

Growing Pains in Irish Biotechnology

Simon Gillespie and Dr. Colette Henry

Centre for Entrepreneurship Research,

Dundalk Institute of Technology,

Dublin Road, Dundalk,

Co Louth,

Ireland

Tel: +353-42-9370506/9370225; Fax: +353-42-9330944;

E-mail: simon.Gillespie@dkit.ie; colette.henry@dkit.ie

www.entrepreneurshipresearch.com

Abstract

Ireland's biotechnology sector is primed for a revolution. Biotechnology, defined as "the application of knowledge of living organisms, and their components, to industrial products and processes" (Biotechnology Clusters, DTI, 1999), is now considered vital to Ireland future economic success (Harney, Enterprise Ireland, 2002). While exact figures are difficult to obtain, the EU estimates that by 2006 the biotechnology sector will be worth an estimated €250billion, employing more than three million workers (Technology Foresight Report, 1999).

To date the sector has not been subjected to concerted academic scrutiny. However, a number of recent studies have begun to investigate the sector. These studies have examined a range of issues, including, the impact of policy tools on the formation of new biotechnology firms in Taiwan (Hsu, Shyu and Tzeng, 2005) and reforms in the biotechnology sector undertaken in Japan (Lynn and Kishida, 2004). A core objective in the Government's biotechnology strategy is to stimulate growth and development among Ireland's emerging, indigenous biotechnology sector (Enterprise Ireland 2002). Currently, there are less than 50 indigenous bio-enterprises in Ireland, most are micro companies and at an early stage of development¹. Furthermore, due to the nature of their activities, most bio-enterprises do not generate any profits in the early years, even bio-companies that have some revenue, tend to invest the bulk of their turnover in long-term product development.

By way of strengthening our understanding of this important area, this paper provides an analysis of the state of the biotechnology sector in Ireland. In contrast to its competition, Ireland as a nation was relatively late out of the starting blocks in the race to the forefront of the biotechnology world markets.

To lessen the gap between the pioneering and fully developed world leaders in biotechnology, the Irish government prioritised the biotechnology sector as an area for increased development together with major funding programmes into three vital areas, attracting overseas biotechnology companies, increasing the levels of applied research funding and creating and developing indigenous biotechnology start-ups.

The paper will aim to provide an insight into the biotechnology sector and the allocation of government investment in this potentially lucrative market both domestically and in a global arena. The paper will try and evaluate if the indigenous companies are allocated the necessary resources to compete globally, as well as assessing the strategies and challenges facing the sector presently and in the future.

There are currently 60 biotechnology-based companies on the island of Ireland. 42 of these companies are indigenous and 18 are multinational corporations. Of these 60 firms 40 are involved in biotechnological research and or processes. These include companies involved in biopharmaceutical discovery and manufacturing, diagnostics, pharmaceutical services, bioenvironmental technology and agri-food technologies. They include a mix of indigenous and multi-national companies.

This paper will examine the Irish biotechnology sector in relation to the development and funding, as well as what strategies are in place presently and future strategies. The paper will then look at investments in indigenous companies and venture capitalism within the industry through and the examination of government policies towards the industry. Also bio-Ireland funding and all the forms of financing used in the industry and how the SFI allocates its funding and resources in the indigenous biotechnology sector.

The paper will conclude with some present challenges facing the industry and look at possible future issues which the Irish biotechnology sector may face in its quest for an increasing share in the global market, as well as the critical role the governments agencies will play in these challenges.

Introduction

Biotechnology is now identified as a key growth sector in Ireland's portfolio of economically successful industries (Technology Foresight Ireland Report, 1999). Defined as the "application of scientific and engineering principles to the processing of material by biological agents" (Forfas Report, 1999), biotechnology is fundamentally a facilitating technology, pertinent to every aspect of daily life through healthcare, food and agriculture as well as pharmaceutical, chemical and environmental procedures and processes.

