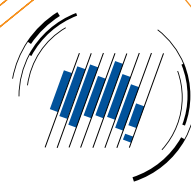


# National Innovation Systems of Selected Nations

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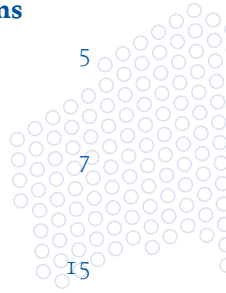


**INDUSTRY  
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# Reports on the National Innovation Systems of Other Selected Nations – In Brief

The Innovation Systems Research Section of the Department of Industry, Science and Resources has compiled a series of Reports from Overseas visits by staff of the Innovation Branch. These Reports, which formed only part of the overseas activity, have nevertheless enabled an abbreviated bird's eye view to be made of how other Nations have approached improving their *National Innovation Systems*.

The Innovation System Reports attempt to cover the fundamental characteristics driving the national innovation systems of a selected group of nations, including:

- Comparative demographics;
- Concentration of effort, eg., market driven, S&T driven, defence driven, picked winners, etc;
- Linkages to leading economies formal/informal;
- Economic performance – historical/change in circumstances, etc;
  - National Innovation System – elements – institutional, relational, geographical;
- R&D – strengths, comparative levels public/private/IP system/commercialisation success/impediments (educational base in passing);
- Economic performance – improvements – Public Policy Interventions;
  - Grants general/strategic
  - Tax incentives
  - Start-up support
  - Spin-offs
  - Technology Parks in brief (not comprehensive)
  - Incubators – how they work
  - Networks and clusters

- Venture capital – funding initiatives
- Skills in vc and links
- Inward investment attraction and promotion
- Export incentives
- Listings on foreign exchanges
- Other innovation support/linkages
- Effects on traditional industries;
- Recent Developments – role of government/private investment/government equity?; and
- Lessons for Australia:
  - Providing evaluations of the operating schemes, or notes on formal evaluations where possible.

The Countries covered in this release are Canada, Finland, Israel, and Norway.

Reports on other nations will be offered as they become available.

Dr Alan J. Jones

*Innovation Systems Research*

October 1999

# Some Characteristics of the Canadian National Innovation System

## Background

One of the largest countries in the world in land mass, Canada has a population of 30 million, heavily concentrated in southwestern Ontario (surrounding Toronto and Hamilton) and the St Lawrence River Basin in Quebec Province (around Montreal).

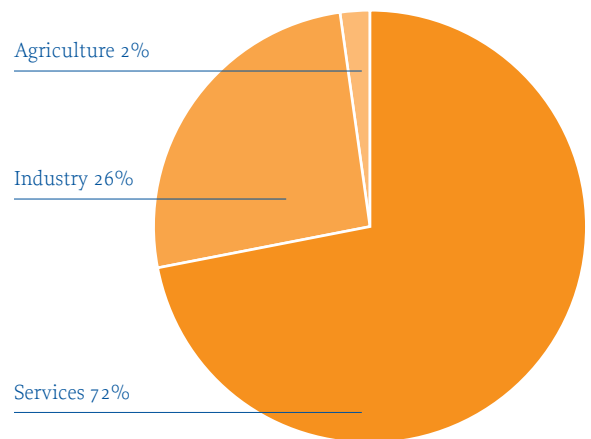
The country's modern history began in the early 17th century when French explorers came to the New World. A lucrative fur trade subsequently developed, and led to the establishment of French and English colonies. Although control of the entire country passed into British hands in 1763, the French language and culture, centred in the province of Quebec, remain a significant part of Canadian life.

Economic development was historically based on the export of agricultural staples, especially grain, and natural resource products such as minerals, oil, gas and forest products and Canada remains a leader in both agriculture and mineral exploitation. Western Canada has the largest worked and unworked deposits of oil outside the Middle East. However, its secondary industry has since evolved to the point that it now ranks as one of the top ten manufacturing nations of the world.

With GDP per capita of \$US24,468 (purchasing power parity), Canadians have a comparatively high standard of living.

Services, comprising about 70% of GDP, are the major component of the Canadian economy. Manufacturing contributes 17% and agriculture, forestry and fisheries 2.6%. While high knowledge industries provide only about one third of total employment, they are seen as an engine for future growth, having contributed more to recent job growth in Canada than all industries combined.

**Sectoral Contribution to Canada's GDP 1997**



Industrial goods, machinery and equipment and automotive products constitute about 60% of Canadian exports. Trade is overwhelmingly with the USA (85% of Canadian exports) and this US-Canadian trade partnership is the world's largest. The relationship was cemented with free trade agreements which have now been extended to Mexico. Canada is thus ensured free access to a market of close to 400 million people.

IT has penetrated deeply into Canadian life – it has one of the highest household ownerships of PCs and taking into account its population size, it ranks just behind the US in internet hosts.

## Foreign Investment

Foreign corporations in Canada are responsible for half of manufacturing's share of GDP. Their impact on Canadian trade is also considerable, contributing half total trade and 75% of manufacturing exports. Foreign direct investment (FDI) has nearly doubled in the ten years since 1988 and was reported to be \$1.4 billion in 1997, with the US being the dominant source of foreign capital.

FDI is seen as key for growth and generation of employment. Aerospace, IT, chemicals, petrochemicals, agrifood, mining and life sciences have been targeted by the Government as priority sectors for investment and over the last 3-4 years, investment in the chemical and automotive industries rose sharply. Major investments by the pharmaceutical industry have been notable, and include:

- Astra – \$300 million for a research centre;
- Hoechst Marion Roussel \$200 million for clinical research;
- Glaxo Wellcome \$120 million for integrated manufacturing and product development;
- Pasteur Merieux Connaught \$350 million research project to develop a cancer vaccine; and
- Amgen \$100 million for research on cancer, diabetes and AIDS.

Investment is encouraged through several instruments – for example campaigns in major investor countries (US, UK, Japan, France and Germany), the development of targeted and customised strategies for specific firms that offer high-yield investment prospects, and the provision of assistance to help smes to grow through international investment partnerships.

Under the banner of Team Canada, resources are drawn together across Provincial and Federal governments as well as embassies and business networks abroad, to establish linkages with key decision makers in target firms and provide a one stop service to address their concerns. It is noteworthy that the IS&T Counsellors in the Canadian embassies employ locally engaged staff that operate a technology transfer agency between Canada and the countries concerned.

