regional high-technology based cluster development. Both INSAT and INEX are based on-campus.

The 2500m^2 state-of-the-art centre provided through INSAT consists of:

- A 230 m^2 clean room including a class II microbiological facility for both inorganic and hybrid bio-inorganic micro- and nano-device fabrication, packaging and evaluation,
- A 120 m^2 microbiology/ chemistry/materials synthesis laboratory,
- A 150 m^2 microscopy/analysis laboratory,
- Office accommodation for researchers, business development and administrative staff,
- A training suite/seminar room,
- 8 business accelerator units for spin-off and other companies.

INEX considers it crucial for the outcome of university-business interactions that the interface is managed effectively. The following list contains the key elements in the INEX strategy to achieve such effective management:

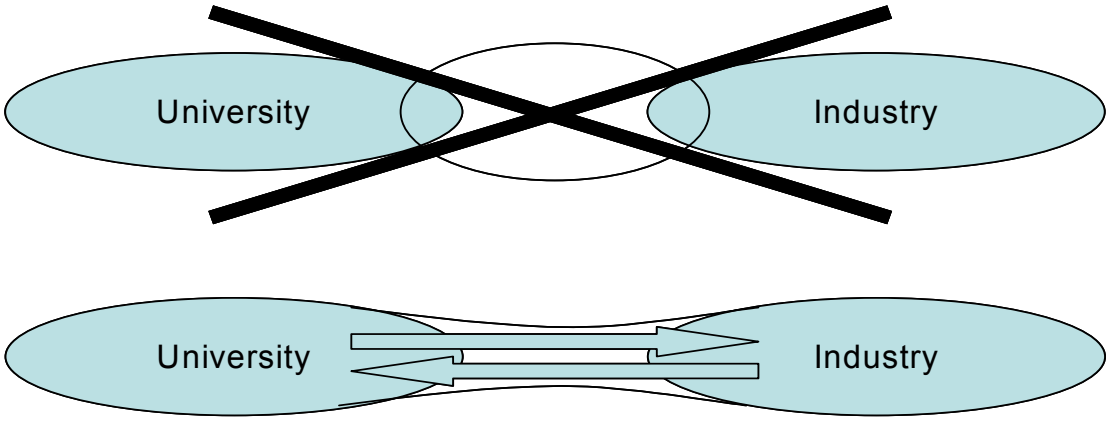
- Providing external users from industry, academia, and government with access to a dedicated bio-hybrid and micro-nanofabrication facility (cf. ‘embedded teams’)

[11] The following is extracted from Snowdon 2002, 2003a, 2003b, and INEX 2003.

- Employing a dedicated team drawn from industry to run and manage the facility
- Mapping INSAT capabilities with industrial needs
- Providing continual professional development courses (from short two-day highly specialised programmes to longer courses)
- Set up as a one-stop shop for licensing and investment opportunities
- Act as a focal point for academic staff to exploit their inventions and developments

Effective management of the university-business interface is only one component of INEX' strategy for commercialisation. The research director of INSAT has developed a model for commercialisation that is quite different from traditional thinking in this field. The model abandons the traditional model of 'technology transfer', and the notion that university interaction with industry should take place in intermediary structures, such as science parks located more or less distant from the university itself. Instead, the Newcastle concept argues that industry must be brouhgt into the university, and only then will new industries spin-out of the university, in any noteworthy scale.

Figure 4 The INEX Concept



Source: Snowdon 2003

In the INEX model the dual objective of (i) efficiently creating spin-off companies and (ii) rapidly developing a more entrepreneurial culture at the university go hand in hand, and mutually reinforce one another. The model takes as its point of departure recognition of a problem of *scale*. In the words of Ken Snowdon:

> High-flying academics in our universities are a source of novel and imaginative ideas, however the absolute number of such academics is limited. Convert them all to spin-off company technical directors and watch UK academic research output falter as they concentrate their efforts on bringing just one idea to market (Snowdon 2003a).

