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IRELAND

Irish Council for Science,
Technology and Innovation

Technology Foresight Ireland

Report of the Chemical and Pharmaceuticals Panel

Forfás

Established by the Government and Forfás to advise on Science, Technology and Innovation

Executive Summary

Strategies that will be effective in ensuring the continued growth of the chemical and pharmaceutical sector are those which will achieve the following:

- Make Ireland a still more attractive location in which to manufacture specialty chemicals and pharmaceuticals
- Ensure that Ireland possesses the national science and technology infrastructure that will meet the needs of the sector between now and 2015
- Allow entrepreneurs to grow indigenous companies and compete nationally and internationally to provide innovative products and services to the sector
- Ensure that there is wide appreciation of the benefits the sector brings to Ireland and of the opportunities and rewards a career in this industry offers.

The Panel has developed four 'future-proofed' strategies that meet the above criteria and that have the support of the sector

- *Rapid Response Regulation,* a strategy that will ensure that Ireland is the most favourable location in the world in which to meet the properly stringent national and international regulatory requirements
- *Techmart,* a strategy based on a system of research vouchers that will reduce the cost of doing research in Ireland and ensure that the national science and technology infrastructure will meet the present and future needs of the sector
- *Home Grown,* a strategy that will encourage indigenous entrepreneurs to grow businesses that will provide new products and services to the sector in Ireland and abroad
- *Hearts and Minds,* a strategy that will ensure that there is wide appreciation of the benefits the sector brings to Ireland.

In the expectation that Government will respond immediately to the sector's unanimously agreed and rigorously prioiritised needs, the Panel has decided to make just four recommendations, only one of which will require significant additional investment by the State.

- The Government will immediately establish a ministerial-level task force, including representatives of the relevant state agencies and the sector, to ensure that all the measures of the Rapid Response Regulation strategy are enacted. It is a strongly held view of the sector that this strategy, requiring relatively small expenditure, has the potential to secure a very significant competitive advantage for Ireland.
- The State will implement the Techmart strategy immediately and will undertake to do the following:
    - *Invest IR£50 million over five years to establish five national centres of excellence in key chemical and pharmaceutical technologies*
    - *Introduce research vouchers, in the amount of IR£200 million over five years, whose value is proportional to a company's research and development spend in the previous year, and which may be used to*

purchase research and development in designated national centres of excellence or third level departments

- *Ensure third level departments which are responsive to the needs of the sector attain the highest standards in teaching and fundamental research by permitting the Higher Education Authority (HEA) to match the spend by the sector in those departments.*

- Enterprise Ireland will make nurturing the growth of the indigenous chemical and pharmaceutical sector among its highest priorities and, toward this end, will immediately establish an advisory group made up of members from the sector to advise it on implementing the measures contained in the Home Grown strategy
- The sector will fund from its own resources, by an agreed contribution from the members of the sector, a nationally coordinated programme to implement the Hearts and Minds strategy. The Institute of Chemistry of Ireland, the sector's professional body, will act immediately to initiate this process.

The above recommendations will cost the State much less than 10 per cent of the expected tax revenue from the sector during the same period, assuming no growth, and will ensure that the multinational companies based in Ireland are in a position to compete, at a time of global consolidation, for the right to play an expanded role in their own organisations, thereby securing their futures. They will also ensure that indigenous companies in the sector are nurtured so that they grow to take advantage of the opportunities, both at home and abroad, presented by Ireland having become one of the sector's recognised world centres.

1. Introduction

This section provides a brief introduction to Technology Foresight.

1.1 Scenario Planning

Governments want to develop and implement strategies that will benefit their citizens in the future. The difficulty faced by governments, of course, is that they do not know what the future will be.

For this reason, governments have begun to use scenario-planning methods, similar to those developed by the large multinational organisations, to identify those strategies which are likely to be effective in the future.

This form of planning involves testing a range of strategies against scenarios representing a number of possible futures. The objective it to identify those strategies which are the most 'future-proof'.

1.2 Technology Foresight

One objective of Technology Foresight is to identify future-proof strategies which will ensure that the science and technology infrastructure of a nation has the capacity to promote and support innovative industry into the future.

Ireland, being a small country in a global economy isolated at the periphery of Europe and lacking significant natural resources, must develop a world-leading capacity to innovate.

Accordingly, the Irish Council for Science Technology and Innovation (ICSTI), started Ireland's first Technology Foresight exercise in March 1998, following a request to do so from the Minister for Science, Technology & Commerce.

The Council established eight Technology Foresight Panels, each chaired by a member of ICSTI, to consider the future technology needs of key sectors.

This report describes the findings of the Chemical and Pharmaceutical Sector Foresight Panel.

1.3 An Inclusive Process

A growing number of countries are using Technology Foresight. As more experience is gained, it is becoming increasingly clear that the process of Technology Foresight is as important as the strategies which it identifies and recommends.

Specifically, it has been found that panels which consult widely, not only generate more effective and more robust strategies, but also catalyse interactions between the different stakeholders. It is often these interactions which lead to the most creative and effective planning for the future scientific and technological needs of a country.