Given the importance of the pharmaceuticals, healthcare, agriculture and food processing industries to the Irish economy, it is of the utmost importance that the Irish market embraces and develops a strong and sustainable biotechnology sector to keep up and eventually spear head global developments in this dynamic and expanding area.

By 2005, it is estimated that the biotechnology sector will generate €250 billion and account for over 3 million jobs within the member states of the European Union (Biotechnology Foresight Ireland 2002 –2005 estimates). Ireland, Ireland was recognised among the top 25 global locations for biotechnology in "Beyond Borders" (Ernst & Young – Global Biotechnology Report 2002). In contrast to Ireland's position in this report, is the stage in which Ireland's indigenous biotechnology sector is presently at.

In stark contrast to the Ernst & Young report from 2002, the Irish indigenous biotechnology sector is in the relatively early stages of development. There are currently 60 biotechnology-based companies on the island of Ireland, 42 of which are indigenous and 18 of which are multinational corporations. Of these 60 firms 40 are involved in biotechnological research or processes. These include companies involved in biopharmaceutical discovery and manufacturing, diagnostics, pharmaceutical services, bioenvironmental technology and agri-food technologies.

These sectors along with the Integrated Communications Technology sector are now key industries prioritised by the Irish government for development and further investment, through structured research and development assistance programmes.

Research Context

The Emergence of Biotechnology in Ireland

When the global biotechnology sector was in its infancy and predominantly occupied by research and development during the 1980s and early 1990s, the idea of Irish economy joining such an industry was implausible on several levels. An Irish biotechnology sector didn't exist during that period because the economy was in recession, poor infrastructural resources, and stealth taxes with no investment incentives, there were unfavourable levels of inflation as well as the "brain drain" of the 1980s. As indicated above, the Irish government was in no position to support or fund any initial concept of developing such a new and unknown sector.

From the mid 1990s onwards, the economical climate of the country began to change. Entrepreneurial competence was rewarded and Irish industry as a whole was growing at unprecedented rates. Towards the late 1990s, the Irish economy was well positioned with both the appropriate economic climate and finances to embrace this relatively new and dynamic industry. Ireland, with its improving infrastructure and increasing capital investment allocation to fund a potentially beneficial sector to its ever growing knowledge-based economy, was now ready to get involved with the biotechnology sector on a global level.

This turnaround in the Irish way of thinking was in part due to Forfas¹ identifying the Biotechnology sector as a strategic input to enabling Ireland's future industrial development plan (Forfas 1996 – A strategy for enterprise in Ireland in the 21st Century). After the publication of the Forfas report, in the late 1990's the Irish government finally put in place a "Biotechnology Strategy". Although the strategy was criticised to a degree in the subsequent publication of the Technology Foresight Ireland Report in 1999, criticising the poorly funded science bases and recommending vast improvement in research and development of new companies and existing companies, the path towards biotechnology was well and truly established.

At the time of this publication, Ireland was far from being identified as a centre for biotechnology. After Greece, Ireland's investment in government supported R&D was less than 1% of total government expenditure². The overall configuration of the Irish biotechnology research programme was weak and Irish biotechnology graduates were emigrating to more sustainable biotechnology industries around the world. In the area of commercialising the Indigenous biotechnology sector, little funding was allocated to start-up companies.

"Unless investment does occur, Ireland will not only fail to benefit from the new biotechnology in terms of a large number of new, high quality, high added value jobs, but many existing jobs in the pharmaceutical and chemical industries, the food and drink industries and in agriculture will be jeopardised" (Technology Foresight Ireland Report, 1999 pg.6)

¹ Forfas - the Irish national policy advisory board for enterprise, trade, science, technology and innovation

² European Report on S&T indicators, 1997

The Technology Foresight Ireland Report in 1999 report argued that for a bio-industry to succeed in Ireland, strong collaborations between the government, universities and industry were fundamental. The report put forward a number of recommendations, which included:

- The development of a quality R&D programme to foster “leading edge” research
- Additional focus on the commercialisation of research output through Biosearch Ireland
- Developing imaginative schemes to foster an indigenous industry while also attracting foreign investors
- The establishment of the Irish Biotechnology Start-up Fund, investing in biotech companies in the early stages of development
- Putting in place a communications strategy to increase public awareness and participation, information, communication and confidence in biotechnology

Through further research into the feasibility of a sustainable biotechnological sector in Ireland with the potential to expand into a global player, the Irish government acknowledged two issues, which could impinge on these potential successes and advancements in the sector. The issues integrated; the need to address public concerns involving modern biotechnology and ensuring an adequate science base in Ireland.

