

InterTradelreland, the Trade and Business Development Body was established in 1999 to 'exchange information and coordinate work on trade, business development and related matters, in areas where the two administrations agree it would be in their mutual interest.'

The logic behind the deepening of economic links is based on a clear economic rationale that increased co-ordination of trade and business development activity can help engineer the realisation of economic spillovers and synergies that will mutually benefit both the North and the South.

In the context of the deepening of economic links on the island of Ireland these benefits will be achieved through:

- co-operation, alliances and trade between firms,
- the opportunity to address a larger overall market,
- exposure of products and services to a wider range of demanding customers; and
- improved supply-side characteristics such as skills, training, technology and telecommunications infrastructure.

InterTradelreland's mission is 'to lead the development of the island economy through distinctive knowledge-based interventions which will produce significant returns in the areas of cross-border trade and business development'.

Knowledge - its creation, dissemination and exploitation - is the key to unlocking the potential of trade and business development. InterTradelreland's strategic framework is built on the use of knowledge to accelerate trade and business development across the island economy.

One of InterTradelreland's key strategic goals is 'to develop the capability of businesses to trade within the island economy by increasing the quality and quantity of knowledge and information on the dynamics of cross-border trade and business development', in our corporate terminology to increase knowledge capital.

The 'InterTradelreland policy research series' (IPR) is designed to contribute to the achievement of this objective by creating a bank of knowledge capital that will guide policy makers, inform business decisions and stimulate a wider debate on the benefits of North/South economic cooperation.

Disclaimer

The contents of this report are believed to be correct at the time of printing. This publication is intended to provide general information to its readers concerning the subject matter of the publication. It is not intended to provide a comprehensive statement of the subject matter of the publication and does not necessarily reflect the views of InterTradelreland. While care has been taken in the production of the publication, no responsibility is accepted by InterTradelreland for any errors or omissions herein.

TABLE OF CONTENTS	
FOREWORD	2
ABSTRACT	3
EXECUTIVE SUMMARY	4
INTRODUCTION	6
SNAPSHOT OF THE BIO-ISLAND	11
CURRENT AND POTENTIAL COLLABORATION	23
CONCLUSIONS AND RECOMMENDATIONS	30
APPENDIX I: Biotechnology Company Profiles	33
APPENDIX II: Geographical Distribution of Companies by Commercial Area	51
APPENDIX III: Glossary of Key Biotechnology Terms	57

FOREWORD

Many countries throughout the world have identified biotechnology as a key, sustainable technology, which will enable economic growth and the competitiveness of many sectors of industry including healthcare, agriculture, food and the preservation of the environment. Indeed, many have predicted that it will revolutionise society with no less an impact than that of the industrial revolution more than a century ago. Governments both North and South have already implemented measures for research and development in biotechnology that will underpin and help to embed a place for the island of Ireland amongst the global leaders. InterTradeIreland's mission is to lead the development of the island's economy through distinctive based interventions, which will produce significant returns of cross-border trade and business development.

It is therefore opportune that InterTradeIreland should have commissioned a survey of the private biotechnology capability on the island of Ireland. This report has been compiled by The CIRCA Group Europe and is entitled, Mapping the Bio-Island, A North/South Study of the Private Biotechnology Sector. The first of its kind, it explores the opportunities to build communities between companies and make the island of Ireland a 'smart place' for biotechnology. The report is also the first of a two part series. The second report will set forth the public biotechnology capability on the island. The reports will serve as reference handbooks for future cooperation between businesses, universities and government, North and South and I believe will provide a measurement from where to start in establishing a successful and competitive all-island biotechnology community.

Professor Michael Comer,

CHAIRMAN, IRISH BIOINDUSTRY ASSOCIATION, 1997 - 2002

Acknowledgements

InterTradeIreland would like to thank The CIRCA Group Europe, Professor Michael Comer and all the firms who participated in the survey, for their assistance with the report.

ABSTRACT

Biotechnology has been described as one of the main projected sources of economic growth for the 21st century. Considering the major contribution that biotechnology can make to several strategic industries, it is vital that Ireland, North and South rapidly adopts a leading role in extending and developing the sector. In a highly competitive environment, embedding a culture of collaboration and harnessing the potential of both jurisdictions will enhance the island's position to successfully compete in this global industry.

Over the last decade, the number of companies has been steadily increasing with the number of start-up companies accelerating in the late 1990's. Currently, the sector is comprised of 59 companies, active in areas spanning diagnostics, agri-food, pharmaceutical services, bio-environmental products/services and therapeutics.

Many of these companies have collaborative associations within the island but only a few have cross-border linkages. Significant interest has been expressed in initiatives that would increase collaboration and networking within the sector. Facilitating closer North/South collaboration was considered an obvious approach and the major opportunity areas covered R&D and joint technology development.

EXECUTIVE SUMMARY

This report quantifies the numbers, the scale and a selection of other characteristics for the private biotechnology sector companies on the island of Ireland. It also examines their current collaborative contacts and their interest in developing greater collaborative linkages. The study involved the identification of the stock of 'modern biotechnology' companies on the island, i.e. those companies who predominantly employ the tools of modern biotechnology to provide products and services. The definition of modern biotechnology employed was the application of molecular biology, cell or tissue culture or recombinant DNA techniques to organisms, cells or parts thereof in the manufacture of a product or as a component of a service provision.

A survey of company executives was conducted regarding their views on commercial activities, staff, R&D performance and their attitudes towards collaboration.

The sector, as defined, is composed of a total of 59 companies employing 4090 people. Of these companies 41 are indigenous and 18 are multinational. The companies are highly diverse in size and activity. Furthermore, of the 59 companies 26 are micro-enterprises, that is, with less than 10 staff, while only 17 have more than 50 staff. Within individual companies staff numbers range from 1 to 800, with almost all of the larger companies classified as being in the healthcare area, namely either in the manufacture of diagnostics or pharmaceuticals.

Those defined as biotechnology companies are involved in a diverse range of sectoral activities. The pharmaceutical-biologics sector is the major employer with a total of 2033 staff in 16 companies, half of which are indigenous; the diagnostics sector is almost as large with a total of 1657 staff in 21 companies (16 of these are indigenous). The major employers are the 8 multinational pharmaceutical-biologics companies, which account for almost half of the total of 4090 in employment.

On average the indigenous companies are predominantly of recent origin (average age of less than 5 years), are smaller (with average staffing of 29) and are usually based around the larger towns or cities with universities. Multinational companies are older (average age of around 19 years), larger employers (with average staffing of 162) and conduct modest R&D programmes (around 8% of the staff involved). They are located in the Republic of Ireland mainly as a result of the incentives (tax benefits, grants, etc.) offered by development agencies.

From the study there is clear evidence of an increasing rate of formation of new indigenous biotechnology companies, with a high level of research activity (average of 26% of staff involved, particularly in the pharmaceutical-biologics sector). Of the 59 companies, 25 originated as spin-offs from university research, while several others are significantly dependent on technologies licensed from universities.

The activities of biotechnology sector companies with regard to collaboration were also surveyed. It was ascertained that many companies have collaborations within the island, but only 5 have cross-border collaborations. The major areas for collaboration were in R&D and technology development. While awareness of networking events was high, many companies felt that the format of these events did not provide an effective mechanism to meet potential partners.

The study had two related objectives:

- to identify the stock, scale and locations of biotechnology companies on the island
- to explore opportunities to build biotechnology communities/collaborations between companies and make the island a 'smart place' to locate

From the study it is quite clear that there is a strong aspiration to grow more biotechnology companies on the island. The current activities of the governments, universities and even the industry show a zealous desire to establish a stronger platform for research and development. This should lead to a more distinct culture of collaboration amongst the aforementioned institutions and help to permanently establish a biotechnology sector in the island. It can be expected that *InterTradeIreland*, working with others, can play a major role in helping to accomplish these ambitions. This can be done in line with *InterTradeIreland*'s mission by assisting to build up the networks which will facilitate and encourage a cross-border exchange of ideas, technology transfer and the formation of alliances.

INTRODUCTION

Defining Biotechnology

Biotechnology is the application of biological systems to industrial processes. More specifically it is the use of organisms, cells or parts thereof in the manufacture of a product or as a component of the techniques used in the provision of a service. Many traditional industries (brewing, cheese-making and baking) also fall within this definition since organisms are used for the production processes. However, these are not normally regarded as being part of 'modern biotechnology' since this terminology is usually reserved for those biological systems to which molecular biology, cell or tissue culture or recombinant DNA techniques are applied.

The applications of modern biotechnology are fundamentally changing a wide range of existing industrial sectors. These particularly include:

- the pharmaceutical industry, which is being impacted at all levels, from the discovery of drugs, through to their testing, validation and manufacture
- the agri-food industry, which is dramatically affected both by changes in the crop materials and their ingredients
- the environmental industry, where a new generation of genetically engineered organisms is being developed to more efficiently convert toxic materials into benign substances
- the manufacture of diagnostics (devices to detect parameters useful for predictive purposes, particularly in medicine), which is now a major industrial sector predominantly based on biotechnology

While many other technologies empower the above industry sectors, it is possible to identify companies within these sectors which are principally based on biotechnology. Thus, a distinction may be made between pharmaceutical companies, where the technology used is primarily based on chemistry, and bio-pharmaceutical companies, where biological systems are employed to synthesise natural or recombinant bio-molecules. This report is concerned with companies predominantly based on modern biotechnology.

Biotechnology, a Global Activity

Modern biotechnology has rapidly become a major focus of commercial activity worldwide. Many informed estimates suggest that by the year 2005 the European market for biotechnology products could be worth over €100 billion¹. The current level of employment in biotechnology based firms worldwide is estimated at 255,000² with a further 145,000 estimated to be employed in biotechnology research at government or other institutions. It is also predicted that by the end of the decade global markets, including sectors where life sciences and biotechnology constitute a major portion of the technology applied, could amount to over €2000 billion with dramatic increases in staffing and the skills needed for the industries involved.

The biotechnology sector has been prioritised in various EU documents. A key document from the Council of the European Union³ recognises:

the important contribution that biotechnology can make towards achieving the target set at the Lisbon European Council for Europe to become the most competitive knowledge-based economy with thus more and better jobs while ensuring that those developments occur in a manner which is healthy and safe for consumers and the environment, and consistent with common fundamental values and ethical principles and in full compliance with the existing framework.

The same document also notes that 'overall spending on R&D and innovation in the Union should be increased with the aim of approaching 3% of GDP by 2010 and that two-thirds of this new investment should come from the private sector.' Additionally it stresses the priority of increasing the resources allocated to life sciences and biotechnology.

¹ *Life Sciences & Biotechnology - A strategy for Europe*, European Commission, COM 27, 2002.

² Data from Biotechnology Industry Organisation (US) and Europabio.

³ *Draft council conclusions and roadmap for a strategy on life sciences and biotechnology*, Council of the European Union, SN 3557/2/02 REV 2, 14 October 2002.

Building a Bio-Island

The governments of the island of Ireland have already made a clear commitment to winning a stake in these international endeavours. Both North and South have put together programmes to extend and develop biotechnology expertise, fund research and create measures to set up new biotechnology companies. In the Republic of Ireland, Science Foundation Ireland has been established to enhance, develop and promote the scale and quality of basic research. Enterprise Ireland has launched a biotechnology strategy aimed at capturing technology from university research, and at supporting start-up and growing companies. IDA Ireland also continues to promote the Republic of Ireland as a location for overseas mobile investment. Similarly, Invest Northern Ireland is actively working to 'contribute to and facilitate the birth and growth of innovative and competitive companies'. The University of Ulster (UU) and Queen's University, Belfast (QUB) have established the Centre for Innovation in Biotechnology and have realised very successful initiatives in the development and construction of bio-incubator facilities for both campuses in Coleraine and Belfast.