The Chemical and Pharmaceutical Panel has, therefore, consulted very widely (see Appendices).

2. The Sector Today

This section provides a brief overview of the current state of the chemical and pharmaceutical sector internationally and nationally.

2.1 Internationally

The global pharmaceutical market was estimated at $250 billion in 1997, of which the top 20 firms control 60 per cent. As might be expected, this sector is highly regulated at both national and international levels. There are many changes taking place in the industry, mainly of a business nature. A characteristic of this sector is its sustained growth and resilience in the face of local and global down-turns.

The global specialty and other chemicals market is very large, and highly diversified. It is dominated by large multinational firms, which themselves are diversified. There is a global trend toward more value being added to the finished product.

Some of the more important changes are the following:

- There is a trend towards flexible production processes that can be tailored to meet the needs of the customer for more complex and higher purity products
- Complex or specialised chemical or biochemical transformations or processes are increasingly being outsourced
- Manufacturers of fine chemicals are becoming increasingly aware of the needs of the pharmaceutical sector and of the opportunity to exploit niche markets
- There is a trend towards drug delivery systems and devices which will impose tighter specifications on the pharmaceutical manufacturers, while at the same time providing new market opportunities
- Cost control will continue to be a primary focus in the face of pressures for flexible manufacturing technologies, purer products, cleaner production and waste elimination
- Communications between manufacturers, physicians and patients are improving rapidly due to the Internet and other information and communications systems.

2.2 Nationally

The chemical and pharmaceutical sector in Ireland is not typical of those in other countries, with virtually no petrochemical industry and very little production of bulk chemicals. The sector in Ireland is characterised by new state-of-the-art manufacturing facilities producing high-tech, high-value specialty chemical and pharmaceutical products for export.

The sector presently employs 16,000 people with associated labour costs of IR£400 million. Employment growth was 14 per cent between 1997 and 1998. There are 200 firms in this sector, with annual exports worth over IR£8,800 million.

The pharmaceutical (proprietary, generic and bulk active ingredients) sub-sector comprises 80 firms, which employ 12,100 people with an average wage bill of IR£300 million. In addition,

service purchases amount to IR£400 million, and create employment for a further 8,000 people.

Nine of the world's top ten pharmaceutical firms have manufacturing facilities in Ireland. Consequently, the pharmaceutical sub-sector is dominated by foreign firms. Unlike the electronics sector, however, employment is very stable: there have been no complete plant closures in 25 years.

The pharmaceutical sub-sector is very profitable and is the largest sector contributor of corporation tax, paying an estimated IR£230 million in 1997; a testimony to strategies based on tax incentives rather than grant-aid. The ratio of tax paid to grants received in 1997 was 53:1. Exports in 1997 amounted to IR£6,220 million; 16 per cent of all manufactured goods exported by Ireland. Imports amounted to IR£1,350 million in 1997, giving a positive trade balance of IR£4,870 million.

The pharmaceutical sub-sector carries out little or no drug discovery in Ireland. There are, however, significant amounts of original process development work in plants producing bulk active ingredients and some development of formulation and delivery systems.

The specialty chemicals sub-sector, while not as large as the pharmaceutical sub-sector, is significant and employs 4,000 staff in 60 companies, including large numbers of highly qualified chemists and chemical engineers, together with very skilled chemical plant operators. Between 30 per cent and 50 per cent of the total work force has a technical qualification. The sub-sector manufactures finished products including adhesives, coatings, printing and photographic materials, cleaning materials, additives for the food and other industries, and intermediate products and actives for the pharmaceutical sub-sector.

The specialty chemicals sub-sector in Ireland has developed mainly since the 1960s. It is a stable industry and, in general, once chemical companies have invested here they have expanded and invested further. While the specialty chemicals sub-sector has invested strongly in production, there is little investment in R&D. This factor is limiting the potential for growth in the sub-sector, which could be significant in a favorable environment.

2.3 Scope of Foresight Exercise

The Foresight Panel was strongly of the view that it should address the future technology needs of both the specialty chemical and pharmaceutical sub-sectors.

3. The Sector Tomorrow

This section describes the key business drivers and the accompanying technological responses which are likely to characterise the sector between now and 2015.

3.1 Business Drivers

The Panel has identified the following key business drivers as those which will require a mainly technological response from the sector:

- Research and Development
- Manufacturing
- Outsourcing
- Product Delivery
- Customer and Markets
- Reputation.

There are, of course, other key business drivers, but it was considered that these would not require a mainly technological response.

3.2 Technological Responses

The likely technological responses of the specialty chemical and pharmaceutical sub-sectors to the business drivers listed in section 3.1 are sufficiently different that they have been summarised separately in Tables I and II.