The Canadian economy is heavily influenced by the US not only through close trade and investment bonds, but because comparative economic conditions in the US have long resulted in a loss of firms and talented individuals to the latter country. Consequently, Canadian policy has for some time aimed to improve the competitiveness of the business environment, and it seems, successfully.

Canada has:

- one of the most highly skilled workforce in the world, combined with moderate wage costs;
- moderate employer obligations to employees;
- internationally competitive corporate taxes;
- major natural and energy resources;
- good infrastructure; and
- an advanced regulatory system.

The *Economist* recently ranked the competitiveness of the Canadian business environment fourth overall.

## Expenditure on R&D

The Canadian public and private sectors are making significant changes to meet the competitive challenges of the global marketplace. Gross expenditure on R&D as a percentage of GDP (GERD) has shown a healthy growth and in 1998, it stood at 1.60. In line with most OECD countries, Canadian GERD grew over the 1980s. However this growth continued during the early 1990s, in contrast with the OECD as a whole, where expenditure declined. The Canadian growth was fuelled by private sector investment in R&D which doubled its expenditure between 1981 and 1990 and almost doubled again during the period 1990 and 1998 when business expenditure on R&D (as a percentage of GDP) reached 1.03. Measured by sector of performance, industry accounts for 2/3 of Canada's R&D.

As one of the G7, Canada favours comparing itself with this group. Canadian GERD ranks second lowest among the G7, due the comparatively low private sector R&D expenditure (Public sector expenditure was \$CA5.5 billion in 1999). Based on performance of R&D, universities contribute 21% of Canada's R&D, and the Government sector 13%.

The World Economic Forum's 1995 review of 48 national economies ranked Canada 18th in expenditure on S&T. This "innovation gap" is considered to have been a contributing factor to Canada's relatively slow productivity performance between 1974 to 1993, when productivity increased by an average of only 0.3% annually.

## Science and Technology

The universities and government research organisations (about 100 federal and 90 provincial laboratories) undertake the bulk of Federally funded R&D (about 40% each), and the business sector performs most of the remainder (20%). Measured by indicators such as the world's share of scientific and technical literature, Canada has particular expertise in biology, earth and space sciences and is strong in engineering and technology and mathematics.

Expenditure on S&T has been declining over the 1990s, as part of the Federal Government's deficit-reduction strategy. Following a review of the S&T system that sought to find ways to make better use of the available resources, the Federal Government identified an additional role for itself beyond support for public (and some private) research – that of acting as an information analyst, knowledge disseminator and network builder. The objective is to foster the successful *evolution* of the Canadian *innovation system*.

Some Government S&T activities were wholly transferred to the private sector, where sufficient S&T capability existed, or were required to be undertaken in public-private collaborations. The Government also sought to develop innovative partnerships with the private sector as a means of sustaining support for researchers. This included:

- a medical discoveries fund – a collaborative venture for investment in early-stage companies with the potential to become industry leaders;
- a natural sciences and engineering fund aimed at applying the knowledge developed in university laboratories with Government support and to enhance the transfer of technology to Canadian industry.
- the Networks of Centres of Excellence program which focuses on leading edge multidisciplinary targeted research based on nationwide collaboration among universities, industry and government. The program aims to achieve "critical mass" amongst researchers and now supports 15 networks, mostly in biology/medicine and IT.
- The program is administered by three Federal granting councils and is designed to accelerate the transfer of technology to the private sector, develop Canada's economy and improve the quality of life. Funding is provided through the program (\$ CA 80 million per annum which is about 1/2 the total envelope), from industry (about 1/4 of the total) as well the universities, Federal, Provincial and other research organisations. Several million dollars are provided per year per network, to enable researchers to work together on a scale not possible under other funding sources.
- Networks involve about 1,000 researchers, 1,400 graduate students and 500 postdoctoral fellows from 50 universities, 400 firms, 40 hospitals, and a range of government and other organisation. The program emphasises benefits to Canada and the exploitation of the results of network research in Canada. Where the receptor capacity in Canadian industry is limited, it is incumbent on the network to stimulate the development of that capacity. They are regarded as a major force behind Canada's success in creating spin-off companies from public sector research.
- Technology Partnerships Canada was established to stimulate increased private sector investment in high technology product and process development in global (and mobile) high-growth industries, particularly aerospace, defence, environmental technologies, enabling technologies (including biotechnology, some computer and telecommunications technologies). The Federal Government participates as a partner in a specific project and is repaid through royalties.

The S&T budget was increased slightly in 1999.

The universities are recognised as making a key contribution to Canada's socioeconomic wellbeing, through the research and teaching they undertake and their community service. Their research constitutes 22% of all the R&D conducted in Canada, they employ 31% of Canada's R&D personnel and produce 65% of Canadian scientific publications. Canadian industry, which outsourced 5% of its total R&D efforts to universities, depends more on universities as a source of innovation than in any other G7 country.

Although Canadian universities only began to experiment with commercialisation undertakings in the last decade, many have achieved notable successes in commercialising research results. For example, in 1997, Canadian universities generated \$15.6 million in royalties and held over \$22.5 million in equity in 366 spin-off companies. The number of spin-off companies doubled over the period 1994-1997 and a Canadian universities created spin-off companies at the rate of 1 per \$10 million in direct research funding. There are about 12 university-related incubators, concentrated in British Columbia (West Coast) and Ontario, which assist in this process.

Nevertheless, the Advisory Council on S&T estimated that the universities' overall contribution to the economy could have been much higher. Among the structural impediments noted were:

- the absence of a coherent IP policy framework;
- as underdeveloped commercialisation capacity in the universities due to insufficient researching of the commercialisation offices and people with the appropriate skills;
- uncompetitive business conditions such as personal taxation rates which are higher than the US and the tax treatment of employee share options, limit the success of firms relying on universities as a source of innovation; and
- low levels of Government investment in university research.

## Federal Support for Industry Innovation

Almost 50% of Government support for industrial technology development is delivered through fiscal incentives. Canada provides immediate and full write-off for expenditures in R&D, including for capital equipment and a 20% tax credit; support for industrial S&T was \$1 billion in 1992. Taking into account the effect of both Federal and Provincial programs, the after tax cost of \$1 of R&D expenditure for large manufacturing firms is estimated to be about 50c in most provinces.