The Cluster Approach

All of the above organisations recognise that it will be necessary to develop mechanisms to overcome the difficulties created by the small scale of the biotechnology community on the island in comparison to the international scene. Developing optimal levels of interaction between companies and organisations is one approach. Such interaction is recognised as being critical to the success of biotechnology industry worldwide. Synergies are usually created where biotechnology companies co-exist. For that reason, clusters of companies tend to develop around technology sources, such as universities or infrastructure created by science parks. In the UK, the Sainsbury report estimated that over 60% of biotechnology companies are located in the London, Cambridge or Oxford area⁴. These companies can then benefit immediately from the existence of the university facilities and expertise, but may also gain from each other. Given suitable circumstances, the interchange and mutual stimulation of ideas, resources, contacts and business opportunities between these companies can make a major contribution to their success. Dr. Steven Burke, of North Carolina Biotechnology Centre, has made a particular study of the factors that distinguish successful biotechnology regions⁵. He identifies the development of interactive communities as a major one and states:

⁴ *Biotechnology Clusters*, Department of Trade and Industry, 1999.

⁵ 'Making places strong in biotechnology', Burke, W.S., *Genetic Engineering News*, 20, no. 16, 2000, p6.

All important human endeavours spring from a community of interactive people who are compelled by an outcome somehow new, important or greater than individual interests. Biotechnology is no exception; it is important to remember that a cohesive human community underlies any place strong in biotechnology. Smart places are as attentive to building community as to construction of any other more tangible resource.

Michael Porter defines clusters as 'geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions⁶'. The concept of interconnection is therefore fundamental to the development of clusters. The availability of a wide range of support companies and organisations is a vital requirement of the wider biotechnology sector. They provide the expertise, services and materials which the sector requires for future growth. The types of companies and organisations required include:

- Suppliers of specialist reagents and samples, materials, and equipment
- Legal expertise related to biotechnology company formation, liability, corporate finance, licensing and contracts, and other areas
- Patent agents, lawyers and consultants with competence in biotechnology intellectual property (IP) issues and in technologies
- Legal and consulting expertise in meeting regulatory standards in domestic and overseas markets
- Managers of clinical trials required for testing efficacy and regulatory compliance
- Specialist services and facilities for analytical testing, contract manufacturing, storage, freight, handling and waste disposal
- Engineering expertise related to bioprocess equipment, clean-rooms, waste handling, etc.

Market forces will ensure availability of such support companies in an established biotechnology community. However, growing communities will commonly not have the full range of services they require, and must look outside the region for certain services until the scale of demand justifies their local provision.

⁶ 'Clusters and Competition', *The Competitive Advantage of Nations*, Porter, M.E., Free Press: New York, 1990.

Objectives

This report seeks to identify the community extent of biotechnology companies on the island of Ireland. It also examines their views on the existence of a 'community' within the sector, and their interest in developing greater collaborative linkages.

The study has two related purposes:

- to identify the stock, scale and locations of biotechnology companies on the island
- to explore opportunities to build biotechnology communities/collaborations between companies and make the island a 'smart place' to locate

Methodology

In identifying the stock of biotechnology companies in the North and South of Ireland, only those whose staff skills/expertise or manufacturing processes were predominantly based on modern biotechnology were selected and surveyed.

While many companies use a mix of bio-based and other processes, a practical effect of the application of the above definition was that companies which use biotechnology as a minor part of their discovery and/or production do not fall within the scope of the report. There are many examples in this category, such as Cross Vetpharm and Galen in healthcare, and the Kerry Group in the agri-food area. Equally, the report does not include several multinational companies whose affiliates may be significant players in international biotechnology, but the local operations of which do not currently involve biotechnology (e.g. Genzyme, Pfizer and Novartis).

SNAPSHOT OF THE BIO-ISLAND

Overview

The biotechnology sector is comprised of 59 companies⁷, currently employing a total of 4090 staff (Table 1). Of these, 41 are indigenous companies and 18 are multinational. The distribution of companies within both groups is shown on Map 1. Both parts of Ireland have active programmes to attract overseas companies to locate here and biotechnology related industries have recently been a specific priority of this effort. There are no multinational companies falling into a biotechnology category in Northern Ireland.

Commercial Areas of Focus

The commercial activities of these companies can be classified into the following sectoral categories:

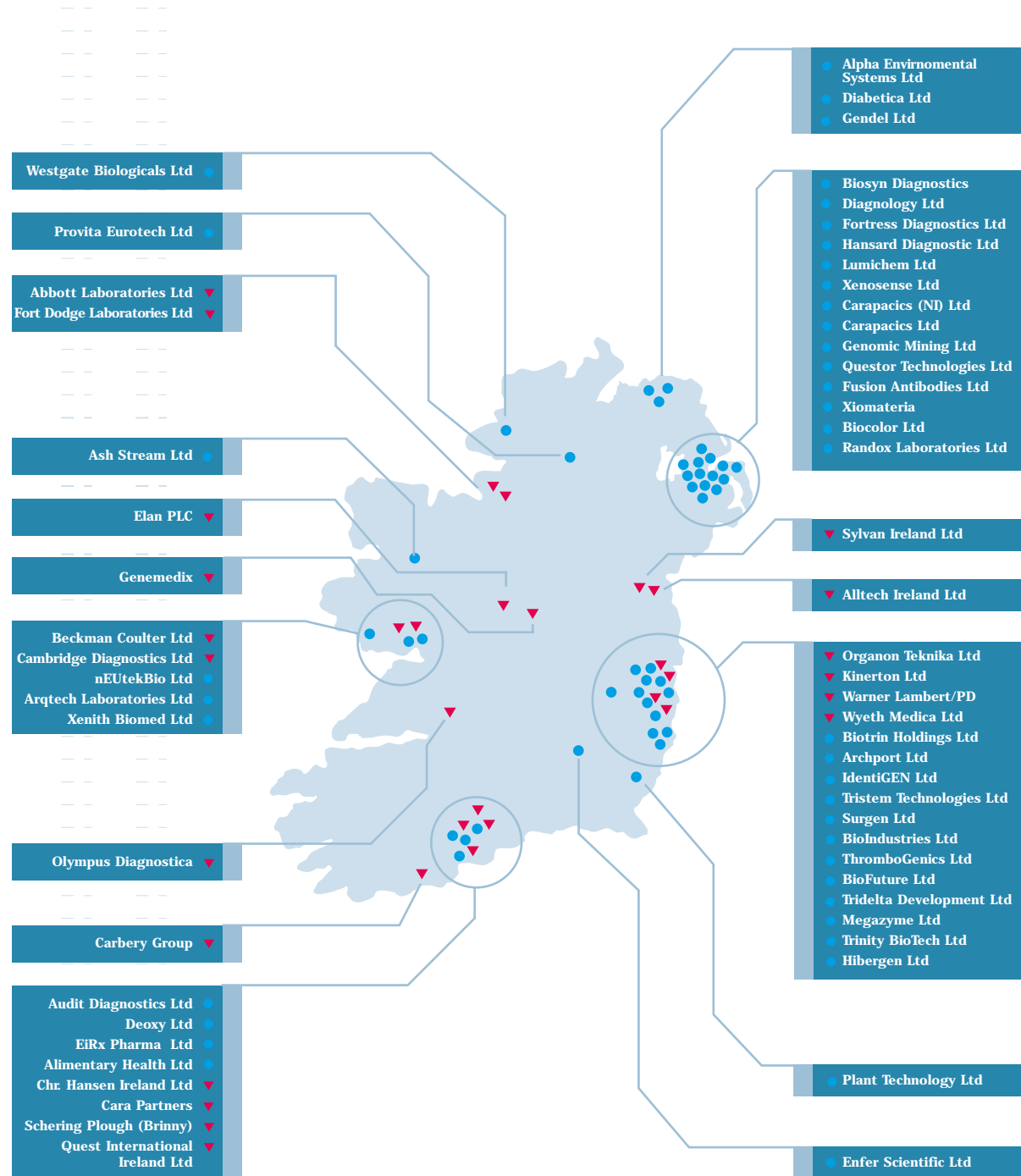
- Diagnostics
- Agri-Food
- Pharmaceutical Services
- Bio-Environmental
- Pharmaceutical-Biologics

The breakdown of companies by these commercial areas is shown in Table 1 and their location illustrated on Map 2.

⁷ Listed in Appendix I

TABLE 1: BIOTECHNOLOGY COMPANIES BY SECTOR & OWNERSHIP

SECTOR	INDIGENOUS		MULTINATIONAL		TOTAL	
	NO. COMPS.	STAFF	NO. COMPS.	STAFF	NO. COMPS.	STAFF
Diagnostics	16	927	5	730	21	1657
Agri-Food	6	61	5	216	11	277
Pharmaceutical Services	7	74	0	0	7	74
Bio-Environmental	4	49	0	0	4	49
Pharmaceutical Biologics	8	60	8	1973	16	2033
TOTALS	41	1171	18	2919	59	4090



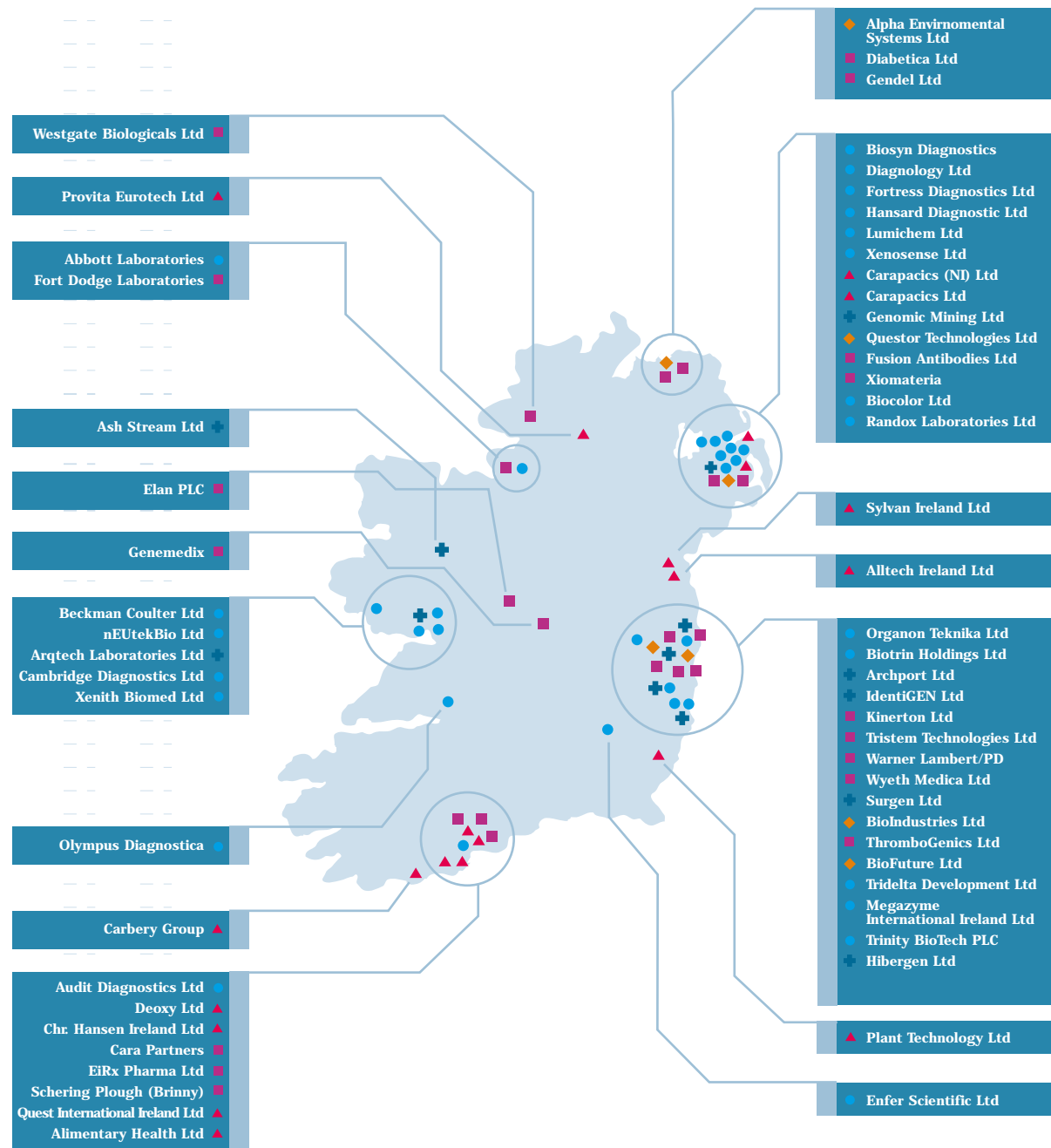
DIAGNOSTICS

Diagnostic companies make devices for the measurement of parameters that are relevant to determining the state of human or animal health either through diagnosis of a particular disease or its resulting consequences. The devices or so-called kits are mainly sold to hospitals or clinics, but are increasingly being used in other situations, for example home measurement of blood sugars by diabetics. Kits contain all of the materials and reagents necessary to conduct a test for a particular property associated with a disease, pathogen, metabolite or other target. Included in this sector are also companies producing bio-based diagnostic materials and reagents.