Table 1 - Technological Response of the speciality chemical sub-sector to key business drivers between now and 2015

Business Driver	Technological Response
Research and Development	
Product Identification	Information and Communication Technologies (ICT)
Time-to-Market	ICT to obtain product/market intelligence ICT to manage technology/project
Patent Extension	Novel packaging/delivery technologies
Manufacturing	
Complex/Pure Products	Novel process control and product monitoring technologies Capacity to undertake biotransformations
Increased Regulation	ICT to manage regulatory process
Cost Containment	Novel process control and product monitoring technologies Greater automation
Outsourcing	
Increasing opportunities	Flexible process technology ICT integration with customer
Food/drugs/electronics	Technologies to meet the specialty chemical needs of these industries
Product Delivery	
Advanced Packaging	Packaging technology compatible with customer's process and regulatory requirements Smart packaging/ease of customer use
Customer/Market	
Niche Markets	ICT to support globally dispersed customer base
Localised Products	Flexible process technologies that can be rapidly re-engineered for product localisation
Reputation	
Ethical	ICT to increase transparency
Sustainable	Novel manufacturing technologies that exploit renewable feedstocks and minimise energy usage and waste
Environmental	Novel technologies to reduce or eliminate waste

Table 2 - Technological Response of the pharmaceutical sub-sector to key business drivers between now and 2015

Business Driver	Technological Response
Research and Development	
Therapeutics Rapid Discovery Effectiveness Time-to-Market Patent Life Extension	Bioinformatics Combinatorial chemistry and rapid screening technologies Combination therapies Drug delivery and medical devices ICT to facilitate integration of drug research and product development Combination therapies Novel manufacturing and formulation
Manufacturing	
More Complex Activities/Systems Increased Regulation Cost Containment	Fewer, more advanced, manufacturing facilities with state-of-the-art process control and product monitoring technologies Outsourcing of selected steps Integration of drug delivery systems into the manufacturing process More links to Centres of Excellence Incorporation of bio-catalysis and microbial techniques into chemical synthesis Containment technologies and environmental control Earlier new product transfer to manufacturing sites Greater automation of processes and monitoring ICT to optimise manufacturing processes
Customer/Markets	
Demographics (ageing population) Lower Cost Therapies and Care Relationship with Customer	Drug technologies to meet needs of aging population Focused portfolio of drugs for treatment and management of families of related diseases ICT to permit direct marketing to the General Practitioner (GP) ICT to permit direct exchange of information with GP and with patient Tailored drug delivery systems (formulation and device) that will facilitate the provision of non-residential, non-specialist health-care
Reputation	
Ethical Sustainable Environmental	ICT to increase transparency Novel manufacturing technologies that exploit renewable feedstocks and minimise energy usage and waste Novel technologies to reduce or eliminate waste

3.3 Strategic Question

The principal conclusions that may be drawn from an analysis of the current state of the sector internationally and nationally, as outlined in sections 2.1 and 2.2, and from the expected technological responses to key business drivers, as outlined in sections 3.1 and 3.2 and summarised in Tables I and II, are the following:

- The future of the sector will be characterised by further mergers leading to the emergence of a small number of global players
- This process of consolidation will lead to excess research and manufacturing capacity which will have to be rationalised
- Rationalisation of this excess capacity will lead to fewer, larger 'super-research' sites and 'super-manufacturing' facilities with the expected benefits of reduced time-to-market and cost containment
- These super-research facilities will employ state-of-the-art science and technology to undertake directed fundamental and applied research leading to the identification of new products
- These super-manufacturing sites will undertake pilot production, process development, manufacturing, formulation, and packaging, and will support the interface to the regulator and the customer
- There is no realistic prospect of attracting super-research facilities to Ireland
- The same is not true of super-manufacturing sites, as the sector in Ireland has an internationally established reputation for excellence in process development and manufacturing and is well placed to be a global centre for such sites
- It is clear, however, that new and improved national science and technology capabilities (advanced synthesis, bio-transformation and formulation) and a responsive regulatory environment will be necessary to support the existing manufacturing plants as they compete for the right to play this more demanding role
- The future of this sector will also be characterised by the emergence of companies providing novel services and products to the sector. A few of these companies may 'go big'
- There is, therefore, the opportunity to grow a vibrant indigenous sector providing novel technologies and services (ICT and biotechnology) in Ireland and abroad. A vibrant indigenous sector will also reduce Ireland's over-dependence on multinational organisations
- Finally, the health of the sector is dependent on the availability of motivated individuals, skilled in the sciences and technologies that will be critical to its future success.

Based on the above analysis it was agreed that the strategic question that must be answered by the Panel was the following:

'What research and development initiatives will be necessary to embed multinational companies and encourage the growth of new ventures in the pharmaceutical and chemical sector?'

3.4 Strategic Answer

The answer to the strategic question, what research and development initiatives will be necessary to embed multinational companies and encourage the growth of new indigenous ventures, is, in the most general terms, those initiatives which will achieve the following:

- Make Ireland a still more attractive location in which to manufacture specialty chemicals and pharmaceuticals
- Ensure that Ireland possesses the national science and technology infrastructure that will meet the needs of the sector between now and 2015
- Allow entrepreneurs to grow indigenous companies and compete nationally and internationally to provide innovative products and services to the sector
- Ensure there is wide appreciation of the benefits the sector brings to Ireland and of the opportunities and rewards a career in this industry offers.