Outside the taxation system, support is provided through mission oriented grants and procurement (30%) and the balance through the S&T infrastructure. The aircraft and parts industry received 32% of this Federal support provided for R&D, followed by engineering and scientific services (16%) and manufacturing (8%). Much of the support is aimed toward encouraging innovation in the SME sector and collaboration with the public sector. Significant programs are:

- **CANARIE** which is an internet development organisation, providing support for the uptake of the internet and the development of next generation products, applications and services;
- **Strategis**, an internet product developed by Industry Canada, contains extensive information for business. Significant items include databases on research and technology capabilities in the public and private sectors, and a business self diagnostic tool linked to providers of appropriate assistance;
- the **Industrial Research Assistance Program (IRAP)** which has an annual budget of almost \$CA 100 million. Under IRAP, professional advice and technical assistance are provided from the public sector to SMEs, to help with product and market development, particularly for exports; and

- **Technology Partnerships Canada (TPC)** makes strategic investments in near market technological development projects. Projects are assessed on the basis of their technological benefits, feasibility, viability, socio-economic benefits and job creation or maintenance potential. TPC investments are conditionally repayable, usually on the basis of royalties tied to sales.

Complementary to such programs, there is a substantial net of databases that provide information on the expertise of new graduates, researchers and R&D companies, technologies available for licensing from the public sector, and a technology matching tool.

## Finance for Business Growth

Federal intervention has, for over 25 years, addressed the financial sector in attempts to recreate the US policy success of the (relatively) large amount of capital provided to small companies.

Some \$CA 14 billion of risk capital is estimated to be available in Canada for investment in small business. Policy has tended to focus on increasing the availability of finance for SMEs, rather than specifically targeting new, technology-based companies.

The major policy tools are:

- The Business Development Bank of Canada (established in the 1940s) is a crown corporation which survived the push to privatisation in many other countries. In 1995 it was given the new mandate of becoming a complementary lender to the small business. While making a profit, it is now required to pioneer new products, particular for underserved areas of the small business financial market in Canada. The current mandate is for 50% of loan authorisations and capital forwarding to be to knowledge based industries and to active exporters.

The Bank pioneered new products, including quasi equity which is of particular interest to knowledge based industries (eg software) which need extended periods of debt and have no hard assets to recover or loan security. The objective is to demonstrate that investment in the risky but high growth industries can be a commercially viable strategy.

In addition, the Bank is mandated to undertake smaller deals than private sector venture capital is doing. Although it has about 1% of the banking assets in Canada, the Bank provides almost 60% of the quasi equity market for deals of less than \$1 million. A commercial focus to this activity is provided through an imposed rate of return objective of *at least* the Government's cost of funds.

The Bank has a mandatory review before the House of Commons where it is accountable for its performance: the policy outcomes are considered very successful.

- The Small Business Financing Act has also been influential. Canadian Banks lend at a standard interest rate and consequently will refuse loans when they judge the element of risk to be high, rather provide loans at higher interest rates, as is commonly done in the USA. To encourage lending to riskier small business ventures, the Federal Government provides a guarantee, under the Act, of 85% of the loans (up to \$CA 0.25 million) that would otherwise would not be made by commercial banks.

The Government charges a fee for the guarantee that covers the costs, including the companies that fail. In 1998, \$2 billion in guarantees (60,000 loans) was offered and it is estimated that about 80% of the loans were fully incremental.

However, there has been some criticism that the program is not targeted toward innovative and knowledge-based firms. To do so would require a major enhancement of the program's administrative personnel.

- Labor Sponsored Venture Capital Corporations (LSVCCs) were started in late 1970s to address the lack of venture capital in Canada compared with the USA. Individuals and Registered Retirement Savings Plans investing in the LSVCCs for at least 5 years, receive Provincial and Federal tax breaks. The LSVCCs are required to invest in smaller firms which are not listed on the Stock Exchange. The largest LSVCCs, “Working Ventures”, has about \$2 billion available for investment at any one time.

Specialised and/or local funds such as the Medical Discoveries Fund (which deals primarily with commercialising university medical discoveries) and the Sports and Entertainment Fund have been established by the LSVCCs to invest in the smaller fry.

However, there are a number of administrative and other issues – the deals are less attractive because the overheads per deal are much the same regardless of company size, and the smaller firms often lack management expertise, particularly in marketing. The funds have larger administrations and do not become involved in the management of the investee companies in the manner of Silicon Valley investors. In addition, most of the people involved in S&T – type investment decisions come from the finance side whereas their equivalents in the USA tend to be wealthy engineers. The funds argue that they cannot find enough new, technology firms for investment. A significant counter criticism is that in the interest of their investors, the funds seek to invest in the individually less risky ventures, that is the young companies as near to market as possible.

- The Canada Community Investment Plan was established in 1995 to meet the relatively small investment capital needs of firms outside the major centres of Montreal, Toronto and Vancouver. It was based on a successful models that occurred spontaneously within Canada. In London, Ontario, for example, a municipal board of directors from the brewery, Massey Ferguson and insurance companies would meet and decide which companies or managers needed expert advice or small investments.

The Plan was developed on a demonstration basis to encourage informal investors to provide “smart capital” to small (but not necessarily innovative) companies in their area. A national competition for funds was held, for which applicants submitted business cases on how they would link informal investors and the local business community. The Government will provide \$0.6 million over 5 years to each of the 22 funds to be established, to match each fund’s contribution of \$0.3 million.

A range of about 200 Community Futures Development Corporations provide some parallel services – small businesses in selected non-metropolitan areas receive up to \$50,000 in business counselling and advisory services, and financial assistance.

A significant issue for Canada is whether finance for growth should be in the form of equity or debt and a Senate Inquiry is being held on the issue. Canadian companies are systematically less well capitalised and generally have more debt on the balance sheet than equity than comparable US firms do.

The problem is most acute for innovative firms which, having highly variable cash flows and inexperienced management, often cannot sustain the debt. According to standard financial theory, debt finance is not appropriate in such circumstances.