The 21 companies active in this area employ a wide range of immuno-assay and sensor technologies. Diagnostics represents a major area of activity for start-up companies from universities because of the low entry barriers, both in terms of manufacturing costs and less complex regulatory requirements than those demanded for therapeutic agents. It is therefore more feasible for small companies to launch products, particularly niche products, onto the market.

AGRI-FOOD

The 11 companies in this sector apply biotechnology in a wide range of agri-food applications. These include extraction of specialist products from biological materials (Carapacis, Alltech & Deoxy), production of specialist microbial cultures for cheese production and for medical foods (Alimentary Health & Chr. Hansen), and production of other specialist biochemical products for food or feed uses. Only a single company on the island, Plant Technology Ltd, is involved in plant biotechnology.



PHARMACEUTICAL SERVICES

While there are many companies which provide services to the pharmaceutical/healthcare sector, this sector includes the 7 companies whose expertise is essentially biotechnical. These companies provide a wide range of biotechnology-based services, usually to other companies in the healthcare area. These include the contract manufacture of recombinant proteins (Archport Ltd), QA of recombinant production (Arqtech Labs), and genomic and analytical services (Hibergen, Genomic Mining & Surgen).

BIO-ENVIRONMENTAL

The 4 companies in this sector provide biotechnology-based products and/or services related to detection, prevention or clean-up of environmental damage. The major products are based on microbial cultures, which are used to treat a variety of waste types.

PHARMACEUTICAL-BIOLOGICS

This sector includes 16 companies developing several forms of therapeutics and vaccines, whose method of discovery and/or production is biotechnology based. Clearly there are many other pharmaceutical companies on the island whose production is based on chemical synthesis or by other non-biotechnology means. As per definition, this study is solely concerned with the biotechnology-based companies.

Companies active in the above areas and a brief description of their products and services are outlined in Appendix I. The geographical distribution of companies according to their respective areas of activity are illustrated in Appendix II.

KEY	COMPANIES
●	DIAGNOSTICS
▲	AGRI-FOOD
◆	BIO-ENVIRONMENTAL
■	PHARMACEUTICAL-BIOLOGICS
+	PHARMACEUTICAL SERVICES

Employment and Company Size

- Indigenous companies employ 1171 people (or 29% of the total staff) in 41 companies, while the larger multinational companies employ 2919 in 18 companies (Table 1).
- The range of employees per company varies widely from 1 to 800 with an average of approximately 69. Data in the Ernst & Young 2002 Report⁸ shows an average staffing of 46 in European biotechnology companies. Multinational companies are generally much larger, with an average staff level of 162, while the indigenous companies have an average employment of approximately 29 staff. This data is generally consistent with the EU average company sizes. Almost 60% of EU biotechnology companies have fewer than 20 employees and only 10% have over 50 employees⁹.
- The largest employer is the pharmaceutical-biologics sector with a total of 2033 staff in 16 companies which are evenly distributed according to size (Table 1, Diagram 1). It should also be noted that Wyeth (which already employs 300) is still in the process of active recruitment of a final staff complement reckoned to be eventually 1300 by the year 2005 (at the full manufacturing capability of the plant). Another significant employer is the diagnostics sector, employing a total of 1657 staff in 21 companies which are evenly distributed between micro-enterprises and medium/large-sized firms (Table 1, Diagram 1).
- Almost half of the companies (26) are so called micro-enterprises of less than 10 staff (Table 2). 16 are small firms employing 11–50 staff while there are only 17 medium/large-sized companies employing more than 50 staff. As might be expected, the smaller companies predominate in the service areas such as pharmaceutical services, and bio-environmental (Diagram 1). Agri-food firms have also generally less than 50 employees.

⁸ Beyond Borders - The Global Biotechnology Report - 2002. Ernst & Young, 2002.

⁹ Innovation & Competitiveness in European Biotechnology, European Commission - DG Enterprise, Paper no. 7, 2002.

DIAGRAM 1: BIOTECHNOLOGY COMPANIES BY SIZE AND SECTOR

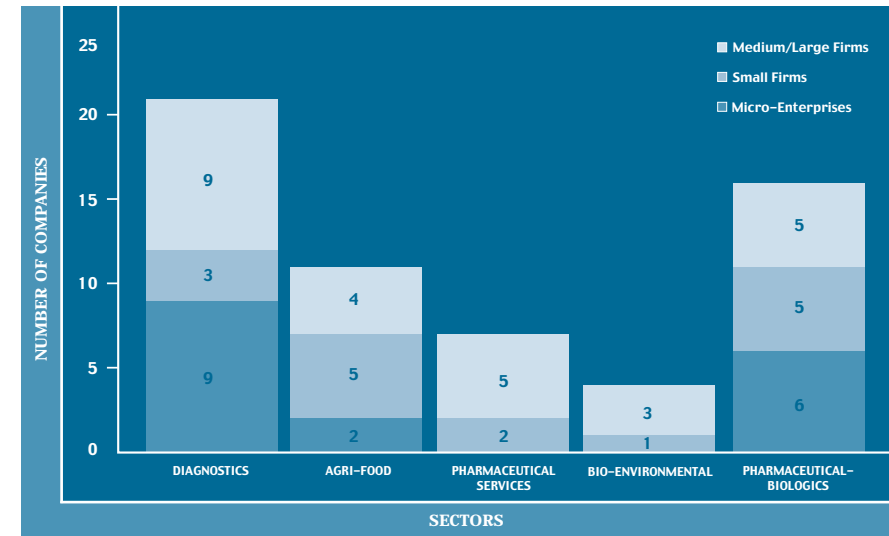


TABLE 2: BIOTECHNOLOGY COMPANIES BY SIZE

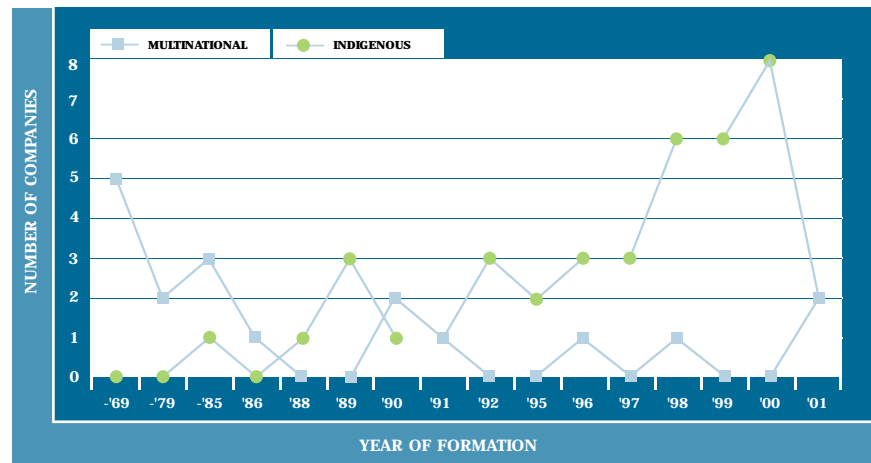
STAFF NOS	INDIGENOUS	MULTINATIONAL	AVERAGE COMPANY AGE
Micro-Enterprises (1-10)	26	0	4.5
Small Firms (11-50)	11	5	11.8
Medium/Large Firms (51+)	4	13	19

Formation of the Sector

- As might be expected, the micro-enterprises tend to be younger (less than 5 years old) and all indigenous (Table 2), while the larger companies are older (on average 19 years) and multinational (76%).
- While there is significant variation in the age of companies within the sector, there is a clear increase in the rate of establishment of new indigenous biotechnology companies in recent years (Diagram 2). This rate is set to continue given the range of initiatives in place both North and South. In particular, the recent UK R&D tax credit will serve to remove barriers to small business investment and further augment growth in this sector¹⁰.
- The oldest biotechnology company is WarnerLambert which was founded in 1956 as General Diagnostics. This diagnostics business was later sold to Organon Teknika. However the WarnerLambert plant in Dun Laoghaire, Co. Dublin still continues to manufacture biotechnology products under the Parke Davis label. The company is now owned by Pfizer. Among the indigenous companies, the first was Biocon, established in 1967, and it is now part of the multinational company Quest International. It could therefore be considered as the first successful start-up.

¹⁰ *Biotechnology in Northern Ireland. Creating a Cluster*, Johnson, E.N., MSc Biotechnology thesis, University of Ulster at Coleraine, 2001.

DIAGRAM 2: YEARS OF FORMATION OF BIOTECHNOLOGY COMPANIES



Clusters

- The phenomenon that biotechnology companies tend to develop around sources of high technology such as universities, institutions, hospitals, etc. is well established. It is a fundamental element for the development of clusters.
- This effect is clearly reflected in this study, which shows that the majority (46 of the 59) of the categorised biotechnology companies are located in clusters in or around the capital cities and/or other university cities (Map 3, Table 3). There are clusters of companies around Dublin (16), Belfast (14), Cork (8), Galway (5) and Coleraine (3). In terms of indigenous companies, Dublin and Belfast are quite similar in size with 12 and 14 indigenous companies respectively. These are effectively of relatively recent origin with average ages of 4.8 and 5.2 years.
- In many cases, these companies are spin-offs from a university and indeed, many still operate from within the university campus. Of the 46 clustered companies, 36 are indigenous and are located around university towns. It is also significant that 25 of the total 59 companies originated as spin-offs from Irish universities, while several others are significantly dependent on technologies licensed from universities in other countries.

TABLE 3: CLUSTERS OF BIOTECHNOLOGY COMPANIES

CLUSTER	NO. COMPS.	NO. INDIGENOUS COMPS.	AV. AGE OF INDIGENOUS COMPS.
Dublin	16	12	4.8
Belfast	14	14	5.2
Cork	8	4	4.8
Galway	5	3	2.7
Coleraine	3	3	5.3

KEY	COMPANIES
	DIAGNOSTICS
	AGRI-FOOD
	BIO-ENVIRONMENTAL
	PHARMACEUTICAL-BIOLOGICS
	PHARMACEUTICAL SERVICES

COLERAINE	
No. Comps.	3
No. Indig. Comps.	3
No. of Staff	54
No. of R&D Staff	16
Av. Age of Comps.	5.3
Av. Age Indig. Comps.	5.3

- ◆ Alpha Environmental Systems Ltd
- Diabetica Ltd
- Gendel Ltd

BELFAST	
No. Comps.	14
No. Indig. Comps.	14
No. of Staff	538
No. of R&D Staff	174
Av. Age of Comps.	5.2
Av. Age Indig. Comps.	5.2

GALWAY	
No. Comps.	5
No. Indig. Comps.	3
No. of Staff	226
No. of R&D Staff	14
Av. Age of Comps.	9.6
Av. Age Indig. Comps.	2.7

- Beckman Coulter Ltd
- nEUTEK Bio Ltd
- ◆ Arqtech Laboratories Ltd
- Cambridge Diagnostics Ltd
- Xenith Biomed Ltd