4. Strategies

4.1 Strategies

This section describes four strategies which have been developed in order to ensure that the national science and technology capability that develops between now and 2015 will embed the multinational companies which dominate the sector and encourage the growth of new indigenous enterprises capable of providing products and services to the sector.

- *Rapid Response Regulation,* is a strategy that will ensure that Ireland is the most favorable location in the world in which to meet the properly stringent national and international regulatory requirements
- *Techmart,* is a strategy based on a system of research vouchers that will reduce the cost of doing research in Ireland and ensure that the national science and technology infrastructure will meet the present and future needs of the sector
- *Home Grown,* is a strategy that will encourage indigenous entrepreneurs to grow businesses that will provide new products and services to the sector in Ireland and abroad
- *Hearts and Minds,* is a strategy that will ensure that there is wide appreciation of the benefits the sector brings to Ireland.

4.2 Consultation

Draft strategies were first circulated to a cross-section of key decision-makers inside and outside the sector at a scenario workshop hosted by Eli Lilly in Kinsale on the 30th October 1998.

At this workshop each draft strategy was tested against three scenarios which encapsulated the key uncertainties about the future. The uncertainities were identified in consultation with key decision-makers from the sector both in Ireland and abroad.

The draft strategies were discarded if they were considered either to be ineffective or too future-dependent. The four strategies, which were found to be relevant and sufficiently future-proof, were refined in light of the feedback from the workshop and are presented in this chapter.

4.3 Rapid Response Regulation

'The Irish-based sector will be the world leader in rapid-response regulation.'

Background

One of the major challenges facing both specialty chemical and pharmaceutical manufacturers is to comply with the properly stringent regulations laid down by both national environmental protection and health and safety agencies and, in the case of the pharmaceutical manufacturers, the regulations laid down by national (US Food and Drug Administration) and transnational (European) drug regulatory agencies.

Specifically, the challenge is to comply with the above regulations while reducing the time required to do so to a minimum. Often, it is the time required to meet national and international regulatory standards that determines the time taken to bring a product to market. In the case of a billion dollar a year drug, reducing the approval procedure by six months can represent a very significant additional profit from a product whose value is directly linked to a patent with a fixed life-time.

As outlined in section 3.3 of this report, developments in this sector are likely to see the large multinationals moving to a smaller number of super-manufacturing sites. These sites will be expected to undertake pilot production for product validation in the case of specialty chemical manufacturers and for clinical trials in the case of pharmaceutical manufacturers. They will both also be expected to undertake advanced formulation for shipping as the final product or dosage form.

All of the above implies a diverse range of complex manufacturing steps and the need to change these steps as the manufacturing process matures. As a consequence, the time and effort that will have to be devoted to complying with existing and new regulations will, unless this issue is addressed, increase significantly. This situation is likely to be further aggravated by the increasing use of biotechnology to perform chemical transformations.

Strategy

Clearly, those countries that possess the scientific and technological capacity to provide 'rapid-response' regulation will be seen as locations offering a very important competitive advantage. This strategy envisages the development of an indigenous service industry, to provide those products and services that will be necessary to effect rapid-response regulation. For this indigenous industry to be viable, it will be necessary to secure the principal regulatory authorities as strategic partners and to exploit the export opportunities that result from the globalisation of rapid-response regulation.

Measures

The following are the measures necessary to put into effect such a strategy:

- The sector will work with the regulatory agencies, national and international, to develop and introduce new rapid-response protocols and standards
- To assist this process the State will make key individuals, in the relevant national agencies, responsible for working with the sector to develop and introduce rapid-response regulation
- Because of the importance of the US Food and Drugs Administration (FDA) in regulating the pharmaceutical sub-sector, the State will encourage the FDA to set up an office in Ireland and to be a strategic partner with the Irish Medicines Board (IMB) in the development of rapid-response regulation
- The State will encourage joint ventures between indigenous companies providing regulatory software and process control and environmental monitoring solutions to the sector
- The State will adopt the system of advanced planning permission and pre-approved sites in partnership with local communities to facilitate the rapid implementation of new ventures.

4.4 Techmart

Background

The sector in Ireland is characterised by state- of-the-art manufacturing facilities producing high-tech, high-value specialty chemical and pharmaceutical products for export and by a reputation for excellence in process development.

The current process of global consolidation in the sector will lead to the emergence of a smaller number of super-manufacturing facilities undertaking pilot production, process development, manufacturing, formulation and support of the regulator/customer interface.

If existing manufacturing plants are going to successfully compete for the right to play this expanded role, thereby securing their future and that of the sector in Ireland, it is vital to ensure that the appropriate national science and technology infrastructure is put in place and that the cost of doing research in Ireland is reduced.