A reorganisation of the Canadian stock markets (in Toronto, Montreal, Calgary and Vancouver) may, however, have an impact on the availability of equity finance within Canada. Some young technology firms have been able to raise small amounts, (around \$5million) on Canadian exchanges but the market apparently finds it harder to provide the next jump, to \$50 million. The higher level of finance is generally sought overseas. The view is that the stock markets are tailored to meet the requirements of the very large firms.

Prompted by their loss of business to the US, the exchanges themselves put up a proposal that Toronto be the specialist for large capital firms and Montreal

for derivative products, futures, and options. New exchanges in Vancouver and Calgary would handle junior companies. The plan is to develop the expertise in junior firms to counter the attraction of the NASDAQ.

## Clusters

The Ottawa region hosts growing clusters of high technology firms in telecommunications, microelectronics, software, health, and environmental products and services. Once a Government-dominated city, the private sector is now the major employer in Ottawa and high technology firms are growing rapidly. Most of the new firms have spun out of existing ones.

The main factors behind the development of Ottawa's clusters are attributed to;

- the concentration of Federal R&D in Ottawa, along with the Government's high technology procurement, which gave entrepreneurs easy access to government technology and information on potential markets;
- starting up business in Canada is relatively uncomplicated by regulations;
- the relocation of all Northern Telecom's Canadian R&D to Ottawa provided significant mass and an international outlook;
- successful entrepreneurs have provided novices with mentors, exemplars, access to facilities and some investment;
- the regional office of the Business Development Bank helps fund start-up companies;
- many industry associations are located in Ottawa; and
- many broker agencies concentrate on building alliances.

While the clusters developed spontaneously, policy has fostered their continued growth. A key factor in this is the formation of business ties through joint

research, contract research and incubator services, between Federal laboratories and universities and the private sector.

## Lessons for Australia

The many parallels between the Canadian and Australian economies would imply that Canadian policy successes and failures should be given particular consideration.

The Canadians adopted a systemic approach in the early 1990s, placing greater emphasis on linkage programs to encourage the flow of knowledge, skills and technology between the public and private research sectors. While the impact of these policies is difficult to isolate, they have created an environment which has, undoubtedly, fostered the growth of high technology firms in Canada. Factors of particular relevance to Australia include:

- Following the realisation that lack of information on the capabilities of public researchers and industry impeded technology transfer, a great deal of information on both sectors was made available through government and other sources. It is particularly accessible through a single entry point, Industry Canada's *Strategis* web site.
- Concentrating industry and public research at one location resulted in a "critical mass". When combined with a key, demanding customer (the Federal Government), it provided the seeding ground for the formation of clusters. Government programs fostering a complex network of linkages around them have supported their growth.
- The alternative approach to massing research at one location, is the achievement of strength through networking the highest quality researchers wherever they are located. Spurred on by the requirement to transfer research outcomes to Canadian industry where it is possible to do so, or to create that capability if it is not, the Network of Centres of Excellence has spawned well over 50 spin-off firms already.

- Canadians have endeavoured to ensure an adequate supply of finance for small but growing firms. Experimentation in the financial sector has resulted in the development of several commercial instruments that deliver bank loans to young technology firms. This has been driven by both regulation and government demonstration programs, and the success of the products developed has been amply demonstrated by the greater readiness of private banks to make riskier loans.

Weaknesses of the system include:

- A loss of firms and talent to the USA. While some loss of firms is considered inevitable, the loss of talented managers and researchers is causing concern.
- The lack of early finance to bridge the gap between where the “love money” runs out and private sector finance becomes available. A combination of Government-supported funds to improve the availability of finance, and programs to increase the investment readiness of firms has been developed.
- A second gap, which the Canadian stock exchanges are now attempting to address, is the larger injection of capital (often around \$50 million) required by growing technology firms.
- Reductions in Government support for S&T appear to have adversely affected industry productivity.

Dr Janet Pagan

*Innovation Systems Research Section*

September 1999

# Finland Some Characteristics of the Finnish National Innovation System

“Finland where nature and technology meet”

## Background

Finland has a population of just over 5 million, in an area of 338,000 square kilometres and is situated between the 60th and 70th parallels. It is rightly known as the land of the lakes or the land of the forests, the former covering 10%, and the latter roughly three quarters of the country. Population density is a modest 17 persons per square kilometre, but over 60% of the population lives in urban areas. The Helsinki metropolitan region (Helsinki, Espoo and Vantaa) account for about a sixth of the country's population, although Helsinki the capital, only has a population of about 550,000. Other important cities are Tampere, Turku and Oulu with populations of between 100,000 - 200,000.

Finland became a Republic in 1917. The Head of State is the President, but ultimate political power is vested in the 200-member unicameral Parliament. The President is elected by popular vote every six years, the Parliament every four years. Female representation in the latest elected Parliament (1999) accounted for 73 of the 200 seats. There are ten political parties represented in the Parliament.

Finland's history is bound up with colonial links to Sweden (1155 - 1809) and to Russia (1809 - 1917). Consequently, the country recognises two official languages Finnish and Swedish, although only 6% of the people use the latter as their mother tongue. On the other hand all road signs are offered in both languages.

Finland is a full member of the UN, OECD, GATT and the European Union (EU), the latter since 1995; and has a Partnership for Peace Agreement with NATO.

## Industry and the Economy

Last century Finland embarked on the road to industrialisation by harnessing its forest resources. Today, forests are still Finland's most crucial raw material resource, although the metal and engineering industries have long been Finland's leading branches of manufacturing both in terms of value-added, and as an employer. Finland is a typical advanced industrialised economy: two thirds of its total output is generated in the service sector. Finland's major export industries are shown in *Chart 1*, about sixty five per cent of those exports going to the EU and EFTA countries. The total value of exports amounted to about FIM 266 billion (\$ A 74 billion) in 1998, of which 19% were classified as high technology.

Unemployment has been the most serious problem for the Finnish economy. In 1990 the unemployment rate was 3.4 per cent, regressing to 18.4 per cent by 1994, but some recovery had occurred by the end of 1998 to 11 per cent.

During part of this period, 1990 - 1998, Finland instituted a series of policy measures that gave rise to phenomenal increases in R&D investments, bringing them to the forefront of all OECD countries in R&D expenditure, and intensifying the contribution to R&D spend by the Finnish private sector. Total R&D investment in Finland in 1998 amounted to FIM 19.7 billion (equivalent to \$ A 5.5 billion), of which FIM 13.4 billion (\$ A 3.74 billion) is private sector spending.