To deal with the issue of public concern and lack of knowledge towards biotechnology, the Irish council for Science Technology & Innovation produced a report in 2005 highlighting the issues involved with the negative coverage of the field of biotechnology was receiving through, for example, the portrayal of the genetic engineering sector and how this was effecting the public perception of the biotechnology sector as a whole. This was highlighted in the Eurobarometer survey carried out in 1999. The report observed the public’s poor understanding of the subject and called for open, neutral, up-to-date information to be readily available to the public.

With the help of the report published in 2003 called “Building Ireland’s Knowledge Economy, The Irish Action Plan for Promoting Investment in R&D to 2010”, the government set about finding a solution to the problem of building an adequate science base in the country. The report established the presence of a sizeable gap between the requirement and actual availability of skills necessary to build biotechnology clusters in Ireland. The report went on to resolve that the future growth of an Irish Biotechnological sector, would be determined by three resolute factors, firstly scientific advances, secondly the ability of firms to find commercially viable ways to apply this new knowledge and finally the competitiveness of Ireland as a location for the undertaking of basic research together with its commercialisation prospects.

The government needed to invest in producing a skilled labour force in this sector and also in the promotion and development of the sector to develop it into a world-renowned nation for Biotechnology. This, together with the establishment of the Science Foundation of Ireland in 1999, coupled with the unveiling of plans for capital

investment and the allocation of necessary resources, further develop and improve Ireland's position as a successful and innovative knowledge-based economy. The issue regarding the falling numbers enrolling in science-based courses at third level was also highlighted in the report. The report stated that:

“Ireland must increase the supply of science-related skills in the economy if the biotechnology sector is to realise its full potential over the next seven years.”
(Building Ireland's Knowledge Economy, The Irish Action Plan for Promoting Investment in R&D to 2010)

The report concluded that Irish universities must gradually decrease their dependence on public funding and become more entrepreneurial and enterprising. This would involve prioritising the needs of the enterprise sector together with using the scarce resources at hand to their advantage, preferably developing a source of income generation to each 3rd level institution. The report finished with the open idea that more funding for the science and biotechnology sectors was required, to reduce the gap between the supply and demand of skilled individuals in the biotechnology sector.

The Role of the Government

Over the past number of years the government has undertaken several high profile funding and development programmes to promote biotechnology. The establishment of the National Biotechnology Programme in 1987, which aimed to develop commercially viable biotechnological research in Irish universities, led to the creation of BioResearch Ireland. This was an externally contracted research organisation employed to explore the concept of commercialising existing biotechnology and developing the expertise and infrastructure necessary to facilitate biotechnology in Ireland.

BioResearch Ireland played a pivotal role in transforming 3rd level research information into practicable industry information. BioResearch Ireland's exact objective is “to create start-up companies based on new technologies”.

The main task of the Science Foundation Ireland (SFI) ³ is to develop and promote the range and value of biotechnological research in Ireland, through funding and development programmes.

Numerous reports strongly indicate that enterprises which perform research and development are more likely to grow and expand as well as provide higher quality and better paid employment.⁴ Between 2000 – 2006, the government allocated €648 million to the SFI, for research and development.