In this context we note the following:

- The relevant science and technological infrastructure in Ireland is, by international standards, second rate. For example, there are no world class Universities (an Oxford, an MIT or a Pasteur Institute) or relevant centres of excellence which the sector can call on if new technologies have to be developed or implemented. The above is compounded further by the fact that, generally, university-industry co-operation is superficial, short term and under-funded
- The reason Ireland has been so successful in attracting the manufacturing operations of the leading multinationals in the sector, specifically the 10 per cent manufacturing tax, is also the reason the same multinationals currently opt to undertake research and development in countries other than Ireland, that is, in countries where the research and development expenditure may be written off against higher rates of corporation tax and the associated costs minimised.

Strategy

The strategy is to instigate a research voucher (tax credit) scheme, the value of which is based on a company's research and development spend in the previous year. These vouchers may be used to purchase strategic or applied research of interest to the sector in designated centres of excellence or third level departments. By removing two of the principal obstacles to the existing manufacturing sites in Ireland becoming super-manufacturing sites, this will have the dual effect of reducing the cost of undertaking research and development in Ireland and of funding the development of a world class national science and technology infrastructure that is highly responsive to the needs of the sector. This is an evolutionary step that will be essential to secure their future and that of the sector as a whole.

Measures

The following describes in more detail the operation of the proposed research voucher scheme:

- Multinational and indigenous companies in this sector will receive a research voucher whose value is based on a company's total research and development spend in the State
- The research voucher will be used by the sector to purchase strategic and applied research in designated centres of excellence or third level departments.

By this means a market will be created which will ensure (i) that the centres of excellence operate as business entities meeting the needs of the sector; (ii) that the third level departments undertake the strategic and applied research necessary to underpin the research and development activities of the sector and (iii) that there is extensive collaboration between the sector, the centres of excellence and the third level departments.

The State will provide the funding necessary to establish five centres of excellence in key technologies, described below, while the HEA will provide additional funding, equal in value to the research vouchers spent by the sector in a third level department, to raise the standards of teaching and fundamental research in these departments to the highest international levels.

Centres of Excellence

The requirement for five centres of excellence in the following key technologies has been identified (see Tables I and II) as being central to the technological response of the sector to key business drivers between now and 2015:

- Advanced Conventional and Biological Synthesis
- Advanced Formulation/Delivery and Packaging Systems
- Flexible, Clean and Efficient Processes
- Process Automation and Monitoring
- ICT to manage the Regulatory and Customer Interfaces.

As the sector evolves, these centres will have to develop to meet the changing needs of the sector or they will fail to attract the funding they require to remain operational. These centres will be co-located with third level institutions in order to provide the necessary infrastructure needed for such centres. This will allow the centres to draw on expertise and assistance from the neighbouring institution and will avoid unnecessary additional capital expenditure by the centres on resources already available in the proximate third level departments.

Third Level Colleges

Monitoring research voucher expenditure in third level departments will allow the HEA to identify those chemistry, biochemistry, chemical engineering and other departments which are pursuing the strategic and applied research that supports the research and development activities of the sector. The matching funds provided by the HEA will allow these departments to attain highest international standards in teaching and fundamental research. This, in turn, will ensure that these departments are of a sufficiently high standard to support the future research and development activities of the sector. The attainment of international reputations for excellence in teaching and research by these departments will also assist the manufacturing operations of MNEs located in Ireland to make a stronger case within their organisations for an expanded role.

4.5 Home Grown

'The sector will work with the State to foster the growth of an indigenous industry and derive all the benefits that arise from a healthy and diverse sector.'

Background

The development of vibrant indigenous companies is essential for the long term health of the sector. There is a recognition that the development of the indigenous sector has been disappointing given the size of the overall manufacturing base.

Strategy

It is clear that the growth of new and existing indigenous companies will contribute to the overall health of the sector by ensuring a diverse skills and technology base. The strategy, therefore, is to appeal to the enlightened

self-interest of the State and the sector to foster the growth of indigenous companies in the sector. In order that new and existing indigenous companies in the sector grow, the following are essential:

- Individuals with ideas for new products or services must be encouraged to establish and grow new companies
- These new companies must demonstrate world class capability, a reasonable customer base and the potential for rapid growth
- New or existing companies with the potential for rapid growth must attract substantial investment in order to rapidly develop products or services and secure market share
- Finally, those companies that are successful must contribute to funding the growth of the next generation of new and existing indigenous companies, via a levy on profits.

In short, the growth of indigenous companies, although essentially market driven, can be nurtured in the critical start up phase of such ventures.

It is clear this strategy will require significant initial investment by the State. It is equally clear, however, that the strategy described is entirely consistent with the mission of Enterprise Ireland which, at a time of unprecedented revenue buoyancy, might reasonably expect to secure the funds necessary for its implementation in partnership with the sector.

Measures

Outlined below are measures necessary to put into effect such a strategy.

Entrepreneurs

The following measures are intended to contribute to the creation of an entrepreneurial class among students in the colleges and those currently employed in the sector:

- The sector will fund, in partnership with Enterprise Ireland, a competition for all students in third level colleges for the best idea for a new product in the sector

- The sector will fund, in partnership with Enterprise Ireland, a competition for all employees in the sector for the best idea for a new venture. The award should be substantial and should permit the winner to develop a detailed business plan around the idea
- The sector will work with the business schools to develop courses designed especially for individuals employed in the sector. In general, these courses should aim to create more flexible individuals capable of taking managed risks to realise a vision for their own or their employer's organisation.