The phenomenal rise in R&D expenditure as a function of GDP is summarised in *Chart 2*. This represents a growth rate in R&D of 15 - 20 per cent per annum. It is noteworthy that the policy measures also included intensification of international scientific and technological cooperation and post-graduate education for researchers.

Chart 1 **Finland's Export Industries 1998**

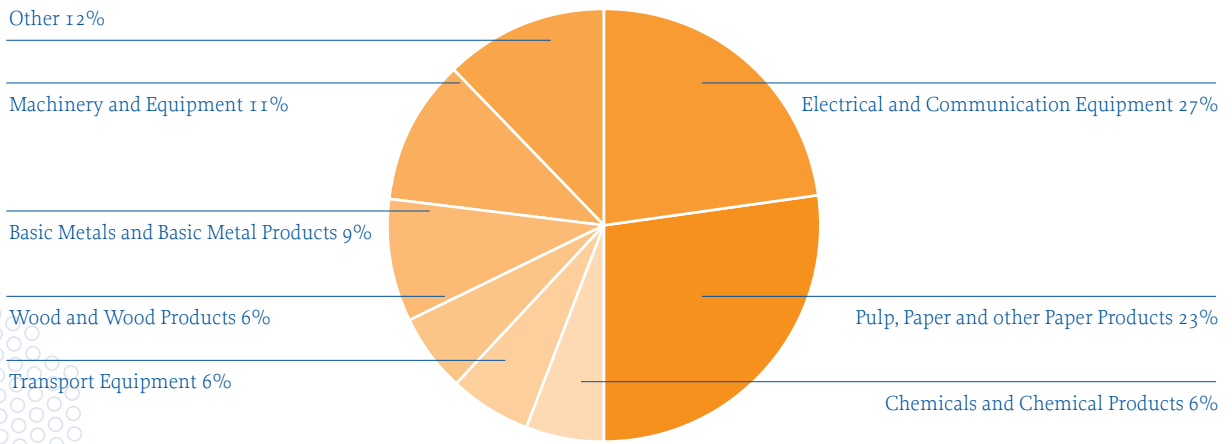
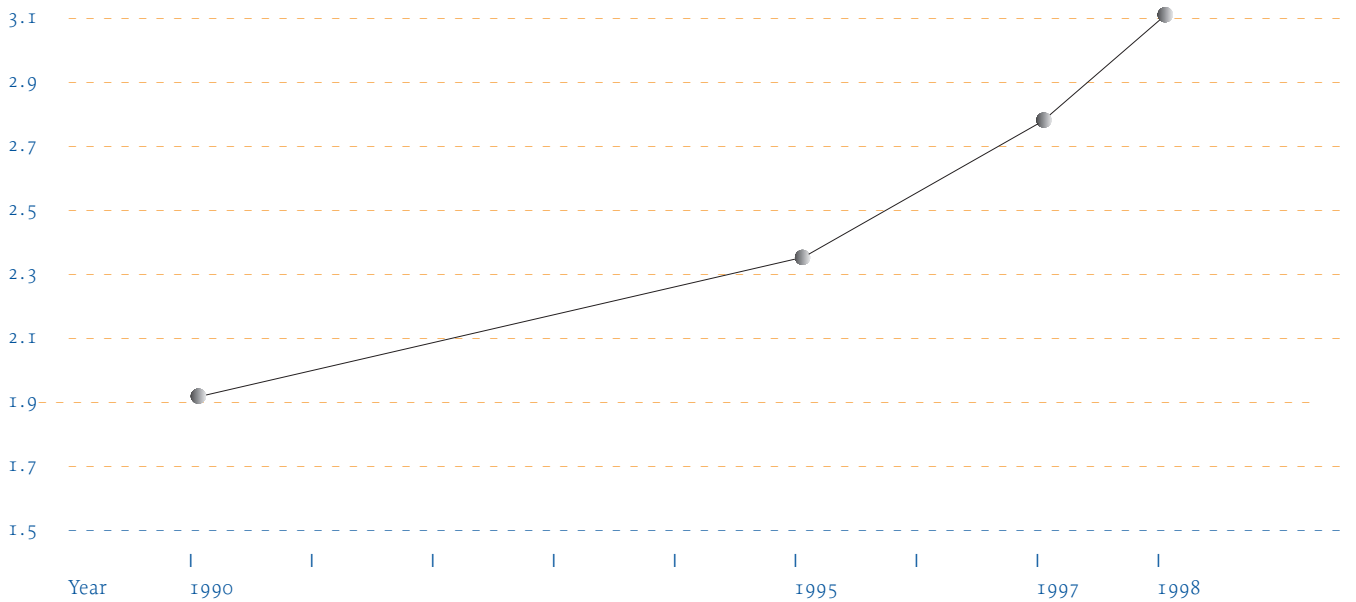