The SFI's research and development funding increased by €58.4 million to €348.4 million in 2002. This increase was broken down into €13.9 million to 3rd level research, €32.7 million directly to the Science Foundation of Ireland and €8.5 million increase to Teagasc's⁵ funding allocation. In 2005 SFI allocated €170 million to biotechnology. The Chart also shows how the funding was broken down and deciphered. The biotechnology sector in Ireland prospects were also enhanced with

³ SFI- Government agency which builds and strengthens scientific and engineering research through grant aid

⁴ Kearns and Ruanne, 2001

⁵ Teagasc- The Irish agriculture and food development authority

the help of government agencies such as Enterprise Ireland the government agency assigned to supporting and developing indigenous industry, which launched a biotechnology strategy to initiate start-ups and help develop them into viable businesses. Enterprise Ireland also launched the first dedicated Biotechnology and Life Sciences Fund in Ireland with an investment of €15 million. Another government agency, the IDA⁶, supports growth within the foreign-owned manufacturing and services industries, and also promotes Ireland as a location for foreign investment for overseas multinational science and pharmaceutical companies.

Prioritising The Biotechnology Sector in Ireland

Biotechnology is now fulfilling its promise to become one of the key sectors in the creation of a high-tech research and industrial base in Ireland and is primed for growth. According to Michael Ahern T.D., Minister for Trade and Commerce:

“The Irish Government is committed to a pro-business, pro-science environment to transform Irish Industry. It is making an unprecedented level of investment in science and technology to create a vibrant and well-supported biotechnology research community, giving a substantial resource for technology solutions and the basis for a stream of technology-based start-ups”(Michael Ahern T.D., Minister for Trade and Commerce).

The biotechnology sector in Ireland, both north and south, is beginning to blossom. On the Island there are 60 companies large and small, focusing on a diverse number of areas. In total they employ over 4000 people and although nearly sixty percent of these jobs are with multinationals, there is an increasing trend in the formation of indigenous companies. With the Biotechnology strategy Enterprise Ireland launched in 2002 organisational resources were integrated to deliver upon the targets set out in the plan.

New venture capital funds appear to be freer flowing in the last couple of years than in the previous decade, with venture capitalists focusing on investing in indigenous start-ups. A recent study (Mapping the Bio-Island, 2004) by the north/South trade and business development body, Intertrade Ireland, reports that twenty-five of the biotechnology companies “originated as spin-offs from university research”.

Dr Ena Prosser, who was appointed the Director of BioResearch Ireland, believes that support for academic research is key to the growth of indigenous biotech companies.

“We need to engage our universities with industrial growth and the knowledge economy. Biotech, like software and electronics is one of the key levers to drive our economy and the investments by the Higher Education Authority and Science foundation of Ireland are key to developing a robust stream of entrepreneurs, ideas and trained employees in the future.” (Dr Ena Prosser- Director of BioResearch Ireland, 2003)

⁶ IDA- Irish state industrial development agency

Funding and Investment

Irish biotechnology at present is benefiting from combined funding of more than €1 billion from the SFI, Enterprise Ireland, the Higher Education Authority, the Health Research Board and the European Union. The majority of this investment is aimed at improving our research and development base, which is vital to strong growth in the sector.

Since 2003, dedicated incubation space for biotechnology start-ups has doubled. The need for laboratory space was identified because of the different requirements between the life sciences and areas like software. Over €4 million has been invested to date by Enterprise Ireland on the provision of wet-lab facilities in Irish third level institutions. When all of these facilities are fully operational, there will be bio-incubation space and support for up to 15 companies. The bio-incubator programme is another element of the Enterprise Ireland strategy “Building Biotech Businesses” designed to fast track opportunities to business. Ireland may have come relatively late to the biotech table, but increased funding for life sciences research is now resulting in more high tech commercial opportunities.

Under the National Development Plan 2000-2006 the government has committed €2.5 billion to research, technological development and innovation. Of this, some €605 million has been dedicated to the programme of Research in Third Level Institutions, from which funding was provided for the National Centre for Sensor Research. In 2005 the funding grew to €131 million, establishing university-based centres of excellence with significant levels of industrial development.