The INEX model proposes to base commercialisation on a combination of the *ideas* of top level researchers, and the *work and effort* of the constant flux of students that pass through university research departments. Only a small change is needed to get this model up and running. Ken Snowdon depicts the 'standard' state of affairs in the following manner:

> Academics routinely propose promising lines of enquiry for a never-ending stream of research students and postdocs to pursue. Those young researchers enthusiastically mould those raw ideas into research theses or publications. They submit those theses and publications, while giving little thought (except in the last paragraph of the thesis and moments before submission) to opportunities for commercial exploitation of what they have done. They submit their work (at 5 pm on the last day of term, go out and celebrate), and the next day - they move on. Their work lays gathering dust, a new student arrives, and the cycle is repeated (Snowdon 2003a).

A key problem is that submission of a research thesis is the final act in most advanced degree programs. A second problem is that although business and entrepreneurial skills training by now form a compulsory component of many UK degree programs, it remains largely unconnected with the actual research the students perform. It is left to the students to make the connection, often without the active support of their thesis advisor. Programs do not embed young people within the private sector business support infrastructure or connect them with its key individuals, nor does it introduce those individuals to the commercial opportunities emerging within universities. In the words of Ken Snowdon:

> These young people - undergraduates, postgraduates and post-docs - represent the largest untapped resource within the UK university system. They are enormously enthusiastic and highly possessive of their research projects. They are the key to the establishment of new high-tech companies and the development of rapidly expanding advanced technology clusters with strong links to the knowledge base (Snowdon 2003a).

INEX has devised a mechanism to 'exploit' this largely untapped resource. The objective is to change the prevailing view among our young people that 'an academic career or a job in industry' are the only career options following graduation. The aim is to make young people aware that starting their own company towards the end of their degree programme, based on technology they themselves have developed, is a viable and attractive career option. In line with this vision, business skills development is an essential component of all undergraduate and postgraduate degree programs supported by INEX. Other than that, the INEX commercialisation model is build upon the following three pillars: (i) Instant IP identification, (ii) Parallel Commercial R&D, and (iii) Spin-off Company Environment & Support.

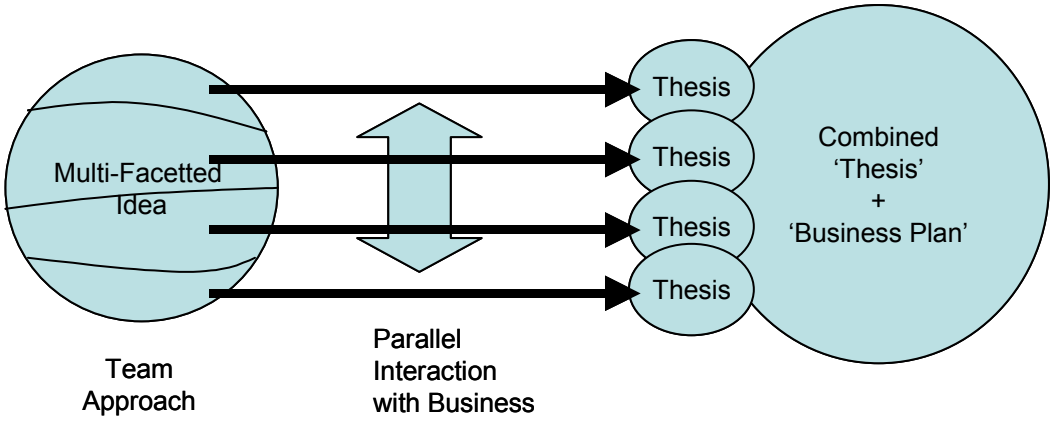
Instant IP Indentification

According to INEX, 'first-hour' identification of potentially valuable IP is crucial to ensure rapid and efficient technology pullout from the knowledge base. Therefore, a serial approach to technology transfer and exploitation should be avoided. This 'first-hour' identification is only possible if appropriately skilled commercialisation managers form an integral part of the R&D team and interact with it on a continual basis. Co-location and direct interaction with researchers is considered a necessity.