Chart 2 **R&D Expenditure as Per cent GDP for Finland 1990-1998**

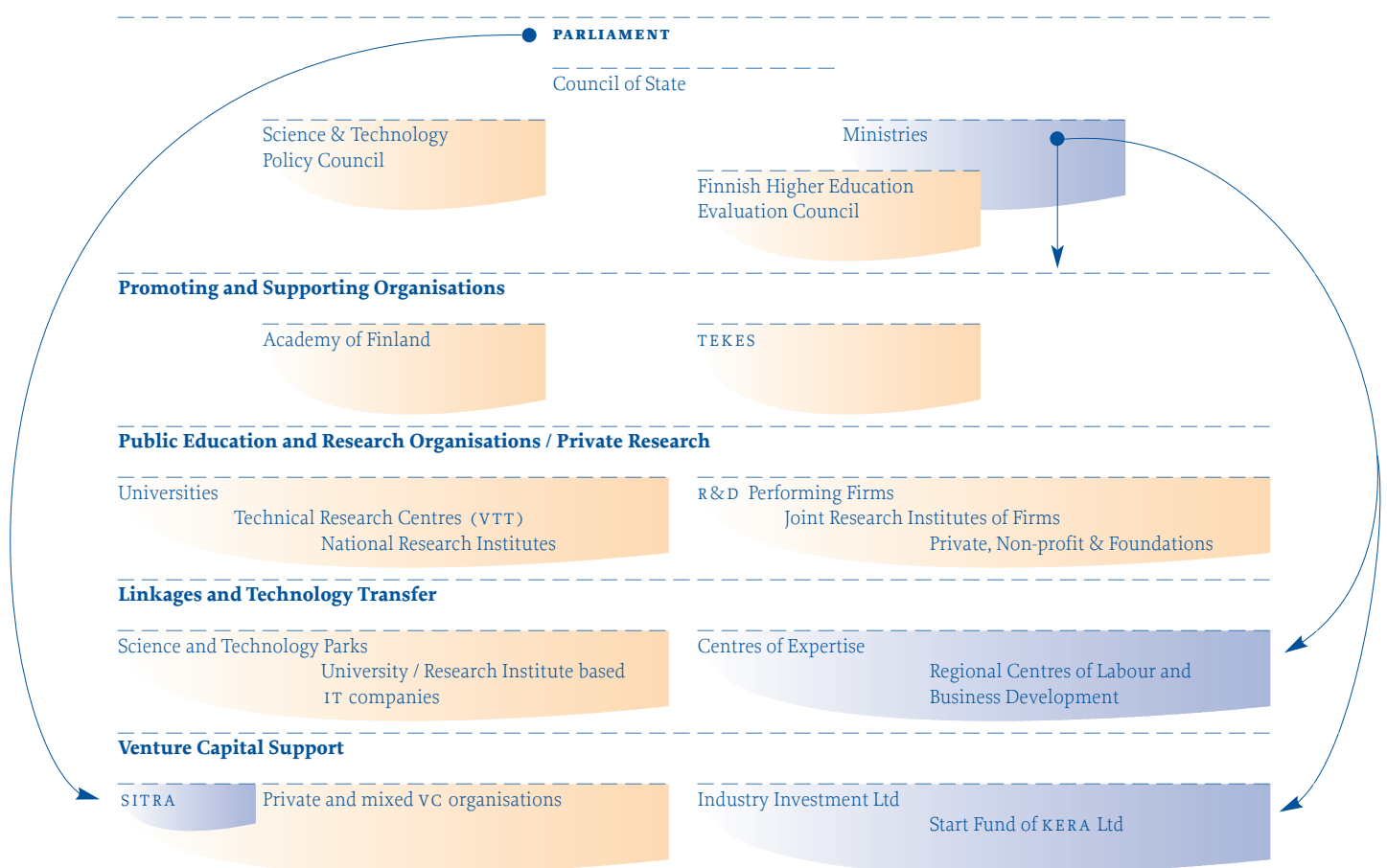


For the purposes of this Report, the policies of the Finnish government are best looked at from the perspective of the institutional framework of the current National Innovation System of Finland. This is summarised in *Chart 3*. The major agencies that will be discussed are:

- The Ministry of Trade and Industry – the Government Ministry primarily associated with industry development;
- TEKES – The Technology Development Centre, which is the main financing organisation for applied and industrial R&D;
- The Technical Research Centres (VTT) – which have characteristics similar to the CSIRO, although there are also National Research Institutes;
- The Universities – restricted to those in the Helsinki region;
- Science and Technology Parks – with a focus on the Helsinki region;
- Technology Transfer Companies;
- Regional Centres – initiatives generally coupled with the science parks and universities;
- SITRA – the Finnish National Fund for Research and Development; and
- Finnish Industry Investment Limited – a State owned investment company designed to promote growth and internationalisation of Finnish companies.

Chart 3 **Institutional Framework of Finland’s National Innovation System 1999**

Research and Development



One of the most significant features shown in *Chart 3* (arrows) is the apparent high involvement of Government, particularly in the investment streams associated with SITRA and Industry Investment Limited, the latter also owning 66% of the Start Fund of KERA Ltd. The high participation in *regional planning* in Finland is also significant.

The length of the visit to Finland did not enable significant information to be obtained on the Academy of Finland, the National Research Institutes, Joint Research Institutes of Firms, Private non-profit or Research Foundations, or of private venture capital organisations, although most of these receive a mention under other headings.

## The Ministry of Trade and Industry (MTI)

The Ministry of Trade and Industry is responsible for Finland's industrial and technology policy and for the creation of preconditions for the development of Finnish industry and enterprise. In addition to trade issues, MTI also contributes to the establishment and growth of small and medium-sized businesses, the safeguarding of profitable business activities, and the promotion of competition.

### *Discussions with Ms Paula M. A. Nyberg, Deputy Director General (MTI)*

Ms Nyberg's main responsibilities rest in the area of technology and research policy, and consequently she provides the policy and performance management interface to the Technology Development Centre TEKES, and the Technical Research Centre of Finland, VTT.

Ms Nyberg discussed a series (commencing 1987) of key triennium review papers produced by the Finnish Science and Technology Policy Council (similar to PMSEIC), and concerned with a development strategy for Finland. The Finnish "National System of Innovation" was outlined in the 1990 review. The third paper in the series "Towards an Innovative Society" was released in December 1993. The paper "Finland: A Knowledge-based Society" was released in December 1996.

The Finnish Government has argued that "it is through the development of the national system of innovation that the future of Finland is created: new development prospects, employment, intellectual and material well-being, an ability to take responsibility for the future". They noted special attention needed to be paid to the functioning of the national innovation system, with investment in long-term educational and research as well as rapid utilisation of what was currently available.

Some of the key features in the implementation of the reports have been:

- the drive for increased evaluation "in all parts of the research system and in different sectors of science and technology policy" (eg., an "International Evaluation of Innovation and Invention in Finland: Strategies for Networking", was released by MTI in 1998);
- cooperation between enterprises (resulting primarily from the impacts of the economic recession);
- measures to develop business services for SME's – counseling, mentoring, educational, financing and research services, and schemes to support their use;
- cooperation between regional organisations to offer the above services, and promotion of interaction between regional activities, national activities and international cooperation;
- establishment of technology centres, attached to universities (now sixteen in number); and
- provision of venture capital – trail-blazed by the Finnish National Fund for R&D (SITRA), and the Regional Development Fund of Finland Ltd (KERA) – all based on public financing.

The importance of knowledge and know-how are recognised throughout the "strategies" as central for international competitiveness. It was noted that securing the conditions for the growth of knowledge-intensive businesses was one of the most important tasks facing economic and industrial policy in the 1990's.