Establishing and Growing New Ventures

The following measures are intended to encourage the establishment of new ventures in the sector:

- Enterprise Ireland will establish two purpose built incubator units, one in Cork and one in Dublin, each capable of housing five start-up companies for up to five years. Seed capital and start-up funding will be provided for these incubator units
- These incubator units could be expanded to accommodate biotechnology companies and ICT companies providing services to the sector
- These companies will have access to centres of excellence established to meet the needs of the sector as a whole in key technologies
- The State will have the right to acquire equity in these companies at preferential rates
- Existing ventures will also have access to all the services provided by the incubator units and centres of excellence in key technologies
- Together, the State and the sector will establish a venture capital fund of IR£100 million with a mandate to invest principally, but not exclusively, in new and existing indigenous companies in the sector or in companies of interest to the sector (ICT, biotechnology)
- Investments in, and any subsequent realisations from, this fund will be taxed at a preferential rate. These exemptions should apply equally to foreign investors, such as the US pension funds

The board of this fund will seek and foster the growth of new and existing enterprises in the sector with the capacity for rapid growth. It will also be encouraged to seek out similar opportunities in the biotechnology and relevant areas of the ICT sectors.

Sustainability

The above mechanisms will require substantial State and sector resources. To sustain this approach over an extended period, it will be necessary for those companies that, as a result, grow and achieve high levels of profitability to contribute to the continued funding of these mechanisms. This funding will be provided by a levy on the profits of companies initiated by this measure, thereby providing a self-financing mechanism.

4.6 Hearts and Minds

'The sector will win the hearts and minds of the young to ensure a supply of skilled individuals and an appreciation among the wider community of the benefits of the sector.'

Background

The business and services sectors have stolen a march on the scientific and technological sectors in glamorising and promoting careers within their industries. This is reflected in young people increasingly choosing to study business and language subjects at second and third levels.

The environmental movement has been very successful in wining the hearts and minds of the young. Consequently, students who do have an interest in science are increasingly likely to study biology, the latter offering the prospect of a career in an eco-friendly or eco-monitoring type industry.

In the context of the Irish educational system, there also exists the following practical constraints: chemistry and physics are increasingly being taught by biology graduates; these subjects are perceived as being more difficult at Leaving Certificate and requiring greater effort-per-point; career guidance counsellors are, for the most part, unaware of the opportunities in the science and technology sectors and of the rewards which such careers can offer; women are still not sufficiently encouraged to become scientists or engineers.

Against such a background, it will be necessary for the scientific and technological sectors in general, and for the pharmaceutical and chemical sector in particular, to be equally successful in winning the hearts and mind of the young.

Strategy

The strategy for the sector will be to play its full part at all levels in the development of effective science and technology education in particular, and education in general. The expected benefits of such a strategy are the following: in the short-term, to encourage young people to pursue careers in the sector; in the medium term, to create positive attitudes among the young toward the sector; and in the longer term, to create positive attitudes among the wider community toward the sector.

Measures

Outlined below are the measures necessary to put into effect such a strategy. These measures are based on those successfully put in place by the ICT sector to address similar problems.

First and Second Level

The education system will aim to do the following:

- Create teacher, pupil and parent awareness of the career opportunities afforded by taking mathematics, physics and chemistry at second level
- Use secondary school scholarships and career opportunities as key incentives for students to study these and related technology subjects

- Increase national awareness of careers in the scientific and technological sectors, emphasising the high quality of employment and high levels of remuneration, through educational programmes and working with national organisations.

The sector will achieve these aims by funding the following:

- Appointment of individuals in companies responsible for academic relations
- Awareness campaigns for local career guidance counsellors
- On-site visits and careers evenings for local schools
- Opportunities for students to work in the sector for a day
- School-Industry exchange programmes for teachers and career guidance counsellors
- In partnership with the State, introduction of the new science curriculum at primary level and new chemistry curriculum at second level
- Chemistry prizes at Leaving Certificate level
- Participation by schools in the Young Scientist and Technologist Exhibition
- Joint information campaign with National Career Guidance Counsellors Organisation.

When similar measures were adopted by a major multinational company (MNC) in the electronics sector, the following success was achieved locally in six schools: between 1994 and 1996, the number of students taking higher level mathematics increased by 113 per cent; higher level chemistry by 65 per cent and higher level physics by 54 per cent.

A potential weakness of the strategy as outlined above is that it does not address directly those students who, for whatever reason, are not studying science.

Third Level

The third level system will aim to do the following:

- Meet existing and future business objectives by improving the availability and quality of graduates and post-graduates
- Deliver Irish third level-based research of value to the sector by campaigning for a small number of Graduate Schools to be funded to the highest international standards in key technologies.