Parallel Commercial R&D

Installation of a parallel commercially oriented R&D programme is equally important. This lets young people develop the commercial aspect as a parallel activity, under the active guidance of a highly skilled and extensively networked business development team and the senior researchers who were responsible for the initial discovery. These parallel R&D programmes form the basis of novel MSc and PhD degree programmes that: (i) are based on commercially valuable IP, (ii) adopts a systems approach, allowing for larger and multidisplinary problems to be tackled in teams, (iii) puts in place potential partners for a future spinout company from the outset, (iv) requires students to assess IP, time to market and appropriate routes to commercialisation, and (v) requires students to draft business plans. The Parallel Commercial R&D approach is illlustrated graphically below:

Figure 5 The Parallel Commercial R&D Approach



Source: Snowdon 2003b

This draft business plan is the last item of work to be submitted within the degree programme, increasing the probability that on the following day, students will have a meeting with seed-corn funders to develop furthers the ideas they have developed, rather than leave the region.

Spin-off Company Environment & Support

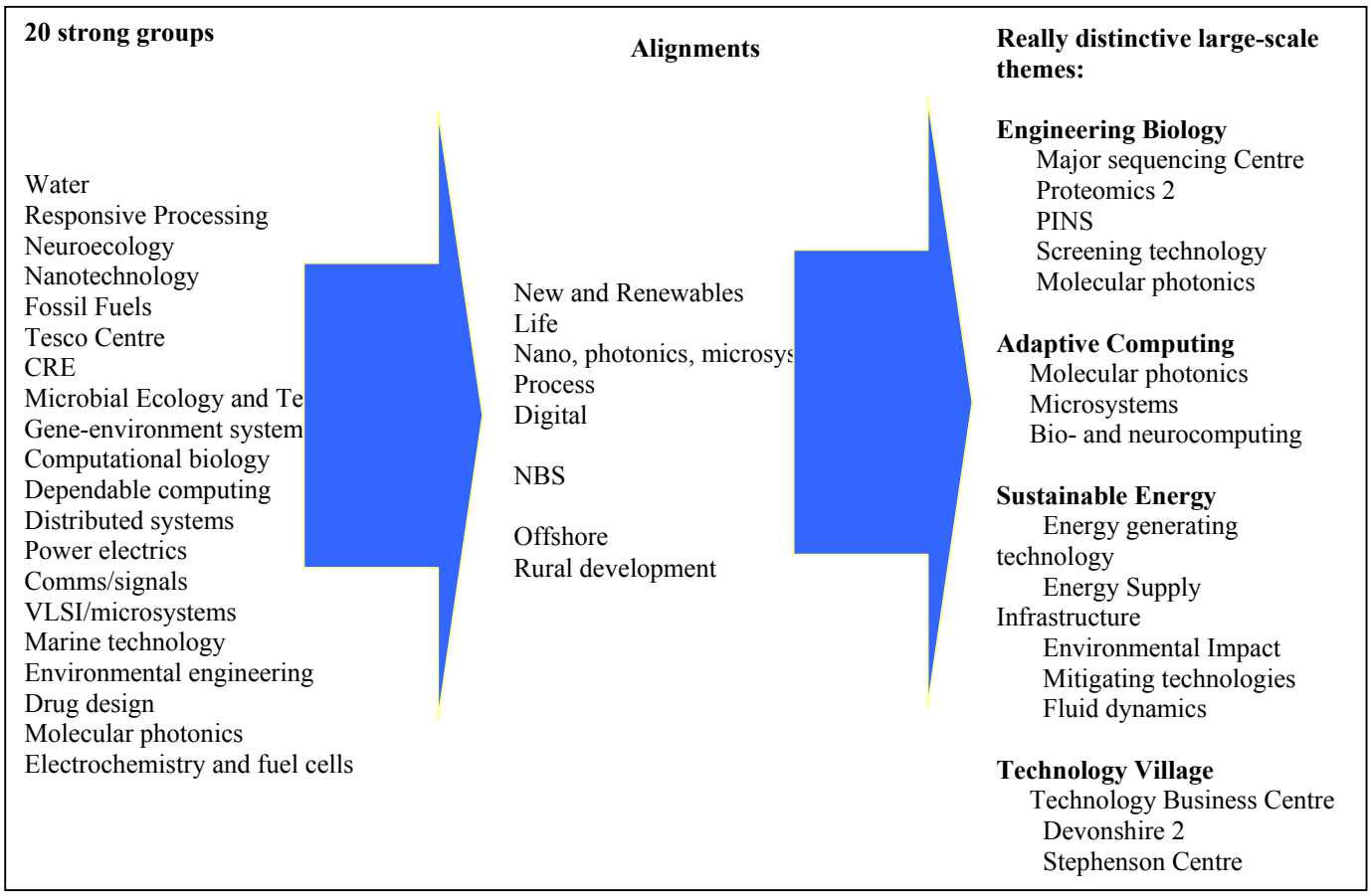
The third pillar is devised in recognition of the fact that young entrepreneurs have few assets, and that comprehensive support mechanisms to assist them in spin-out company formation must be installed, if they are to have any chance of survival. The INEX model therefore provides for: (i) Salary subsidies in the form of Entrepreneurial Fellowships for up to 18 months, (ii) A full range of business support services, including administrative, financial, and legal advice, and (iii) Accommodation in incubator units entirely integrated within the on-campus university R&D environment.