The biotechnology sector in Ireland is in the top three sectors for attracting venture capitalist funding in Ireland. In a survey carried out in 2004⁷, 15% of venture capitalists interviewed identified biotechnology as a sector in which they would be likely to invest. When the same question was put to the banks, the banks stated that only 5% of their funding is allocated to the biotechnology sector. The state agencies funding allocation only gives the biotechnology sector 5% of its total funding also.

Even though the Irish Biotechnology sector is still in its early stages of development, it is showing very positive signs for success. In the Intertrade report 2003. There are 60 indigenous biotech companies and at least another 4 start-ups preparing for launch. Their activities range from developing new methods of diagnosing and treating disease to products that assist in remedying mean environmental damage and prevention of such issues. What differentiates the biotechnology industry from others are the longer lead times involved in product and services development, which force some biotechnology companies to look at alternative sources of finance such as venture capitalism. In their early stages of development, biotechnology firms have to look beyond debt, venture capital and equity, all of which are common sources of finance in this sector. Some biotechnology firms even look to innovate deal structures to ensure a flow of funds as they commercialise their research⁸.

Traditionally the average EU member states spend on R&D has fallen behind their US counterparts with the Irish R&D expenditure behind the EU average. The SFI is trying

⁷ Henry, Colette et al – Access to Finance for Woman Entrepreneurs in Ireland: a supply side perspective

⁸ Keenan, Neil – Biotech sector continues to grow: Sunday Business Post 28/09/03

to redress this imbalance, with its allocation of €634 million to be invested in research between 2003-2006. SFI's goal is to attract academic researchers that can generate new knowledge and technologies in this sector. The long-term goal of this investment is to filter through to campus companies that are developing and commercialising technologies developed in academia.

The venture capital options open to biotechnology companies in Ireland has improved, with the establishment of two Enterprise Ireland backed biotech funds by Seroba and Growcorp. Overseas Venture Capitalists are also showing an interest in the Irish Biotechnology sector, and particularly in companies at the later stages of their development processes. According to the Irish Venture Capital Association, for every €1 million invested by local funders, overseas investors in the biotechnology sector invest €2 million. Seroba BioVentures manages the Irish Biosciences Venture Capital Fund (IBVCF), Ireland's first exclusively dedicated life science fund. Seroba launched a €20 million IBVCF in February 2002. It provides funding for promising new ventures from emerging companies as well as from third level institutions.

As the costs and timeframes involved in developing new technologies and products increases, biotechnology multinationals are outsourcing research projects to smaller biotechnology firms and indigenous Irish firms are in a position to benefit from these practices. All these schemes are assisting the development of a diverse and innovative Irish biotechnology sector. The only drawback to this is that more scientists of the necessary calibre are needed to develop the biotechnology incubators into an integrated national structure.

Seroba BioVentures funds various biotechnology companies with a large portfolio, which includes:

- AGI Therapeutics Ltd, with an investment of €9.5 million together with a syndicate of investors.
- Alimentary Health Ltd, Seroba has invested €1.3 million with Enterprise Ireland.
- Deerac Fluidics Ltd has received funding to the value of €2.8 million from Seroba and an Irish syndicate of investors.
- Diabetica Ltd, received seed funding from Seroba
- Eclipse Clinical Technologies, received €2.91 million from Seroba as well as from Irish investors.
- Opsona Therapeutics, received part of its €6.25 million in funding from Seroba.
- TriMed Research Inc, received €5 million from Seroba

A private venture capitalist firm called Growcorp was set up in Ireland recently. It is an integrated bioscience investment, advisory and incubation company, which delivers the resources to give a new biotechnology company a head start it needs to survive in this aggressive marketplace. Growcorp was the first private company in Ireland with an investment fund targeted specifically at the biotechnology sector with the help of the European Bioscience Fund. Growcorp invests at early stages of biotechnology companies with amounts up to €1.27 million, as well as leading syndicates with funds in excess of €5 million for more advanced businesses. Growcorp works with entrepreneurs to get their business from start-up to commercial

reality with services from strategy optimisation to fund-raising and team building advice. Growcorp's portfolio includes biotechnology companies such as:

- Fluorocap
- Gas Sensor Solutions Ltd
- Merrion Biopharma Ltd
- NEUtekBio Ltd
- Orakine Ltd
- Pharmatrin Ltd

The Science Foundation of Ireland (SFI) was established to facilitate and award government funding in the area of research in biotechnology. The SFI invests in academic researchers and research teams to innovate and generate new knowledge, leading-edge technologies and competitive enterprises. SFI invests with a strategic outlook and lends its expertise and knowledge to developing companies and individuals either through research or practical aspects of their studies. The SFI now funds over 80 researchers and has commitments of over €170 million. It indirectly employs 550 plus life-science researchers in Ireland.

To complement the SFI's work, Enterprise Ireland has launched its Biotechnology Strategy, with the target of increasing the number of Irish Biotechnology companies to 60 by 2006 and 130 by 2010. Together with sales growth of €230 million in 2006 and €635 million by 2010. These projections are expected to increase employment in this sector to 5000 staff.

The evident Growing Pains in Irish Biotechnology

The universal problem for newly established biotechnology businesses is the mismatch between early stage needs, and the resources, both human and financial, available to meet those needs. In the Enterprise, Trade and Employment Report on Business failure (2001), stated that 33% of businesses fail within the first 4 years of operation. Within the biotechnology sector, the failure rate is much higher because on top of the normal reasons for failure are issues such as internal and external economies of scale as well as longer product development lead times.

Other issues, such as access to funding, growth capital, investment and commercialisation of bio-research are critical obstacles to overcome in order for biotechnology companies to grow and prosper in this demanding global marketplace.

- ***Lack of access to funding and growth capital***

Research indicates that access to funding particularly venture capital funding is an issue for biotechnology companies, which is slowly becoming more accessible as the industry gains more recognition through its development and expansion. One of the main barriers to venture capital funding in biotechnology arises from the unique feature of the sector. Due to the long-term development of products and technologies, which is an extremely costly and complex process with a lot of uncertainties appended. To add to this funders and investors have also been put off by the small size of most biotechnology companies. As already indicated there are very small numbers of start-up companies being allocated funding by banks and venture capitalists. While investors are slowly coming around to the idea that investing in

biotechnology is beginning to become acceptable and competent. On the opposite side of the coin, biotechnology ventures have traditionally had a high failure rate⁹. According to Harding and Lissenburgh (2000), it is estimated that for every 100-biotechnology research ideas, only one is likely to have any commercial potential.

From an investment standpoint, biotechnology is a high-risk activity, both from a cash flow and lifespan perspective. In terms of Irish Biotechnology, accessing venture capital funding is a major obstacle and issue because of both risk and the newness of the industry in terms of other well-established sectors. While venture capital funding in Ireland has increased significantly in recent years (Henry et al, 2004), funding is still concentrated in the ICT market. In 2002, the government announced Ireland's first venture capital fund solely to the biotechnology sector under the management of Seroba with a fund of €25 million and to date has completed a first round of funding of €15 million.

While such initiatives are welcomed, most active investment houses, banks or state agencies require a good knowledge of the industries in which they are being asked to invest. This issue, together with the relatively innovative and dynamic temperament of the biotechnology sector, leaves it a difficult sector to become involved in from a funding perspective. This is also amalgamated with research that shows that awareness of venture capital firms on the part of the entrepreneurs is low, and this is where specialist advisors need to be brought in to guide and advise the proposals to the venture capitalists.

- ***The Investment and Commercialisation of Bio-Research and Development***

It is generally accepted that research capacity is the key issue for the long-term development of the biotechnology industry. Since 1994, the Irish government has increased the level of investment in R&D five-fold from €500 million between 1994-1999 to €2.5 billion between 2000-2006 under the national development plan. Conversely, Ireland invests 1.4% of GNP into R&D, while the UK invests 1.84% of GNP. According to a recent report¹⁰, this proportion of resource allocation needs to be raised significantly to 2.5% of GNP to ensure a more sustainable economic environment for this island nation to maintain its competitiveness in the global market place.