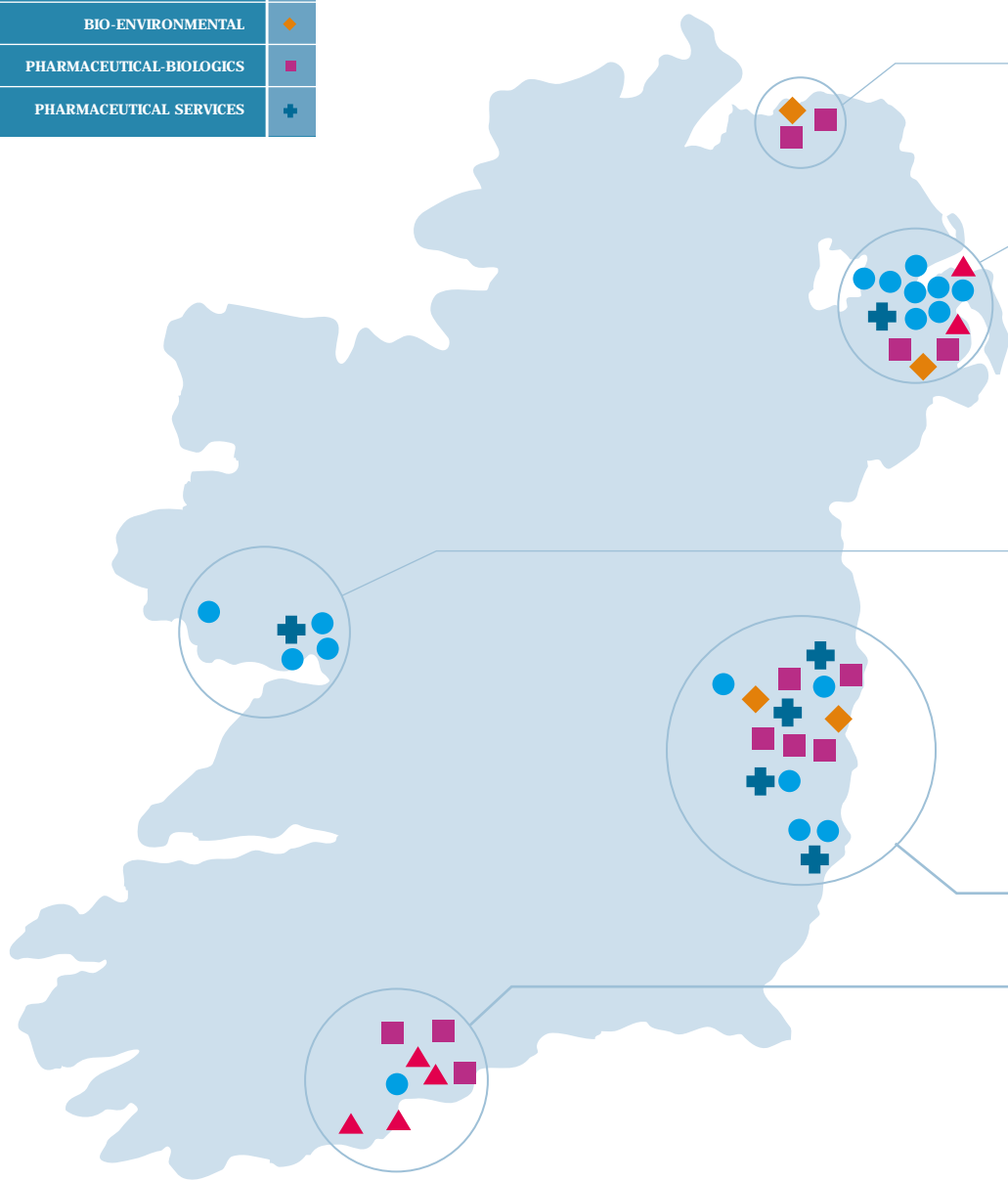
- Biosyn Diagnostics
- Diagnology Ltd
- Fortress Diagnostics Ltd
- Hansard Diagnostic Ltd
- Lumichem Ltd
- Xenosense Ltd
- ▲ Carapacis (NI) Ltd
- ▲ Carapacis Ltd
- ◆ Genomic Mining Ltd
- Fusion Antibodies Ltd
- Xiomateria
- Biocolor Ltd
- Randox Laboratories Ltd
- Questor Technologies Ltd

CORK	
No. Comps.	8
No. Indig. Comps.	4
No. of Staff	1,050
No. of R&D Staff	40
Av. Age of Comps.	7.25
Av. Age Indig. Comps.	2.8

- Audit Diagnostics Ltd
- ▲ Deoxy Ltd
- ▲ Chr. Hansen Ireland Ltd
- Cara Partners
- EIRx Pharma Ltd
- Schering Plough (Brinny)
- ▲ Quest International Ireland Ltd
- ▲ Alimentary Health Ltd

DUBLIN	
No. Comps.	16
No. Indig. Comps.	12
No. of Staff	829
No. of R&D Staff	71
Av. Age of Comps.	9.6
Av. Age Indig. Comps.	4.8

- Organon Teknika Ltd
- Biotrin Holdings Ltd
- ◆ Archport Ltd
- ◆ IdentiGEN Ltd
- Kinerton Ltd
- Tristem Technologies Ltd
- Warner Lambert/PD
- Wyeth Medica Ltd
- ◆ Surgen Ltd
- BioIndustries Ltd
- ThromboGenics Ltd
- BioFuture Ltd
- Tridelta Dev. Ltd
- Megazyme Ltd
- Trinity BioTech Ltd
- ◆ HiberGen Ltd



Research Performance

- Measured as numbers of staff involved in R&D, 39 companies are engaged in research and development. Table 4 shows that the research staff within these companies (535) account for 13% of the total workforce in the biotechnology sector.
- There is very significant variation in R&D performance between indigenous and multinational companies. Only 8% of multinational staff are involved in R&D while 26% of indigenous company staff are thus engaged. This is unsurprising given the fact that multinationals are specifically attracted to Ireland by manufacturing incentives and they are generally only involved in this activity. In general these corporations conduct their R&D elsewhere, and usually at the corporation's headquarters.
- Within the indigenous companies, the sector with the highest overall rate of R&D performance (80%) is the pharmaceutical-biologics sector. Again this is unsurprising as these companies are primarily focused on R&D during the period of development of their products. Indigenous companies within all sectors have a level of R&D activity, averaging 26% of staff (Table 4).

TABLE 4: R&D STAFFING WITHIN INDIGENOUS & MULTINATIONAL COMPANIES

SECTOR	INDIGENOUS		MULTINATIONAL	
	R&D STAFF	% OF TOTAL STAFF	R&D STAFF	% OF TOTAL STAFF
Diagnostics	205	22	53	7
Agri-Food	22	36	20	9
Pharmaceutical Services	24	32	0	0
Bio-Environmental	3	6	0	0
Pharmaceutical-Biologics	48	80	160	8
TOTALS	302	26	233	8

CURRENT & POTENTIAL COLLABORATION

Current Collaboration

This aspect of the study examined company attitudes as to the extent of their interaction with other companies or institutions. Creation of linkages between companies, and between companies and research institutions, is often facilitated by state and private organisations. Both North and South have state-funded programmes to encourage university–industry collaboration. In particular BioResearch Ireland (www.biores-irl.ie) has been instrumental in developing university–university and university–industry contacts. The Irish Bio-Industry Association [IBIA] (www.ibec.ie), as well as promoting a stronger research base, has been actively endorsing and encouraging business to business and university–industry contacts. This was a fundamental component of their conception and an underlying policy for the development of the bioindustries in Ireland.

In addition, there are three separate series of networking meetings, which are designed to bring companies (and academics) together for mutual interaction. These are:

- **BioConnect:** An organisation sponsored by several state and private organisations in the South and run by a voluntary committee. It runs approximately four afternoon meetings per year, on an all-island basis, arranged around invited speakers giving presentations on relevant themes. The main objective is to facilitate networking throughout the island, giving a meeting venue to interested parties.
- **Life & Health Technologies Partnership:** This was established to facilitate networking amongst individuals within the sector in Northern Ireland and has expanded to include the Republic of Ireland and the UK. Meetings, held monthly, are mostly in the format of breakfast meetings and bring together academics, industrialists, clinicians and government officials, as well as members of the service/support community.
- **First Biotech:** This is an initiative by the organisation which runs the 'First Tuesday' networking meetings for the Information Technology industry. Meetings are run on a bi-monthly basis and feature a panel discussion on a topic of relevance to the sector, followed by a network session (www.firsttuesday.ie).

The study examined company policy on attitudes to collaboration, and the adequacy or added value of current collaborative opportunities. Company views were extremely varied, although in general very positive. Of the 38 companies which responded to the questions on collaboration, 27 had existing collaborations with other companies or organisations on the island, while 11 had not. Of the 27 involved in collaboration, 78% are indigenous companies. However, the majority (64%) of companies with no collaborations are also indigenous. By another measure, of the 6 multinational companies which answered this question, 5 have collaborations on the island.

Interest in Collaboration

Interest in collaboration predominantly relates to company needs. Therefore, companies at the research or discovery stage of their development will often be interested only in R&D contacts. As they become more involved in further business development activities, such as manufacturing, marketing or promotional activities, the range and diversity of their collaborative interests will normally increase.

None of the companies examined indicated that they were not interested in collaboration. Indeed, several of those that did not have a current collaboration noted their regret at this situation. Some of the multinational companies do not have major opportunities for local collaboration as they are exclusively involved in manufacture. Any collaborative intentions around R&D, product promotion and other activities may be dictated from head office.

The commonly-held views on collaboration can be summarised as follows:

- Almost all companies are very interested in collaboration with other companies or organisations on the island, where there is a relevant need and an appropriate partner.
- Most companies do not expect to find relevant partners on the island because of the small scale of the sector (both industry and research).
- There are no major obstacles to collaboration, but there is a common perception that opportunities to effectively meet collaborative partners do not exist.

The major perceived opportunity areas for collaboration among the 34 responding companies are in R&D (74% indicating an interest) or joint technology development (59%) (Table 5). In this context it should be noted that the ideal partners are not only found in the same technology areas, but that accessing expertise in divergent yet complementary disciplines is considered a major advantage in partnering.

TABLE 5: PREFERRED AREAS FOR COLLABORATION*

	NO. COMPS.	%
R&D	25	74
Technology Development	20	59
Training	5	15
Marketing	11	32
Sub-contract of Manufacturing	14	41
Joint Promotion at International Events	12	35

*some companies indicated several areas of interest

There is also a significant interest in partnership for subcontracting manufacturing (41% of responding companies) and in joint promotions at international events (35%). The latter of the interests generally came from the small companies. Those company representatives who had been involved in joint promotions noted that start-ups can often learn promotional skills from larger companies at such events. In addition, several companies believed that there is a significant networking advantage in being part of a larger delegation at international events. Surprisingly, there was little appeal in joint training activities with only 15% of the responding companies indicating an interest.

Companies were also asked about cross-border collaboration. Of the 36 respondent companies, the vast majority (31) had no such collaboration. Only a minority of companies (5) had existing North/South collaboration. However, the comments made by companies indicated a strong interest, in both directions, in developing such collaborations, many welcoming recent initiatives to facilitate North/South meetings. Further discussion would also suggest that companies are interested in any initiatives which will increase the effective critical mass of the biotechnology sector. Encouraging and developing or facilitating closer North/South collaboration is an obvious way to accomplish this. Some companies also proposed that joint North/South collaborative funding programmes should be established. The rationale for this is clear. R&D is a major area of collaboration, and since much R&D is state-funded, a mechanism to allow North/South company collaboration in R&D would be not only useful but considered most desirable. In terms of identifying barriers to collaboration, the most frequently cited obstacle by respondent companies was funding (among 52% of respondents). Another significantly perceived barrier was finding a relevant partner among the small population of companies and R&D organisations on the island (39%).

TABLE 6: PERCEIVED OBSTACLES TO COLLABORATION*

	NO. COMPS.	%
Capital Availability	12	52
Absence of Relevant Partners	9	39
Personnel Availability	8	35
Government Support	4	17

*some companies indicated several perceived obstacles

Many companies pointed to the unique nature of their technology, and indicated the low probability that relevant partners exist within the island of Ireland. Several companies referred, in various ways, to the small critical mass and, in particular, the lack of available personnel (35%). A lack of government support was the lowest perceived barrier, being cited by only 17% of companies.