The sector will achieve these aims by funding the following:

- Curriculum development
- Undergraduate and postgraduate scholarships in chemistry, chemical engineering and related disciplines
- A Women in Science and Technology programme
- Research awards for leading academics and research groups in selected graduate schools.

Mature Students

The sector will aim to do the following:

- Educate mature students, often highly motivated individuals active in the local and wider community, about the objectives and activities of the sector.
- These aims will be achieved by undertaking the following:
- Actively participate in the numerous educational programmes aimed at mature students (night courses to modular degrees) by presenting courses introducing the sector
- Preparation of a support pack to assist members of the sector to readily present such courses.

Decision Makers and Wider Community

The sector will aim to do the following:

- Generate greater awareness of the value of the sector to the wider community among key decision-makers
- Gain the active support of key decision-makers for those measures outlined above.

These aims will be achieved by funding the following:

- An independent study into the value of the sector to the wider community
- A national advertising campaign disseminating the findings of this study
- Individual briefings by key players in the sector to key players nationally.

5. Recommendations

This section outlines the recommendations of the Panel and indicates the Panel's intention to monitor, on behalf of the sector, their implementation.

5.1 Recommendations

In the expectation that government will respond immediately to the sector's unanimously agreed and rigorously prioiritised needs, the Panel has decided to make just four recommendations, only one of which will require significant additional investment by the State.

- The Government will immediately establish a ministerial-level task force, including representatives of the relevant state agencies and the sector, to ensure that all the measures of the Rapid Response Regulation strategy are enacted. It is a strongly held view of the sector that this strategy, requiring relatively small expenditure, has the potential to secure a very significant competitive advantage for Ireland.
- The State will implement the Techmart strategy immediately and will undertake to do the following:
    - *Invest IR£50 million over five years to establish five National Centres of Excellence in key chemical and pharmaceutical technologies*
    - *Introduce research vouchers, in the amount of IR£200 million over five years, whose value is proportional to a company's research and development spend in the previous year, and which may be used to purchase research and development in designated National Centres of Excellence or third level departments*
    - *Ensure third level departments which are responsive to the needs of the sector attain the highest standards in teaching and fundamental research by permitting the HEA to match the spend by the sector in those departments.*
- Enterprise Ireland will make nurturing the growth of the indigenous chemical and pharmaceutical sector among its highest priorities and, toward this end, will immediately establish an advisory group made up of members from the sector to advise it on implementing the measures contained in the Home Grown strategy. (Existing funds available to Enterprise Ireland could be utilised for this strategy)
- The sector will fund, from its own resources, by an agreed contribution from the members of the sector, a nationally coordinated programme to implement the Hearts and Minds strategy. The Institute of Chemistry of Ireland, the sector's professional body, will act immediately to initiate this process.

The above recommendations will cost the State less than 10 per cent of the expected tax revenue from the sector during the same period, assuming no growth, and will ensure that the multinational companies based in Ireland are in a position to compete, at a time of global consolidation, for the right to play an expanded role in their own organisations, thereby securing their futures. They will also ensure that indigenous companies in the sector are nurtured so that they grow to take advantage of the opportunities, both at home and abroad, presented by Ireland having become one of the sector's recognised world centres.

5.2 Implementation and Follow-up

The above recommendations must be implemented immediately if the indigenous and multinational companies based in Ireland are to be in a position to compete, at a time of global consolidation, for the right to play an expanded role in the sector and, thereby, secure their futures.

Accordingly, the Panel will continue to consult widely and will meet every six months. The purpose of these twice-yearly meetings will be to agree a short statement describing progress on implementation of the Panel's recommendations. This statement will be circulated to all those who were consulted or who made an input to the process and, via the media, to the sector as a whole.

Appendix I - Panel Members

Dr. Donald Fitzmaurice, Chairman	University College Dublin
Dr. Henry Doran, Deputy Chairman	Schering-Plough (Avondale) Company
Dr. Bernard Bolger	Loctite (Ireland) Limited
Dr. Kieran Brady	Swords Laboratories
Dr. Donal Coveney	Chamfield Limited
Dr. Alva DeVoy	Ulster Bank Investment Managers
Dr. Dermot Diamond	Dublin City University
Dr. Declan Gilheany	NUI - Dublin
Joseph Harford	Yamanouchi Ireland Company Limited
Professor Frank Hegarty	NUI - Dublin
Pat MacGovern	IDA Ireland
Dr. Anita Maguire	NUI - Cork
Matt Moran	Irish Pharmaceutical and Chemical Manufacturing Association (IBEC)
Dr. Tom O'Ceallaigh	Merck, Sharp and Dohme (Ireland)
Jim O'Daly	Newport Synthesis Limited
Dr. Padraig O'Murchu	Intel Ireland Limited
Dr. Joe Rowley	AGB Scientific Limited
Dr. Robert Rutledge	Henkel Ireland Limited
Dr. Fionnuala Walsh	Eli Lilly SA
Dr. Eamonn Kinsella Secretary	The CIRCA Group Europe Limited