Graduates are given a significant equity stake in spin-offs formed. Senior researchers, who may have generated the actual IP, receive a small equity stake. This reflects the respective levels of risk, and provides the necessary incentive to graduate entrepreneurs. Senior researchers, who would probably not have pursued the idea to commercialization anyway, are 'incentivised' via the opportunity, over time, to acquire equity in a large number of spin-outs, with the added advantage of negligible personal risk. For them it is a win-win situation. And they can continue to do what they do best – generate ideas.

2.2.10 Technology village and estate strategy

While INEX provides an example of a Research Institute initiative to promote the commercialisation of research, the concept of the *Technology Village* may illustrate a key Faculty-level initiative. Technology Village is a concept developed by the Faculty of Science, Agriculture and Engineering (SAGE). The basic idea is that the best way to ensure that SAGE takes up a position "at the heart of regional economic development", is to place regional economic development at the heart of the faculties (Young 2003). In order to achieve that, SAGE has mapped its research, and aligned its priorities with the Centres of Excellence defined in the region: Digital Technology and Media; New and Renewable Energy; Process Industries; Nanotech and Microsystems; and Life Sciences. This realignment of research is illustrated in figure 6 below.

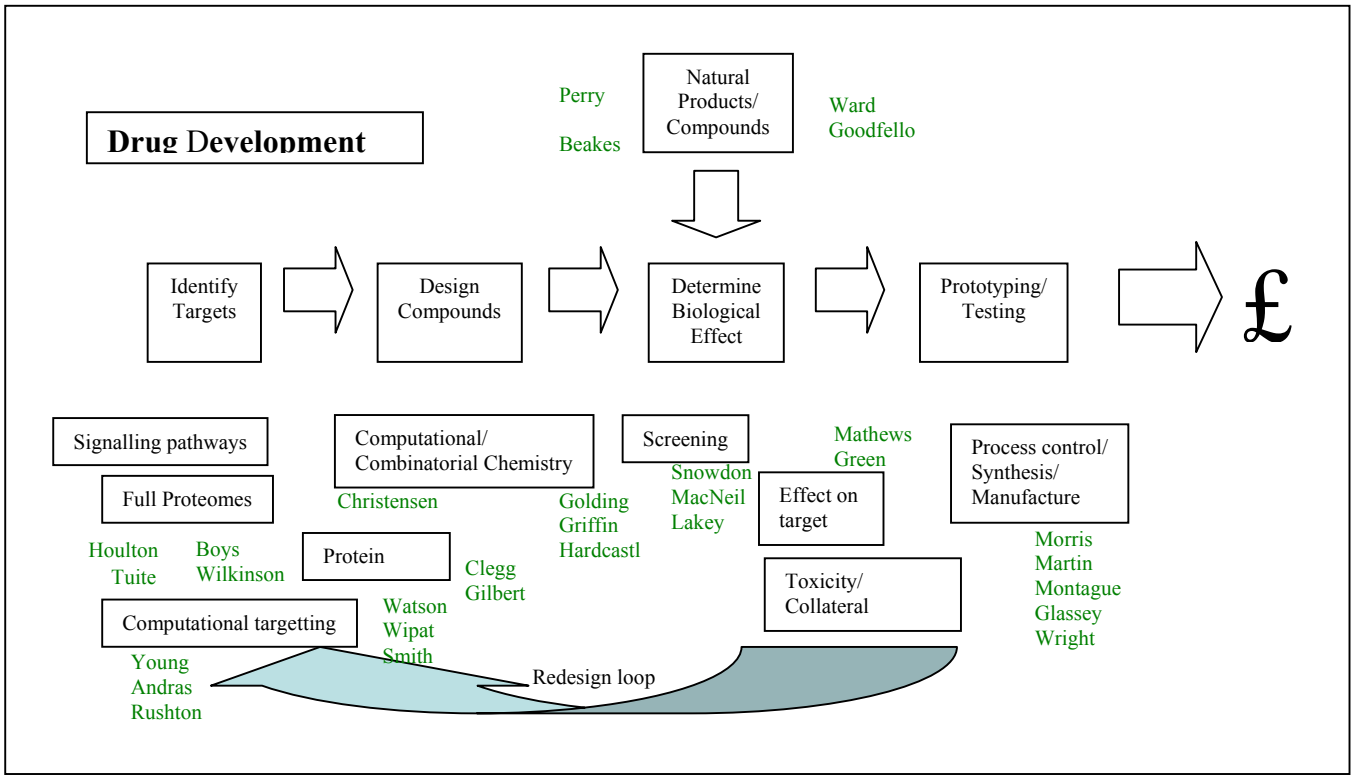
Figure 6 Reconfiguration of the Science, Agriculture and Engineering research base



Source: Young 2003

In addition to this realignment of research with the Centres of Excellence, SAGE has identified a number of multidisciplinary innovation and commercialisation chains. For the purpose of illustration, an example hereof is given in figure 7 below.