Some companies also indicated that they experienced a low level of direct contact by local university researchers with companies. To quote one CEO, 'nobody in Irish academia ever contacts us, and I mean ever!' There is, therefore, a need to engineer or facilitate such contacts. This is a role that could be explored more often by government agencies. For example, the Irish Development Authority (IDA) typically introduce prospective high technology, foreign direct investment companies to university academics working in areas relevant to their technology.

In addition, some multinationals noted that administrative difficulties may often arise concerning contracts and intellectual property agreements, and that also confidentiality issues can pose significant hurdles for collaboration outside the company.

In general, it would appear that there are no particularly significant barriers to collaboration if a relevant opportunity presents itself.

Opportunities for Partnering

In general existing barriers to partnering were not seen as being insurmountable. However, many companies (particularly those with niche technologies) have a perhaps realistic view that they are unlikely to find an abundance of appropriate partners within our small biotechnology community. Nevertheless, there is an equally strong view that there is a lack of opportunity to effectively meet any potential partners that may exist. The emphasis on the format of possible meeting venues is important as there are, in fact, existing networking events which have a high recognition among companies. For example, companies were asked about their awareness of BioConnect, and the Life & Health Technologies Partnership. There was a high recognition and appreciation of these meetings among responding companies. Of the 39 companies who responded, 30 (75%) were aware of one or other of these organisations. Awareness of these organisations will certainly grow over the next year as joint meetings are planned, something that will also assist North/South interaction.

Another useful initiative to develop company interaction involves the joint www.biotechnologyireland.com and www.bionorthernireland.com websites (hosted in the South and North respectively). These 'sister' sites host profiles of biotechnology companies and provide information on events, jobs, etc. The sites were less well known among companies with just less than half of the respondents aware of their existence.

While both BioConnect and the Life & Health Technologies Partnership have regular meetings, many companies felt that the format did not allow them to efficiently communicate their partnership needs to other attendees. To quote one executive, '[we] would love to find a networking system which would allow us to say what we do'. Suggestions to improve existing practice included:

- an online pre-notification system whereby attendees at networking events could log-on in advance and specify their partnering interests
- occasional networking meetings (e.g. BioConnect or LHTP) where members could make brief presentations ('elevator pitches') outlining their interests and capabilities. This would allow them to specify particular partnering needs, and allow also the audience to identify potential areas for collaboration.

This was a recurring theme in the survey discussions and returns. Some quotations relevant to the need for partnering meetings include:

- 'Open, multi-level discussion forums need to be created, whereby suitably motivated Irish organisations can identify areas for collaboration along the lines of those pioneered by Biotechnology Scotland.'
- '[We need a] national forum for networking and collaboration in areas of complementary expertise, similar to BioConnect.'
- '[We need a forum for] sharing business experiences. This is happening with some of the more progressive Enterprise Boards but I am sure at a national and cross-border level a lot of valuable information could be imparted.'
- '[We are] interested in any collaboration in technology development and R&D which fits with our business strategy. [There is a] lack of information on collaborative opportunities.'
- '[We need] more networking opportunities. At present it is extremely difficult to get funding for North/South collaborative products and the time and effort required is prohibitive.'
- '[We need] more seminars and opportunities [to meet partners]. [We] don't ever get anything in the mail.'

CONCLUSIONS AND RECOMMENDATIONS

In summary, the overall picture of the biotechnology sector is of a highly diverse and growing group of companies. There is an important core of larger, somewhat longer-established and generally multinational companies. There is clearly an increasing trend in the formation of indigenous companies. We are aware of at least five further start-ups that are preparing for launch within the next 18 months. The diagnostics sector is particularly strong with 21 companies, the majority of which are indigenous. Bio-pharmaceutical multinationals are a major employer, but several indigenous bio-pharmaceutical companies have also been formed in recent years.

Whereas the number and scale of companies is growing, the establishment of a successful sector can be significantly enhanced by the creation of effective linkages between and among the biotechnology companies and related institutions. The study shows a healthy interest in such collaboration. However, there is also an apparent awareness among companies that they are located within a small sector of industry, within an as yet underdeveloped community on a small island. While there are existing opportunities for the companies to meet, the nature of these does not appear to fulfil the needs of many companies. Opportunities to broadcast specific partnering desires are a clear requirement of the sector.

Some recommendations that emerge from the study include:

- Further initiatives should be pursued for networking events, which would provide a more effective opportunity for companies to define their collaboration needs and thereby meet appropriate partners. This could be done through encouraging changes in the format of meetings run by existing network organisations.
- The study examined biotechnology manufacturing or service companies. However, development of successful clusters requires that appropriate support companies are also advantageously in place. An examination of the adequacy of the range of support companies is recommended, perhaps by comparison with other regions of a similar scale and stage of development.
- Specific initiatives to support North/South collaboration would be welcomed by many companies. It is recommended that the feasibility of allowing joint North/South submission of applications for financial support (where relevant and necessary) be explored with InterTradeIreland and other funding agencies in both jurisdictions.
- Opportunities for joint representation of companies and/or institutions at international events should be explored with development and promotion agencies North and South.
- InterTradeIreland, as the all-island trade and business development body, is strategically positioned to facilitate the development of a stronger and larger biotechnology industry community from an all-island perspective.

APPENDIX I
BIOTECHNOLOGY COMPANY PROFILES

BIOTECHNOLOGY COMPANIES

NAME OF COMPANY: Abbott Laboratories, Diagnostic Division
ADDRESS: Finisklin Industrial Estate, Sligo

DESCRIPTION OF PRODUCTS/SERVICES:
 Diagnostic reagent, kits for HIV testing.

NAME OF COMPANY: Alimentary Health Ltd
ADDRESS: Guardwell, Kinsale, Co. Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 Alimentary Health have developed a platform of probiotic technology from which they will develop and produce a range of medical foods and drugs for use in treatment of particular GI diseases. Further products based on the properties of the Alimentary Health patented bacterial strains will also be developed.

NAME OF COMPANY: Alltech Ireland Ltd
ADDRESS: Sarney, Summerhill Rd, Dunboyne, Co. Meath

DESCRIPTION OF PRODUCTS/SERVICES:
 Alltech research, develop and manufacture natural ingredients (enzymes, plant extracts etc) as nutritional feedstuffs for livestock and poultry, and for use in alcohol and food production. The company HQ is in Kentucky, USA, and manufacturing is conducted in plants in the USA, Canada, Mexico, UK and Serbia. The company's 'European Bioscience Research and Marketing Center' is located in Ireland, and the Irish facility also includes a separate quality control and development laboratory and a state-of-the-art blending and packaging plant.

NAME OF COMPANY: Alpha Environmental Systems Ltd
ADDRESS: Loughanhill Industrial Estate, Coleraine, Co. Londonderry, Northern Ireland BT52 2NR

DESCRIPTION OF PRODUCTS/SERVICES:
 Alpha environmental pollution control experts, who specialise in the remediation of contaminated land and groundwater, with BOSCA (British Oil Spill Control Association) Level III accreditation. They use a wide range of biological and microbial products in association with novel technologies to remediate contaminated land and groundwater. They also developed a Bio-injection Unit that allows bacteria to be injected into the ground at various depths and pressures.

NAME OF COMPANY: Archport Ltd
ADDRESS: Dublin City University, Glasnevin, Dublin 9

DESCRIPTION OF PRODUCTS/SERVICES:
 Archport offers a range of biotechnology services including establishment of cell banks, scale-up and optimisation of animal cell production processes. Additional services include GMP compliant production and purification of materials for clinical trial or market supply, eg monoclonal antibodies and proteins for vaccines, therapeutics, gene therapy or diagnostic use.

NAME OF COMPANY: Arqtech Laboratories Ltd
ADDRESS: Unit 5, Kilkerrin Park 3, Liosbaun I.E, Galway

DESCRIPTION OF PRODUCTS/SERVICES:
 Testing laboratory for recombinant proteins.

NAME OF COMPANY: Ash Stream Ltd
ADDRESS: Hollymount, Claremorris, Co. Mayo

DESCRIPTION OF PRODUCTS/SERVICES:
 Veterinary services and reagents to the pharmaceutical/biotechnology industry.

NAME OF COMPANY: Audit Diagnostics Ltd
ADDRESS: 2 Westlink Park, Doughcloyne, Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 Manufactures a comprehensive line of liquid stable diagnostics reagents. Markets a line of benchtop biochemistry analysers.

NAME OF COMPANY: Beckman Coulter (Ireland) Ltd
ADDRESS: Mervue Industrial Estate, Galway

DESCRIPTION OF PRODUCTS/SERVICES:
 Clinical chemistry diagnostics reagents.

NAME OF COMPANY: Biocolor Ltd
ADDRESS: Valley Business Centre, 67 Church Road, Newtownabbey, Northern Ireland BT36 7LS

DESCRIPTION OF PRODUCTS/SERVICES:
 Biocolor designs, produces and markets bioscience assay kits, which aid research studies of mammalian cells, tissues and fluids.

NAME OF COMPANY: BioFuture Ltd
ADDRESS: 62C Heather Road, Sandyford Industrial Park, Foxrock, Dublin 18

DESCRIPTION OF PRODUCTS/SERVICES:
 BioFuture manufactures a range of microbial products for industrial and municipal waste water treatment and for institutional/janitorial markets. In addition BioFuture provides a range of products for specialist markets including marine, aquaculture, agriculture, bioremediation and composting.

BioFuture designs, manufactures and supplies environmental solutions for a variety of situations in the waste water, bioremediation, marine, aquaculture, drain maintenance, janitorial and composting sectors. Product formulations are reviewed at regular intervals to incorporate advances in biotechnology, thus providing clients with cutting-edge solutions for their environmental requirements. All products manufactured by BioFuture are environmentally acceptable, stable, safe, non-hazardous, non-corrosive and biodegradable.

NAME OF COMPANY: BioIndustries Ltd
ADDRESS: Unit 66D Heather Road, Dublin 18

DESCRIPTION OF PRODUCTS/SERVICES:
 BioIndustries provides services and products for biodegradation of waste waters. This involves a service to identify micro-organisms suitable for client biological wastes, and development of customised waste water treatment systems to improve the waste management process.

NAME OF COMPANY: Biosyn Diagnostics
ADDRESS: Unit 13 Ormeau Business Park, Cromac Avenue, Belfast, Northern Ireland BT7 1JA

DESCRIPTION OF PRODUCTS/SERVICES:
 Diagnostic products.

NAME OF COMPANY: Biotrin Holdings Ltd (also Biotrin International Ltd)
ADDRESS: 93 The Rise, Mount Merrion, Co. Dublin

DESCRIPTION OF PRODUCTS/SERVICES:
 Biotrin is a healthcare company that specialises in providing a range of novel and proprietary tests for the clinician and research scientist. It is also the leading supplier of parvovirus B19 tests and is the only company to have FDA approved tests for that virus. Biotrin has two distinct business units:

- Infectious Diseases, which provides tests for the detection of new and emerging viruses
- Organ Damage, which provides a range of proprietary biomarker tests for clinical detection of organ damage, and for assessment of animal and human toxicity

NAME OF COMPANY: Cambridge Diagnostics Ireland Ltd
ADDRESS: Mervue Industrial Estate, Galway

DESCRIPTION OF PRODUCTS/SERVICES:
 Development and manufacture of in vitro diagnostic products.

NAME OF COMPANY: Cara Partners
ADDRESS: Little Island Industrial Estate, Little Island, Co. Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 Extraction of pharmaceutical derivatives from ginkgo leaves.

NAME OF COMPANY: Carapacis Ltd
ADDRESS: School of Chemical Engineering, Queen's University, Belfast, 97 Lisburn Road, Belfast, Northern Ireland BT9 5A6

DESCRIPTION OF PRODUCTS/SERVICES:
 Production of chitin/chitosan derivatives, astaxanthin pigment from nephrops shell waste.

NAME OF COMPANY: Carapacis (NI) Ltd
ADDRESS: QUBIS Ltd, Queen's University, Belfast,
 Lisburn Road, Belfast, Northern Ireland BT9 7BL

DESCRIPTION OF PRODUCTS/SERVICES:
 Bioprocessing of eggshell waste for biopolymer production for use in biomedical devices.