In addition to this report, a number of papers have been published concerning the commercialisation process involved in biotechnology in third level institutions in Ireland, have identified several weaknesses in the current system and economic climate. An Enterprise Strategy Group (ESG) survey (2004), profiled the current status of commercialisation among Ireland's R&D institutions, identified a number of serious weaknesses in the commercialisation process. The report commissioned by Intertrade Ireland in 2002, found that many of the staff involved in the commercialisation process lacked the skills necessary to successfully transfer research into commercial products and services. The report identified the following weaknesses:

⁹ Based on US research, Forfas Report, 1999

¹⁰ Building Ireland's Knowledge Economy - 2004

- ❖ Low number of staff involved in commercialisation
- ❖ Inexperienced and under qualified staff
- ❖ Time dedicated to other duties performed by commercialisation staff
- ❖ Limited budgets for commercialisation

Some of the Key Findings

The report concluded by stating that, in order for commercialisation to be improved in Ireland, the individual institutions would need to develop a clearer policy commitment to the importance of the commercialisation function. The report finished by declaring such a commitment was necessary in order to ensure adequate resources for the commercialisation role.

Ireland is currently going through the difficulties that the Australian biotechnology went through about five years ago, as it also was not in the commercial aspect of biotechnology from the start and was a relatively late arrival to the global stage. Australian research institutes and universities have also yielded innovations that could have been furthered with proper development and funding but could not because of lack of growth capital and inexperienced management in this sector. To an extent Ireland is currently facing similar problems. The Australian Biotechnology authorities developed three strategies to try and overcome these obstacles to further development.

The strategies were¹¹:

- (1) Heavy reliance on public capital to develop a revenue stream leveraging aligned products and services.
- (2) Improve access to foreign capital through mergers with foreign companies.
- (3) A third strategy used by Australian companies was to partner early with larger foreign-based companies to gain access to sophisticated and expensive development capabilities.

From these strategies conceived five years ago, greater government incentives had been made available, funds have been raised from overseas and some Australian companies have set up in the US and recruited the necessary and experienced management. Also initiatives have been put in place to promote the national visibility of the sector as well as a new and improved national BioAus website.

¹¹ Timothy F Herpin et al, Australian Biotech companies: Navigating the maze, 2005

Conclusions

This paper has provided an insight into the resources as well as the funding methods used by Irish biotechnology companies at present. As the paper shows, there is a fissure between the biotechnology funding available and the demeanour in which companies are seeking out and searching for the funding, which is vital to their continued existence if they want to strive forward into the global market place.

As Ireland is a small open economy, it will need to develop a critical mass if it is to create a successful biotechnology sector on the island. However the policy makers and state agencies are trying to narrow the gap between policy objectives and implementation with newly set up support agencies and funds managers. With all these stakeholders put in place, the indigenous industry is still between seed and early growth stages and major issues are surfacing regarding collaboration, commercialisation and access to funding with administrative and industry problems slowing down the Irish biotechnology industries progression into a state of sustainability and expansion.

Irish biotechnology can learn from the experiences of foreign sectors that are at a more advanced level and draw on them to make sure that Irish industry does not experience the same barriers to growth and development.

Funding opportunities are significant for both investors and companies in search of investment. Although with the nature of the industry and the medium-term cash flow problems companies endure, the venture capital state management consortium has the necessary funds and skills to help indigenous companies overcome such apparent and critical shortcomings experienced in the biotechnology industry.