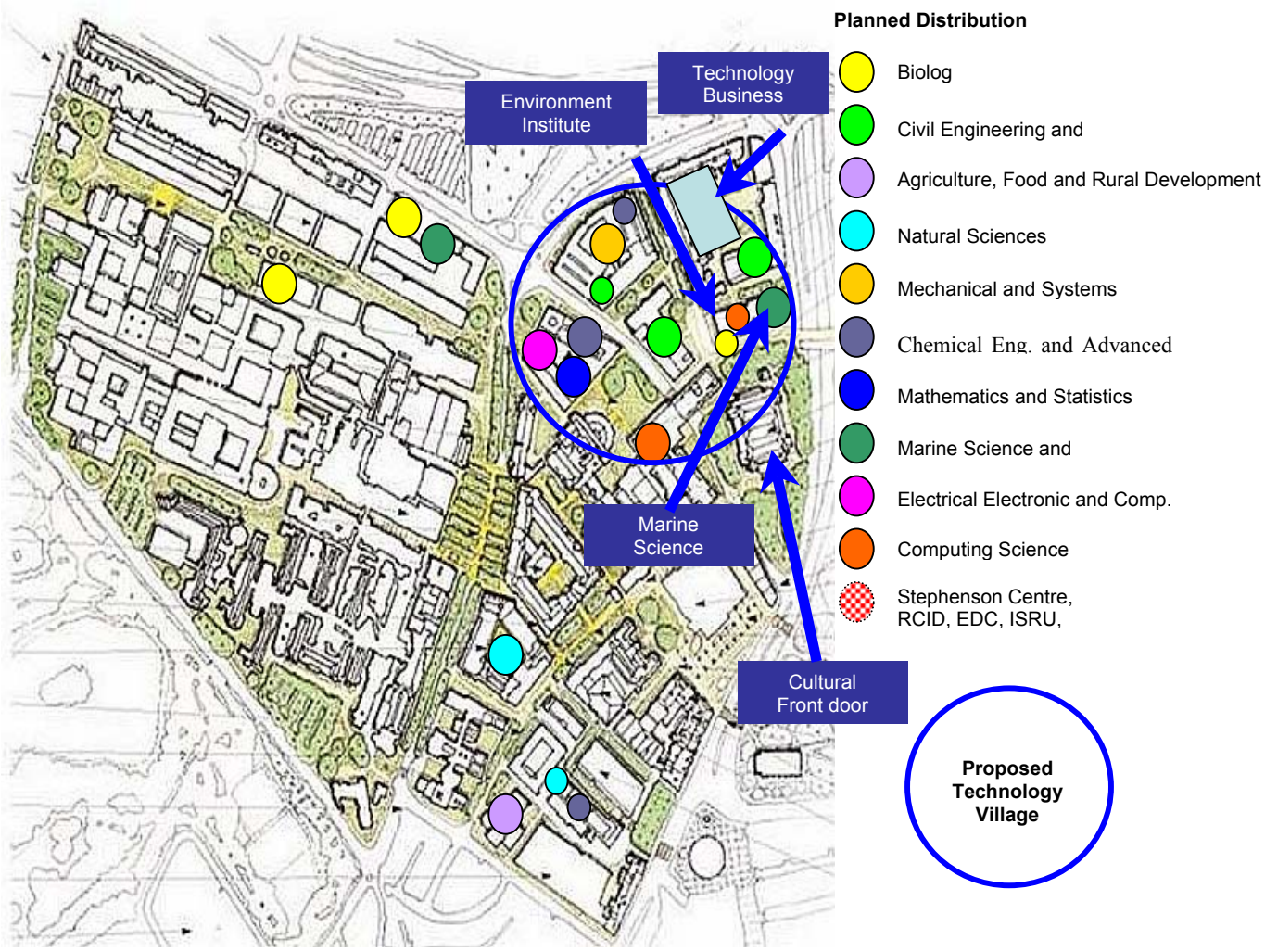
Figure 7 Realigning research for the commercialisation of drug development



Source: Young 2003

This realignment of research and the identification of multidisciplinary innovation and commercialisation chains has been supplemented by a third initiative: a spatial reordering of the constituent schools and institutes of the Faculty, to constitute a Technology Village within the campus area, cf. Figure 8 below. This spatial reordering of SAGE is still in its early phases, and it shall not be described in furhter detail here. For now it suffices to note that the approach taken at the University of Newcastle operates in many layers, and that it involves a quite comprehensive restructuring of its research, its teaching as well as of its estate. In sum, the concept of *Technology Village* is built on one key premise: by getting enterprise into the same location as expertise, and by aligning research, an unusual science park is created, namely "a science park with a lot of science in it" (Young 2003).

Figure 8 Technology Village – Reorganising SAGE



Source: Young 2003

2.3 Key observations

The University of Newcastle is an interesting case because the university management, in restructuring the university institutionally, has professionalised its interface with business and its contribution to the regional economy. Further, the University of Newcastle is an interesting case because of the model for commercialisation that it has devised within the confines of its university innovation centre in nanotechnology. This model constitutes a new and cutting edge approach to the third mission agenda. The novelty of the approach is to systematically think in terms of processes and students, rather than narrowly in terms of senior researchers, patents and start-up companies. There is a shift in focus, from commercialisation of research results to an entrepreneurialisation of the university and its students as such.

It is important to stress that the Newcastle approach constitutes a determined and wide-ranging effort to bring economic development to the heart of the university – rather than thinking of 'third mission' activities as something that can be taken up as merely an appendix to its existing research and teaching, or be 'out-sourced' to a smaller or larger number of intermediary institutions.