NAME OF COMPANY: Carbery Group
ADDRESS: Ballineen, Co. Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 Whey protein, cheese, alcohol, flavours, yeast extract, savoury blends.

NAME OF COMPANY: Chr. Hansen Ireland Ltd
ADDRESS: Rohan Industrial Estate, Little Island, Co. Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 Production and sale of bacterial starter cultures, and rennet, for use in production of cheddar and other cheeses.

NAME OF COMPANY: Deoxy Ltd
ADDRESS: The Mill Business Centre, Crosses Green, Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 Deoxy was founded to investigate and research carbohydrate-based ingredients targeted towards the functional food business. It develops and manufactures carbohydrate materials for use in the food and pharmaceutical sectors. These include:

- dietary fibres
- prebiotics
(non-digestible food ingredients that can stimulate beneficial gut bacteria)
- low-fat/reduced-fat food formulations
(composite carbohydrate systems for fat replacement with retention of sensory properties.)
- hydrocolloid gelling systems

NAME OF COMPANY: Diabetica Ltd
ADDRESS: University of Ulster, Cromore Road, Coleraine, Co. Londonderry,
 Northern Ireland BT52 1SA

DESCRIPTION OF PRODUCTS/SERVICES:
 Diabetica is performing cutting-edge research and development to provide new strategies and products for the management and treatment of diabetes and obesity.

The founders are world-famous scientists with a rich portfolio of patented discoveries resulting in the development of a number of potential products for the control and treatment of type 1 and type 2 diabetes and related illnesses.

Diabetica is a progressive biotechnology company with internationally renowned research expertise, led by the academic co-founders Professor Peter R. Flatt, Dr Neville H. McClenaghan and Dr Finbarr P.M. O'Harte.

Diabetica is dedicated to the generation and exploitation of cutting-edge technology in the service of human health and welfare and has six core areas of strategic research directed towards novel treatments, diagnostics and screening for diabetes, namely: (i) dietary control products; (ii) antidiabetic drugs for type 2 diabetes; (iii) anti-obesity products; (iv) tissue engineering for type 1 diabetes; (v) multidrug screening and drug discovery; (vi) functional assays.

NAME OF COMPANY: Diagnology Ltd
ADDRESS: Redwood House, Riverside Office Park, Newforge Lane,
 Belfast, Northern Ireland BT9 5NT

DESCRIPTION OF PRODUCTS/SERVICES:
 To develop rapid diagnostic technologies that would appeal to consumers as well as the clinician or healthcare provider. Using this strategy, Diagnology launched the first 'point of care test' for the specific detection of herpes simplex virus type 2 (POCKit HSV2 Rapid Test) in September 1998, and followed this with the launch of a rapid test to detect bacterial vaginosis (POCKit BV Quadro Rapid Test) in September 2001.

NAME OF COMPANY: EiRx Pharma Ltd
ADDRESS: 2800 Airport Business Park, Kinsale Road, Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 EiRx Therapeutics is involved in genomics research on apoptosis, the genetically regulated physiological process that regulates the normal process by which cells die. By identifying novel early points of intervention in this cell death process, EiRx will develop new drugs to safely and effectively modulate apoptosis in target disease states. The core expertise in apoptosis is based on the research of Professor Tom Cotter of University College, Cork.

Recently, EiRx Pharma Ltd has been established by the merger of EiRx Therapeutics Ltd, Physiomics Plc and CuDos Ltd, to create a unique new early-stage pharmaceutical company with substantial competitive advantages derived from the linkage of the pioneering biochemical network mapping system (systems biology) of Physiomics, and the toxicology, biomarkers and pre-clinical development capabilities of CuDos, with EiRx Therapeutics' apoptosis regulating targets and compounds, and discovery methods. From this interaction of technology the company can effectively drive therapeutic development faster and more cost effectively.

This approach is being applied to the development of novel validated targets, diagnostic assays and drug compounds for cancer, inflammation, autoimmunity and neurodegeneration, while deriving near-term revenues from non-core 'fee for services' activities in the systems biology and ADMET areas.

NAME OF COMPANY: Elan PLC
ADDRESS: Monksland Industrial Estate, Athlone, Co Westmeath

DESCRIPTION OF PRODUCTS/SERVICES:
 Fully integrated bio-pharmaceutical company developing products for Alzheimer's disease, Parkinson's disease, multiple sclerosis, pain management and autoimmune diseases.

NAME OF COMPANY: Enfer Scientific Ltd
ADDRESS: Boxer House, Newbridge Industrial Estate, Newbridge, Co. Kildare

DESCRIPTION OF PRODUCTS/SERVICES:
 Enfer Scientific is involved in diagnostic testing for the food and agriculture industries, specialising in rapid screening tests. Their most successful product to date is a rapid BSE test.

NAME OF COMPANY: Fort Dodge Laboratories
ADDRESS: Finisklin Industrial Estate, Sligo

DESCRIPTION OF PRODUCTS/SERVICES:
 Veterinary vaccines manufacturer.

NAME OF COMPANY: Fortress Diagnostics Ltd
ADDRESS: Unit C3 Dundonald Enterprise Park, Carrowreagh Road, Dundonald, Belfast, Northern Ireland BT16 1QT

DESCRIPTION OF PRODUCTS/SERVICES:
 Fortress Diagnostics manufactures and distributes a range of medical diagnostic and point-of-care tests. This range includes test kits designed for laboratory and blood bank and rapid diagnostic tests for near patient testing. Products are marketed via traditional export methods, the web and as over-the-counter products.

NAME OF COMPANY: Fusion Antibodies Ltd
ADDRESS: PO Box 374, Belfast, Northern Ireland BT1 2WD

DESCRIPTION OF PRODUCTS/SERVICES:

Fusion Antibodies is a biotechnology company that specialises in two key areas: firstly, production of monoclonal antibodies and their synthetic equivalents, which are used for therapeutic, prognostic and diagnostic applications in the fields of cancer and infectious disease; and secondly production of custom antibodies as a service to big pharma, biotechnology and academic institutes. A range of complementary services are available, further details of which can be found on the website (www.fusionantibodies.com).

NAME OF COMPANY: Gendel Ltd
ADDRESS: Science Innovation Centre, Science Research Park, Cromore Road, Coleraine, Co. Londonderry, Northern Ireland BT52 1ST

DESCRIPTION OF PRODUCTS/SERVICES:

Gendel has developed a unique, proprietary platform technology for the localised delivery of biological molecules to target sites within the body. Bio-pharmaceuticals may be loaded into the body's own natural carrier system by a physical process and released at the target site in response to the application of non-invasive, low intensity ultrasound. Gendel's technology may be employed for the delivery of a range of biological payloads including antibodies, enzymes, peptides, oligonucleotides and DNA, as well as carrier peptides and gene therapy vectors. Gendel has demonstrated in vivo release of antibodies together with delivery and uptake of specific payloads at target sites including the kidney and liver.

NAME OF COMPANY: Genemedix
ADDRESS: Sragh Industrial Estate, Tullamore, Co. Offaly

DESCRIPTION OF PRODUCTS/SERVICES:

Genemedix is a state-of-the-art mammalian cell operation to produce bio-pharmaceuticals e.g. recombinant erythropoietin.

NAME OF COMPANY: Genomic Mining Ltd
ADDRESS: Department of Oncology, University Floor, Belfast City Hospital, Belfast, Northern Ireland BT9 7AB

DESCRIPTION OF PRODUCTS/SERVICES:

Genomic Mining is a micro array based biotechnology company with a specific interest in cancer. Through the development of cancer specific oligonucleotide micro arrays, Genomic Mining aims to help define the crucial transcriptional changes underlying cancer initiation, progression and metastasis. In addition Genomic Mining aims to use these specialist micro arrays to define molecular markers of resistance to chemotherapeutic agents currently in use and to define novel markers of response.

Genomic Mining has been formed to take advantage of a specific niche within the evolving field of functional genomics as it relates to cancer and in particular breast cancer. Professor Patrick Johnston, Dr Paul Harkin and Professor Roy Spence are all lead researchers in various aspects of the molecular biology and treatment of cancer.

Genomic Mining is focused on the development of cancer specific oligonucleotide micro arrays encoding the complete repertoire of genes, including splice variants expressed in various cancer types. A major focus of this company will be in the area of 'pharmacogenomics', that is, using molecular mining based approaches as a means of identifying novel markers of resistance to chemotherapeutic drugs or novel prognostic markers of disease. As a consequence Genomic Mining will play a fundamental role in the future development of the next generation of targeted chemotherapeutic agents in breast cancer.

Genomic Mining has a strategic interest in cancer and aims to compile a vast database of information on large numbers of tumour samples, using state-of-the-art bioinformatic analysis. The ability to generate proprietary tissue specific arrays will allow the company to carry out the extensive analysis required to extract biologically relevant information in a cost-effective manner. Novel markers identified in this manner will be used to generate second-generation diagnostic or prognostic arrays encoding small numbers of specific genes.

Genomic Mining is seeking to utilise and build upon the technology and in-house expertise. It is planned that specific markers will be clinically developed as therapeutic targets through strategic partnerships.

The company is seeking collaborations and alliances for the commercialisation of the technology and resources in the areas of pharmacogenomics and therapeutic developments.

NAME OF COMPANY: Hansard Diagnostic Ltd
ADDRESS: 37 Knockbracken Healthcare Park, Belfast, Northern Ireland BT8 8BH

DESCRIPTION OF PRODUCTS/SERVICES:
 Manufacture and distribution of point-of-use diagnostic tests, namely blood grouping anti sera, latex agglutination tests, infectious diseases (HIV, HBsAg etc).

NAME OF COMPANY: Hiberger Ltd
ADDRESS: IDA Business Park, Bray, Co. Wicklow

DESCRIPTION OF PRODUCTS/SERVICES:
 Identification of genetic targets with medical relevance and licensing SNaPIT genotyping technology.

NAME OF COMPANY: IdentiGEN Ltd
ADDRESS: Institute of Genetics, Trinity College, Dublin 2

DESCRIPTION OF PRODUCTS/SERVICES:
 Genetic testing services.

NAME OF COMPANY: Kinerton Ltd
ADDRESS: Blanchardstown Industrial Park, Blanchardstown, Dublin 15

DESCRIPTION OF PRODUCTS/SERVICES:
 Kinerton is engaged in the synthesis, purification and isolation of peptide-based active ingredients for two of Beaufour Ipsen's leading products – Decapeptyl (r) and Somatuline (r). It is one of the few companies worldwide using solid phase synthesis technology for the manufacture of approved therapeutic peptides.

Beaufour Ipsen is currently planning to locate a Peptide Research & Development function at Kinerton which will be operational by the end of the year.

NAME OF COMPANY: Lumichem Ltd/Fluorescent Chemicals
ADDRESS: Queen's University, Belfast, Lanyon North, University Road, Belfast, Northern Ireland BT7 1NN

DESCRIPTION OF PRODUCTS/SERVICES:
 Provision of amino acids.

NAME OF COMPANY: Megazyme International Ireland Ltd
ADDRESS: Bray Business Park, Bray, Co. Wicklow

DESCRIPTION OF PRODUCTS/SERVICES:
 Enzyme production.

NAME OF COMPANY: nEUtekBio Ltd
ADDRESS: Suite 14, Galway Technology Centre, Mervue Business Park, Galway

DESCRIPTION OF PRODUCTS/SERVICES:
 Monoclonal antibody based diagnostic assay, gene reporter based assay.

NAME OF COMPANY: Olympus Diagnostica GmbH (Irish Branch)
ADDRESS: Lismeehan, O'Callaghan's Mills, Co. Clare

DESCRIPTION OF PRODUCTS/SERVICES:
 For Olympus Diagnostica: Chemistry-Immuno Systems – instruments/reagent kits/lab automation for the hospital laboratories or commercial laboratories, testing at speeds of 400 to 6,600 tests per hour. For Olympus Diagnostica (Irish Branch): the Irish Branch is the sole reagent development and manufacturing site within the Olympus organisation for the global business.

NAME OF COMPANY: Organon Teknika Ltd
ADDRESS: Farnham Drive, Finglas Road, Finglas, Dublin 11

DESCRIPTION OF PRODUCTS/SERVICES:
 Development, manufacture and distribution of in vitro rapid assay human diagnostic kits.