For the above reasons increasing resource allocations have been made to TEKES and this organisation has become more involved in the problems encountered by SMEs. In addition, the primary organisation for developing, transferring and applying technology for use by enterprises, the Technical Research Centres of Finland (VTT) has been restructured, dividing it into nine sectoral research units, each with an executive Board, partly composed of external members.

Ms Nyberg stressed that it was a deliberate Government decision to push for increases in R&D investment and to target GERD at 3%+. In a very frank exchange, Ms Nyberg also noted that all the new focus has not been without problems:

- there may be more money for research, but finding good people to do the work is an increasing dilemma. Recently, a major task force has been established, led by the head of SITRA, to also look at the return on investment in R&D;
- commercialisation of R&D was a weakness in Finland, it has not been the practice to establish new companies (therefore TEKES was activating researchers to establish start-ups);
- the Technology Parks have incubators, but there are quality variations, arising from regional differences and management;
- IP was not well developed – researchers and professors own their own results – the first licensing offices have only recently commenced operations;
- seed-capital was not readily available, although SITRA had started to work in this area, and TEKES was offering advice; and
- it was not possible to introduce a tax system for R&D support, because their Department of Finance was not willing to consider it.

Inter-firm collaboration has been encouraged through TEKES, with IP rights established on the basis of the EU/RTD program rules. The system of cooperation

has also been used to encourage university-firm cooperation, which was non-existent in the 1970's. It has also enabled large and small companies to work together, which proves very effective. But there are difficulties for small firms who must find time to allocate to shared activities. TEKES, through the VTT, now runs a series of "technology clinics" where the small firms pay 50% of the costs for discussions with VTT and university researchers to obtain the best innovations and learn from best practices.

In 1998, it was decided that Ministries with R&D programs for differing, but overlapping areas, would work together in a cooperative manner. This represents a new-type of governmental cooperation and avoids duplication.

As a corollary, the company tax rate in Finland is 28%, but about to be raised to 29%. There are no equivalent capital gains considerations in operation. However, it is without question that the Finnish Government would like to attract MNCs to Finland – their question is how? – since it cannot be based on grants, or tax, etc.

## TEKES – The Technology Development Centre

*Discussions with Dr Martti AfHeurlin,  
Deputy Director General*

TEKES's primary objective is to promote the competitiveness of Finnish industry and the service sector through technology. Their activities aim to diversify production structures, increase production and exports, and create a foundation for employment and social well being. It has a staff of 230 people, of which 45 are located in the 'Regions' and 25 in seven international posts. In effect, TEKES is the program delivery arm of the Ministry of Trade and Industry, and to that extent is similar to AusIndustry.

The TEKES budget runs at FIM 2,320 million (\$A648 million) per annum, most of which is dedicated to industrial R&D grants and applied technical research, with about FIM 240 million for capital loans for R&D, and an equal amount for energy research. TEKES also receives funding from the EU Structural Funds. The

TEKES budget stabilised in the mid-90's at about FIM 1,450 million, but has risen steadily since 1997 to its present levels. In reality, only 5.6% of government finances actually go to businesses in Finland. However, the major impacts of the funding have been on the structure of Finnish industry and on its exports.

About 60 per cent of the TEKES funds are devoted to "individual projects", funded at the enterprise (on a 50:50 basis) and university/research unit level, but including pro-active networking with other resources, services or technology, and attention to business and project planning. The other 40 per cent of TEKES funding is applied to National Technology Programs.

*Loans:* Start-up firms exhibiting "some kind of activity" can apply for a capital loan from TEKES. The funds simply go to the balance sheet to strengthen the firm. The loans are of an equity type, but do not involve ownership. Their magnitude can range from a few hundred thousand up to 10 million Finnish Marks. The loans are administered by TEKES, but use a State payment system, which monitors all loans. There are also Risk Loans which are subject to repayment should the firm be successful. If unsuccessful, Mr Heurlin indicated a mechanism for discussion with the client.

Mr Heurlin noted that it was, however, the Projects and Programs "that brought the results".

*Project Grants:* The average number of "individual projects" funded per annum is about 2,500, with firms receiving 62% of the total funds, the universities receiving the rest. Three quarters of the funding for firms goes to SMEs employing less than 500 people. As many as 40 per cent of the firms are new to TEKES in any one year. On the other hand investments in innovation and technology in traditional industry sectors have been considered as important as new areas.

The project grants are market oriented – "the markets dictate the direction we must go – companies are competing and can make new choices everywhere". Mr Heurlin stressed there is no mechanism for permanent funding – there is continuous discussion with industries on industry strategies – a platform for future planning.

The "individual projects" are funded on the basis of response to applications, BUT these have been much discussed before the application. The discussions focus on how the firms utilise the innovation environment, and TEKES tries to bring potential channels together. To quote: "this is responding to projects in an active way".

*National Technology Programs:* These projects can involve from 5 to 20 firms working with the universities and research institutes in key areas of national interest. Selection involves a bottom's-up/top-down approach, but with a strong market orientation. Initiatives might arise from expert group discussions to test an idea, followed by an invitation for a wider range of people to discuss opportunities in an open seminar. Such scoping can take up to a year.

On the other hand, TEKES can "bring some kind of program together". This is generally followed by more research. These national programs can be technology based (eg., machine vision) or industry oriented (eg., dry paper).

At present there are 60 National Technology Programs, fifteen new ones being added last year. These include 1600 participating companies and 500 R&D groups. These programs also act as a platform for international cooperation. Mr Heurlin noted that TEKES was not yet satisfied with the international measures in their programs, and in the next 5 years hoped to strengthen this 5-fold with the USA.

In all the National Technology Programs the finances are allocated to a program manager usually housed in a university or an industrial organisation. There is also a Program Board that advises TEKES – this frequently links to a wider group and all other activities in the country. TEKES, on the other hand has final say on the projects receiving support. These programs have a duration of three to five years and are funded at a level of FIM 30 million to hundreds of millions, usually at a 50% level.

*Clustering:* According to Mr Heurlin it has been a Finnish tradition for firms to work with Government, but University-Industry cooperation has been very poor. The “new policy” looks at the long-term needs of industry.