DISCUSSION – Strengths and weaknesses of the two models

A key strength of Symbion is its expertise and know-how in supporting new businesses in their early development. The range of consulting services offered in-house by Symbion Management is very wide, and is indeed by European standards impressive (compare EC 2002). A further key strength is that by locating at Symbion new businesses get access to a wide and well-nurtured network of existing companies in the two target industrial clusters, IT and Biotech. The greatest weakness of Symbion seems to be its links to the higher education institutions of the area, however. Though such interaction does of course exist, there is little *systematised* and *institutionalised* interaction with universities, business schools, etc. One reflection of this is that student awareness of Symbion – and more generally of commercialisation of research as a career option – is rather low. We argue that neither Symbion nor the universities can be blamed or held responsible for this low level of interaction. Instead, the low level of interaction should be seen as a result of the model itself – a result of promoting commercialisation of research by setting up intermediary institutions. A recent benchmarking report by the OECD stresses this point. Discussing the traditional approach to science parks, the OECD phrases the problem in the following manner:

> A relatively large infrastructure of intermediary organisations has developed in response to succesive initiatives…[T]he issue at stake is whether excessive emphasis on specialised transfer agencies could monopolise knowledge flows and act as a barrier to the creation of positive knowledge culture diffused throughout the industry-science nexus. In other words, is there a risk in consigning ISRs [Industry-Science relations] to peripheral units away from the core? (OECD 2002: 153)

The danger is, in brief, that by building intermediary institutions such as Symbion, we may in fact institutionalise and sedimentate a low interaction between higher education institutions and industry. By creating these intermediary institutions we produce the illusion of bridging the gap between science and economy, while in fact such intermediaries contribute significantly to keeping the *institutions* of science and economy *apart*. This brings us to the key strength of the Newcastle model. Here the vision is not to *transfer* certain research results with particular commercial potential from the university to the regional economy, rather it is to make *the university as such* an active player in the regional economy, i.e. to place the university "at the heart of the regional economy". A fundamental difference between this model and the traditional model is that the traditional model is tailored to help commercialise research whereas the former seeks to build an institution that is capable of *producing* commercialisable research. The traditional model is tailored

to help new entrepreneurs commercialise research-based technologies, whereas the Newcastle model seeks to make entrepreneurs of students and commercialisable technologies of research.

The Innovation Chain

Students => Knowledge => Commercialisable Research => Products => Sales

The traditional model addresses only the last phases of the innovation chain, whereas the Newcastle model is full range in its scope. In this sense, one may say that the Newcastle model – which we may term the 'campus model' as opposed to the traditional 'greenhouse model' – represents a second generation of science park thinking: *universities as science parks*. The traditional model may successfully nurture a set of new businesses every year, but its contribution to rendering Greater Copenhagen a more entrepreneurial economy will at best be modest. With regard to this wider task, the campus model is far more promising. In 2001, the Global Entrepreneurship Monitor made a comprehensive report on entrepreneurship in Denmark. This report concluded:

> Whichever way the data is analysed, the evidence is that entrepreneurial education in Denmark is in need of a major overhaul… The government's current preference for a "hands off" and indirect approach to ministering the nation's education in this area seems to present a rather bleak future, given the nature of the changes that are required to be made. Only direct government intervention is likely to have any effect on issues such as the encouragement of a more entrepreneurial attitude amongst the members of education establishments and in the courses offered by those institutions (GEM 2001: 126-127).

A first step in that direction would be, to place future science park initiatives firmly within the institutional framework of existing higher education institutions. More generally, a clear choice should be made: Which of the two models for promoting the commercialisation of research is opted for – one without intermediary institutions, or one in which intermediary institutions are thought to be key? [12]

[12] According to Malcolm Young, a key barrier to promoting commercialisation of research is the co-existence and "confusion of different models of engagement of the science base" - e.g. one without intermediaries, with one in which intermediaries are thought to be key (Young 2003).

In conclusion, the two models for promoting the commercialisation of research may be summarized schematically as follows:

Table YX Two Science Park Models – First and Second Generation?

	Symbion	*University of Newcastle*
Overall concept	Greenhouse model	Campus model
Prime objective	Business incubation	Regional economic development
Innovation chain	Final phases	All phases
Key resource	High-Tech Business Plans	Students

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