NAME OF COMPANY: Plant Technology Ltd
ADDRESS: IDA Industrial Estate, Dublin Road, Enniscorthy, Co. Wexford

DESCRIPTION OF PRODUCTS/SERVICES:

- Production of micro-propagated foliage and flowering plants. Development of customised micropropagation, and other horticultural systems.
- Plant health consultancy in plant pathogen detection and control.
- Consultancy services in establishment of plant tissue laboratories, in sourcing and application of associated technologies, and in plant-breeders' rights issues.

NAME OF COMPANY: Provita Eurotech Ltd
ADDRESS: 21 Bankmore Road, Omagh, Co. Tyrone, Northern Ireland BT79 0EU

DESCRIPTION OF PRODUCTS/SERVICES:
 Provita manufacture and supply natural animal health products. The Provita range of products fall into the following categories: probiotics, feed supplements, colostrum products, electrolytes, air purifiers, hoof-care products, feed additives and mint gels.

NAME OF COMPANY: Quest International Ireland Ltd
ADDRESS: Kilnageary, Carrigaline, Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 Enzymes for baking, confectionery, brewing, fruit processing and protein hydrolysis, as well as clarifying agents and foam stabilisers for brewing.

NAME OF COMPANY: Questor Technologies Ltd
ADDRESS: David Keir Building, Stranmillis Road, Belfast, Northern Ireland BT9 5AG

DESCRIPTION OF PRODUCTS/SERVICES:
 Biotechnology products aimed at niche markets within the water/wastewater treatment sector, e.g. Biocol, a process for removal of colour from textile waste water plus a test kit for the detection/prevention of sludge bulking at activated sludge plants.

NAME OF COMPANY: Randox Laboratories Ltd
ADDRESS: 55 Diamond Road, Crumlin, Co. Antrim, Northern Ireland BT29 4QY

DESCRIPTION OF PRODUCTS/SERVICES:
 Randox manufactures a wide range of clinical diagnostic reagents and kits and is one of the world's leading suppliers of quality control serum. The company has recently launched the world's highest throughput automated immuno-assay system, Evidence(r), based on its proprietary protein biochip array technology. This system currently offers a range of multi-analyte chips which combine conventional and novel markers for improved disease diagnosis.

NAME OF COMPANY: Schering Plough (Brinny)
ADDRESS: Inishannon, Co. Cork

DESCRIPTION OF PRODUCTS/SERVICES:
 The Brinny plant is Schering-Plough's centre of excellence for the manufacture and quality assurance of its biotechnology based pharmaceutical products. The main product for worldwide distribution is INTRON A, an interferon used for the treatment of certain cancers and viral diseases. They also produce other biotechnology products for commercial use and development/clinical trials.

NAME OF COMPANY: Surgen Ltd
ADDRESS: Royal College of Surgeons, St Stephen's Green, Dublin 2

DESCRIPTION OF PRODUCTS/SERVICES:

- Pharmacogenomic clinical study design and management.
- DNA extraction, analysis and long-term storage.
- Genomic analysis services for both clinical and basic research teams. Surgen has particular expertise in cardiovascular pharmacogenomics, and has also established programmes in colorectal cancer, anaesthesia and epilepsy.

NAME OF COMPANY: Sylvan Ireland Ltd
ADDRESS: Beechmount Industrial Estate, Navan, Co. Meath

DESCRIPTION OF PRODUCTS/SERVICES:
 Sylvan produce and sell mushroom spawn and associated products for the mushroom industry. Sylvan worldwide is also engaged in the development and manufacture of biopesticides, secondary metabolites, nutraceuticals, and specialized mushrooms.

NAME OF COMPANY: ThromboGenics Ltd
ADDRESS: Unit 14, Bridgecourt Office Park, Walkinstown Avenue, Dublin 12

DESCRIPTION OF PRODUCTS/SERVICES:
 ThromboGenics is developing staphylokinase variants for several indications and currently has six other compounds in its preclinical development pipeline.

NAME OF COMPANY: Tridelta Development Ltd
ADDRESS: 48 Main, St Bray, Co. Wicklow

DESCRIPTION OF PRODUCTS/SERVICES:
 Veterinary diagnostics.

NAME OF COMPANY: Trinity BioTech PLC
ADDRESS: IDA Business Park, Bray, Co. Wicklow

DESCRIPTION OF PRODUCTS/SERVICES:
 Immunodiagnostics and hemostasis diagnostic kits.

NAME OF COMPANY: Tristem Technologies Ltd
ADDRESS: Arena House, Arena Road, Sandyford, Dublin 18

DESCRIPTION OF PRODUCTS/SERVICES:
 Stem cell technologies.

NAME OF COMPANY: Warner Lambert/Parke Davis – division of Pfizer
ADDRESS: Pottery Road, Dun Laoghaire, Co. Dublin

DESCRIPTION OF PRODUCTS/SERVICES:
 Healthcare enzymatic products.

NAME OF COMPANY: Westgate Biologicals Ltd
ADDRESS: Westgate, Lough Eske, Co. Donegal

DESCRIPTION OF PRODUCTS/SERVICES:
 Muscosal healthcare products based on replication of human mucus using active ingredients extracted from dairy whey.

NAME OF COMPANY: Wyeth Medica Ltd
ADDRESS: PO Box 1157, Dublin 12

DESCRIPTION OF PRODUCTS/SERVICES:
 The Wyeth BioPharma campus at Grange Castle will comprise 3 separate facilities – a drug development facility, a drug substance facility, and a drug product facility. These facilities will go into production on a phased basis over the next 4 years.

NAME OF COMPANY: Xenith Biomed Ltd
ADDRESS: Tully Industrial Park, Ballynahown, Co. Galway

DESCRIPTION OF PRODUCTS/SERVICES:
 Diagnostic kits manufacture, pregnancy and allergens test kits.

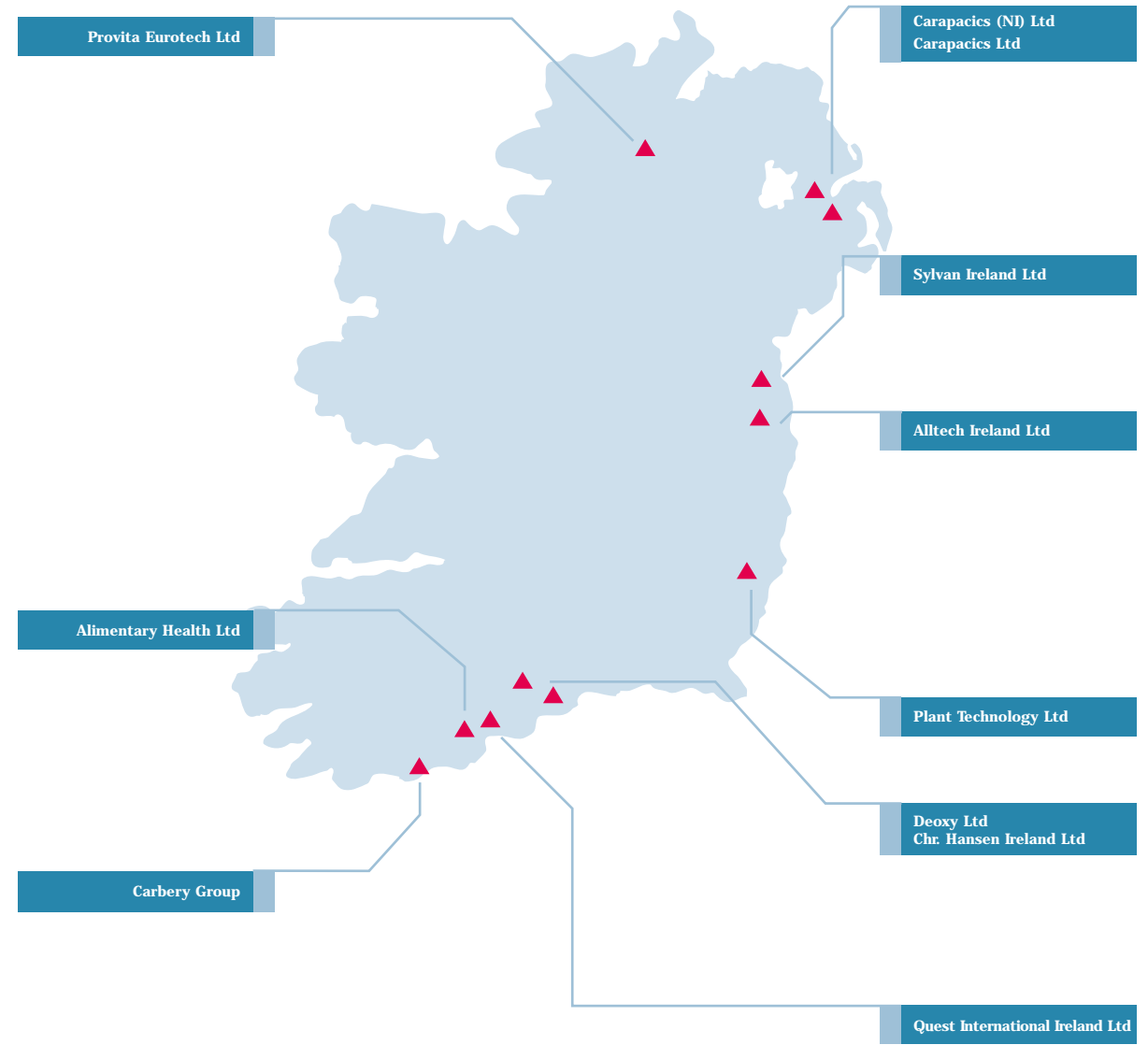
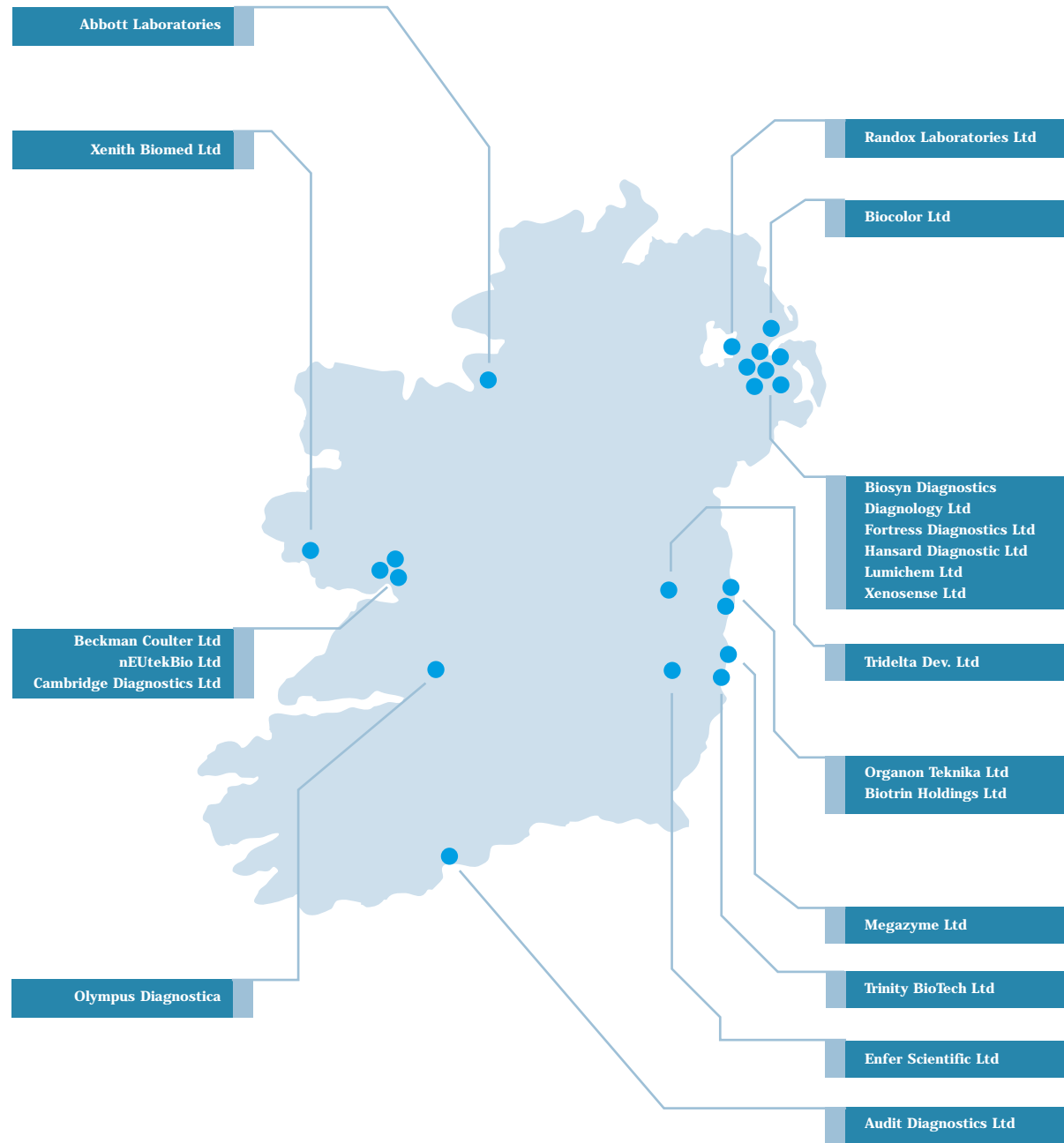
NAME OF COMPANY: Xenosense Ltd
ADDRESS: 10 Malone Road, Belfast, Northern Ireland BT9 5BN