Appendix II - Workshop Participants

Mr. W. Barrett	Eli Lilly SA
Mr. D. Brady	Olin Chemicals Limited
Mr. D. Buckley	Merck, Sharp, and Dohme
Dr. E. Cashell	Cork Institute of Technology
Dr. D. Corr	Nanomat Limited
Dr. D. Coveney	Chamfield Limited
Dr. E. Curtis	Hewlett Packard Limited
Dr. M. Delaney	Cork Institute of Technology
Mr. A. Dineen	Janssen Pharmaceutical
Dr. M. Donnellan	Antigen Limited
Professor D. Donnelly	DIAS
Mr. M. Donnelly	City West Innovation Centre
Dr. H. Doran	Schering Plough (Avondale) Company
Professor P. Engel	University College Dublin
Dr. D. Fitzmaurice	University College Dublin
Mr. S. Garland	Aughinish Alumina Limited
Mr. N. Giles	Green Party
Dr. D. Gilheany	University College Dublin
Dr. K. Goggin	Eli Lilly SA
Mr. R. Griffin	Waterford Institute of Technology
Dr. K. Halpin	Forfás
Mr. J. Harford	Yamanouchi Ireland Company Limited
Ms. S. Hedigan	University College Dublin
Professor F. Hegarty	University College Dublin
Dr. R. Hourihane	Cork Institute of Technology
Dr. J. Kavanagh	Abbott Ireland, Sligo
Dr. P. Kavanagh	Iropharm Limited
Dr. R. Kavanagh	Industrial Research and Development Group

Dr. M. Kearney	Forfás and WITS
Dr. E. Kinsella	CIRCA Group Europe Limited
Dr. M. Lane	Trinity College Dublin
Dr. F. Larkin	Kinerton Limited
Dr. A. Maguire	University College Cork
Mr. M. McCabe	Department of Enterprise, Trade & Employment
Dr. R. McConnell	Schering Plough (Brinny) Company
Mr. K. McCauley	SIFA Limited
Mr. P. MacGovern	IDA Ireland
Mr. M. Moran	Irish Business and Employers Confederation
Dr. T. O'Ceallaigh	Merck, Sharp, and Dohme Limited
Mr. J. O'Daly	Newport Synthesis Limited
Mr. P. O'Driscoll	FMC International
Dr. P. O'Murchu	Intel Ireland Limited
Dr. J. O'Reilly	Cara Partners
Dr. E. Prosser	Elan Corporation plc
Dr. J. Rowley	AGB Scientific Limited
Dr. N. Russell	Dublin Institute of Technology
Mr. D. Ryan	Roche Ireland
Dr. R. Rutledge	Henkel Ireland Limited
Professor M. Ryan	University College Dublin
Mr. A. Shiels	Enterprise Ireland
Mr. P. Short	BP Chemicals
Mr. B. Sweeney	Irish Council for Science, Technology and Innovation
Dr. T. Taylor	Burgess Galvin
Mr. A. Weaver	University College Cork

Appendix III - Organisations Consulted

Institutes of Technology	
Heads of Schools of Science	
Mr. M. Baker	Carlow
Dr. E. Cashel	Cork
Dr. T. Creedon	Tallaght
Dr. S. Finnegan	Athlone
Dr. M. Hussey	Dublin
Dr. J. Hynes	Letterkenny
Dr. E. Martin	Waterford
Dr. R. Nevin	Limerick
Dr. S. O'Brien	Dundalk
Dr. S. O'Shea	Tralee
Dr. P. Timpson	Sligo
Universities	
Deans of the Faculties of Science	
Professor P. Brent	University College Cork
Dr. M. Carroll	Trinity College Dublin
Professor G. Doyle	University College Dublin
Dr. T. McCarthy	Maynooth University
Dr. P. Morgan	University College Galway
Professor J. Ross	University of Limerick
Professor M. Smyth	Dublin City University
Heads of the Departments of Chemistry	
Professor R. Butler	University College Galway
Professor F. Hegarty	University College Dublin
Professor K. Hodnett	University of Limerick
Professor B. Jennings	University College Cork
Professor J. Kelly	Trinity College Dublin
Professor M. Quinn	Maynooth University

Professor. H. Vos	Dublin City University

Other Organisations
Conference of the Heads of Irish Universities
Irish Congress of Trade Unions
Royal Irish Academy
Pharmaceutical Society of Ireland
An Taisce
Health Research Board
Economic and Social Research Institute

Appendix IV - Representative Bodies

Irish Pharmaceutical and Chemical Manufacturing Association
Irish Pharmaceutical and Healthcare Association
Animal and Plant Healthcare Association
Irish Chemical Marketers Association
Association of Heads of Schools of Science, Institutes of Technology
Association of Heads of Chemistry Departments in Ireland
Irish Science Teachers Association
Royal Society of Chemistry
Institute of Chemistry of Ireland
Industry Research and Development Group
Society of the Chemical Industry
Institute of Engineers of Ireland
Institution of Chemical Engineers
Council of Directors of Institutes of Technology
Women in Technology and Science
Irish Medical Organisation
Irish Pharmaceutical Union