References

Biotechnology Foresight Ireland 2002 –2005 estimates, Dublin: Government Publications

Burrill, S. G., (1998), “Biotechnology: Structure, Challenges and Opportunities of a Global Industry in Transition”,
Innovation: Management, Policy & Practice, Vol. 1, Issue 4, p. 3

Enterprise Ireland (2003) “Technology Innovation Strategy, From Knowledge to the Marketplace”. Dublin: Government Publications

Enterprise Ireland, (2003), “Technology Innovation Strategy, From Knowledge to the Marketplace”. Dublin: Government Publications

Eurobarometer 5.2.1. (1999). “Biotechnology Attitudes in Europe.” Commission of the European Union, INRA - European Coordination Office, Brussels.

European Commission, Directorate General XII (1996). “Biotechnology R&D in Europe” published by the Science Research and development, EUR 17459 EN

European Commission (2002), “Life Sciences & Biotechnology – A strategy for Europe”, COM 27.

Ernst & Young (2002), “Global Biotechnology Report”

Forbes, T., Low, G., (2004), “Observations from the Scottish Biotechnology Sector”,
The International Journal of Entrepreneurship and Innovation, Vol. 5, Issue 3, pp. 179-190

Forfás (1996) “A strategy for enterprise in Ireland in the 21st Century” Dublin: Government Publications

Forfás, (1999) “Technology Foresight Ireland-Health and Life Sciences Panel”.
Dublin: Government Publications

Forfás (1999) “Technology Foresight Ireland Report” Dublin: Government Publications

Forfás (2002) “Baseline Assessment of the Public Research System in Ireland in the areas of Biotechnology and Information and Communications Technologies”. Dublin: Government Publications

Harding. R (2003) “Why Invest in Biotechnology, and How? Britain and Germany Compared”. The Work Foundation, London

Harney. M (2002), “Building Biotech Businesses”, Enterprise Ireland Dublin: Government Publications

Henry, C., Hamouda, A. and Johnston, K. (2004) “Access to Finance for Woman Entrepreneurs in Ireland: a supply side perspective”

Hsu, Y.G., Shyu, J.Z. and Tzeng, G. H. (2005). “Policy tools on the formation of new biotechnology firms in Taiwan”, *Technovation*, Vol. 25, Issue 3, pg. 281.

Irish Council for Science Technology & Innovation Technology Foresight Report, (1999). Dublin: Government Publications

Keenan, Neil (2003) “Biotech sector continues to grow” *Sunday Business Post* 28/09/03

InterTradeIreland,(2004),“Mapping the Bio-Island”
<http://www.intertradeireland.com/uploads/pdf/Biotech-1.pdf>

Irish Council for Science and Technology Innovation, (2005) “Technology Foresight Ireland Health and Life Sciences Report” Dublin: Government Publications
[ttp://www.forfas.ie/icsti/statements/tforesight/health/execsumm.htm](http://www.forfas.ie/icsti/statements/tforesight/health/execsumm.htm)

Kingston, W., (2001),“Protecting the inventions of smaller high-tech firms”, *The International Journal of Entrepreneurship and Innovation*, Vol. 2, Issue 1, pp. 5-12.

Lynn, L. H. and Kishida, R. (2004), “Changing Paradigms for Japanese Technology Policy: SMEs, Universities, and Biotechnology”, *Asian Business and Management*, Vol. 3, Issue 4, p. 459

Report to the Interdepartmental Committee on Science, Technology and Innovation, (2004), “Building Ireland’s Knowledge Economy-The Irish Action Plan For Promoting Investment in R&D to 2010”. Dublin: Government Publications

Prevezer, Martha (1998). “Clustering in Biotechnology in the USA”, *The Dynamics of Industrial Clustering*, New York and Oxford, Oxford University Press, 124-93.

Shohet, Simon (1998). “Clustering and UK Biotechnology”, *The Dynamics of Industrial Clustering*, New York and Oxford, Oxford University Press, 194-224.

Timothy F Herpin (2005), “Australian Biotech companies: Navigating the maze”

US Department of State (2005), “2005 Investment Climate Statement: Ireland”,
<http://www.state.gov/e/eb/ifa/2005/42063.htm>

http://www.sfi.ie/uploads/documents/upload/Biotech_Investment.pdf