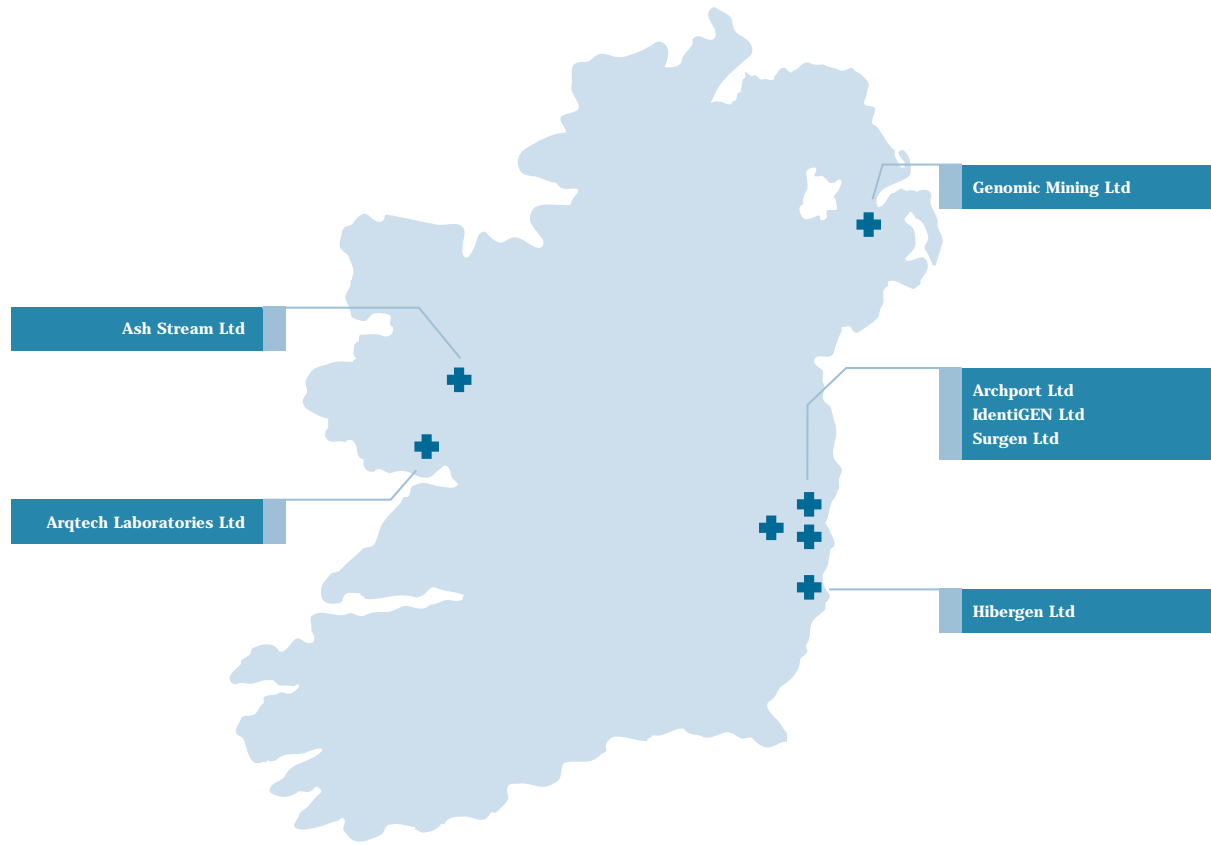
DESCRIPTION OF PRODUCTS/SERVICES:
 Research, development and manufacture of food safety test kits for use with SPR Biosensors.

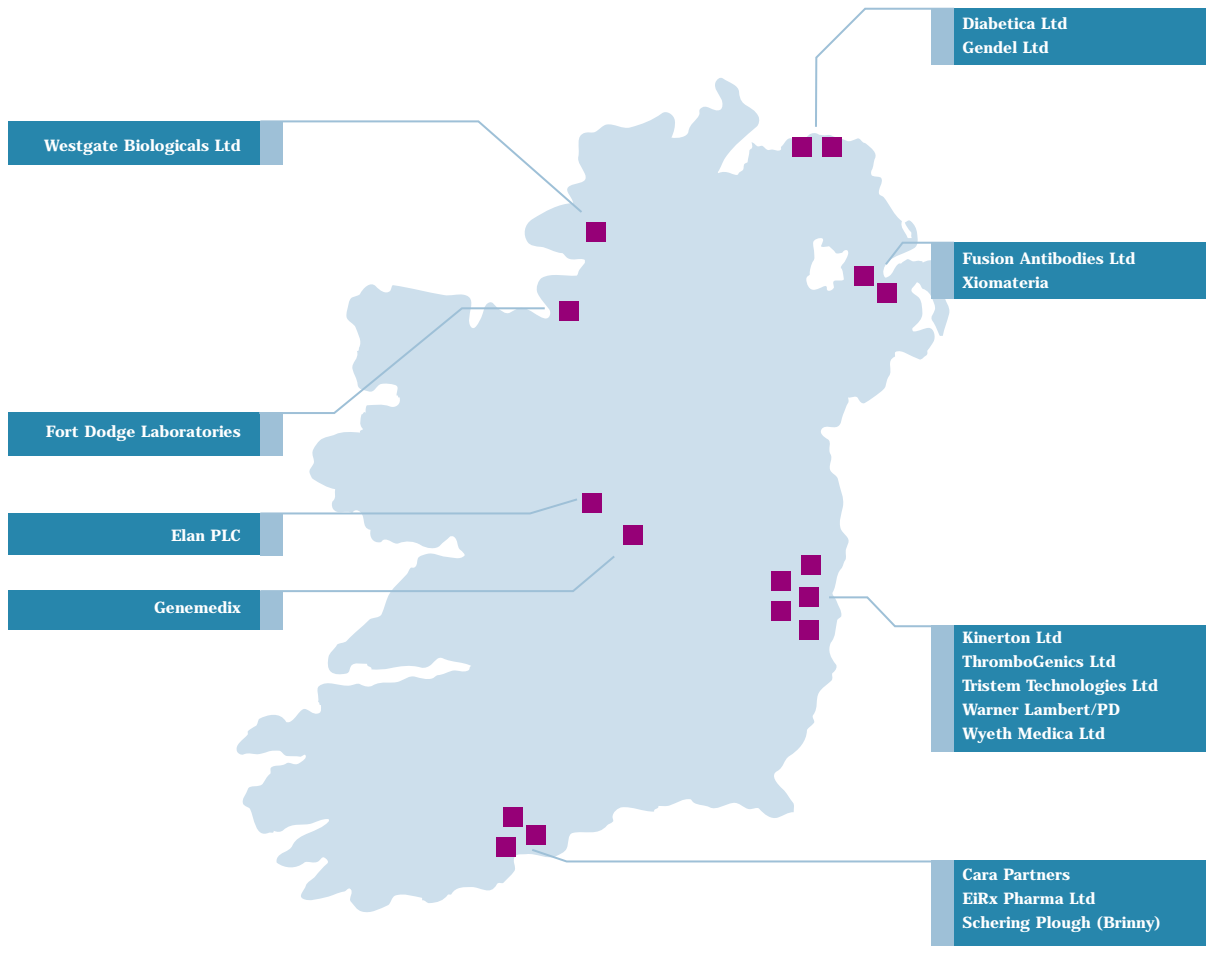
NAME OF COMPANY: Xiomateria
ADDRESS: School of Pharmacy, Queen's University, Belfast, Medical Biology Centre, 97 Lisburn Road, Belfast, Northern Ireland BT9 7BL

DESCRIPTION OF PRODUCTS/SERVICES:
 Novel biomaterials that mimic the defence mechanism of body tissues ('biomimetic').

APPENDIX II
GEOGRAPHICAL DISTRIBUTION OF COMPANIES
BY COMMERCIAL AREA







APPENDIX III
GLOSSARY OF KEY BIOTECHNOLOGY TERMS

GLOSSARY OF KEY BIOTECHNOLOGY TERMS

ALLERGENS: Antigenic substances capable of producing immediate-type hypersensitivity.

BIOINFORMATICS: The science of managing and analysing biological data using advanced computing techniques, so as to identify relationships between biological phenomena and health or other characteristics. This is especially important in analysing genomic data

BIOMIMETICS: Synthetic, chemical substances that perform some of the functions of a biological molecule, i.e. that mimic a molecule.

DIAGNOSTICS: Products for the detection or measurement of parameters relevant to determination of the state of health, and the diagnosis of disease or its consequences.

ELECTROLYTES: Substances that dissociate into two or more ions, to some extent, in water. Solutions of electrolytes thus conduct an electric current and can be decomposed by it (electrolysis).

GENE THERAPY: A procedure aimed at replacing, manipulating, or supplementing non-functional or malfunctioning genes.

GENOMICS: The study of genes and their function.

GENOTYPE: The genetic constitution of an organism or cell, as distinct from its expressed features or phenotype.

GENOTYPING: The detailed localisation of genes and markers along the human sequence to facilitate screening for mutations and the discovery of disease genes.

IMMUNO-ASSAY: A diagnostic device that uses antibodies to measure and/or identify target substances.

IN VITRO: Studies performed outside a living organism.

IN VIVO: Studies performed within the animal or human body.

MEDICAL FOOD (NUTRACEUTICAL): A food or part of a food that has a specific health benefit, typically in the prevention or treatment of disease.

NUCLEOTIDE: A sub-unit of DNA or RNA consisting of a nitrogenous base (adenine, guanine, thymine, or cytosine in DNA; adenine, guanine, uracil, or cytosine in RNA), a phosphate molecule, and a sugar molecule (deoxyribose in DNA and ribose in RNA). Thousands of nucleotides are linked to form a DNA or RNA molecule.

OLIGONUCLEOTIDE: A molecule usually composed of 25 or fewer nucleotides, used as a DNA synthesis primer.

PHARMACOGENOMICS: The study of the interaction of an individual's genetic make-up and their response to a drug

PROBIOTIC: A live microbial culture which beneficially affects the human or animal host by improving its intestinal microbial balance, or by other means.

RECOMBINANT DNA TECHNOLOGY: Procedure used to join together DNA segments in a cell-free system (an environment outside a cell or organism). Under appropriate conditions, a recombinant DNA molecule can enter a cell and replicate there, either autonomously or after it has become integrated into a cellular chromosome.

RECOMBINANT PROTEIN: Protein derived from recombinant DNA technology (see above).

SENSOR (BIOSENSOR): A device which involves the coupling of a biological material (for example, enzyme, receptor, antibody, whole cell, organelle) with a microelectronic system or device to enable rapid, accurate, low-level detection of substances in body fluids, water, and air.