According to Mr Heurlin, the cluster effect has been particularly significant. Namely, the development of electronics for the traditional pulp and paper industry and other control systems provides for complementarity with the telecommunications area. The development of Nokia from the mid-80’s was also achieved with the cooperation of small supply-chain companies in the mobile communications field. The critical decision was to go digital in 1985 – then a relatively new concept. It was anticipated that diversification would occur.

While on the subject of “cluster thinking”, Mr Heurlin stressed the impact of IT on the forest industry and on biotechnology. That is, “complementary technologies provide a platform for developing further applications in other sectors”. Importantly, Finland’s balance of trade had become positive in the high technology sectors since 1995 – mainly from telecommunications, but also embracing pharmaceuticals, instruments, telecommunications devices and systems and electronics.

TEKES has concentrated its efforts into three main areas of technology:

- Information Technology – international evaluations of the programs in digital media have shown that TEKES’ programs have taken Finland to the “crest of the wave” at a very early stage.
- Chemistry and Biochemistry – TEKES has paid particular attention to how realistic the business plans are, and the growth potential shown; and
- Production and Energy Technologies.

*Note:* Details are available on the sub-set contents of IT and Chemistry and Biotechnology, and on the inputs from the EU programs to these activities.

The “Technology Units” within TEKES that administer the above areas also work with regional bodies to coordinate the strengths and activities within regional Finland. This kind of cooperation involves technology incubators, technology parks, business parks, technology research centres, universities, regional governments and ultimately the investment funds with TEKES; and appears a truly coordinated and united approach, and could well find application to regional Australia. The functional aspects of this approach are described in more detail with respect to “Science and Technology Parks”.

Beginning in 1998, TEKES undertook a systematic investigation of *each* project, using a single harmonised approach with a particular emphasis on the impact of program participation on turnover. TEKES experts make the company assessments. Feedback is provided to the firms and to policy makers on what expectations might be realistic. The view is that the process better equips the firm for meeting its goals.

Of interest is the fact that for each million Finnish marks placed by TEKES, the projects financed in 1998 were expected to create six or seven new permanent jobs, FIM 20 to 40 million in turnover, and FIM 10-30 million in exports within five years.

According to a study carried out by the Technical Research Centre of Finland, TEKES financing has significantly affected the business and success of SMEs. The study showed that 70 per cent of the projects added to the sales of products and services. Nearly 4 of 5 product development projects led to a new product for market. One-half of the projects lead to the birth of a new business, and one-half also increase the number of personnel employed.

Mr Heurlin was at pains to stress the close cooperation between TEKES and the Academy of Finland with respect to the needs for trained researchers. In addition, he noted the strong links at the project level between TEKES and SITRA and Finnish Industry Investment, the main investment houses for commercial development. However, Mr Heurlin could sight only a few examples of “spin-offs” - he considered it too early to tell – there were a few businesses “with Internet work, but no real business yet”.

Indeed, Mr Heurlin noted that the Finn’s generally have too few successful companies or people who have made good progress or made money. There was “lots of potential”, but maybe attitudes about safety/risk were conservative. The venture capital people tended to invest at the later stage, making very few high risk investments.

TEKES personnel are largely drawn from industry and the research agencies. Presently TEKES is loosing people to industry but trying to hire people with 10 years experience in industry to support their program management imperative. According to Mr Heurlin, “these people must not only understand the technology, but also business and enterprise thinking, and where possible the knowledge of running smaller companies”.

## Science and Technology Parks (Universities, Technology Transfer Companies, Regional Centres)

### *Finnish Science Parks in General*

The Finnish Science Parks form the basis for the Finnish system of incubators. They number sixteen and are spread geographical throughout most of Southern Finland, most being associated with one or more Universities. The oldest one (1983) is in Oulu, where considerable activity associated with the company Nokia is also located

The Finnish Science Parks collectively provide emerging companies and investors with assistance, support and encouragement. The Finnish Science Parks Association (FISPA) is at the core of a co-operative network including the universities, science

parks, technology support agencies, investment houses, municipalities, national organisations and other institutes and organisations.

International companies and investors wishing to start a business or gain a foothold in Finland are encouraged to operate through the Parks system.

### *Innopoli/Otaniemi Science Park*

*Discussions with Lauri Ylostalo,  
Managing Director, Otaniemi Science Park*

Innopoli Ltd is without doubt the lead Technology Park in the Helsinki district, located in the city of Espoo. It is associated with the Helsinki University of Technology, the Technical Research Centre of Finland (VTT), the Finnish Pulp and Paper Research Institute, the City of Espoo, and one of the larger business incubators in Finland, the Otaniemi Science Park. Some of Innopoli’s tenants include the Spinno Program – which evaluates business ideas and offers entrepreneurial training to newly founded firms; Culminatium Ltd – which offers “Centre of Expertise” business assistance programs throughout Finland; the Foundation for Finnish Inventions; prototype production facilities, professionals in marketing and financial administration, law offices and a travel agency.

The Otaniemi Science Park (OSP) serves as a business incubator for Innopoli. OSP was founded in 1986 on the campus of the Technical University of Helsinki, and is a limited company owned by Finnish companies and the City of Espoo. Its objectives are to generate and develop new companies with a focus on small high-technology companies. It is involved in active incubator management, and through Innopoli Ltd has links to Olartek, which offers later stage production space for emerging companies.

In essence, the Otaniemi Science Park employs “technology spotters” who regularly survey the activities in R&D in the University and/or technical research centres seeking out those areas and persons that show interest and promise in the commercialisation of their research. The projects found are able to qualify for entry into a first stage incubator. The incubator performs the role of evaluating the possibilities of the business idea and its

further development, notably by offering a training consultancy, and access to other research institutes.

The core to the OSP is the Spinno Business Development Centre and its programs. Spinno is effectively the Trade Mark for the Technology Park Innopoli Ltd which is across the road from OSP. It especially contributes to evaluating the start-up projects for their application and potential for IP protection, to the training of entrepreneurship of the project proponent, and the interdisciplinary and cooperative interactions between the appropriate institutions. Another adjacent site houses a large Technical Research Centre (VTT), employing 1200 people.

### *Spinno Business Development Centre (BDC)*

#### *Discussion with Ms Mart Tuominen, Innopoli*

Spinno BDC is another joint venture of the scientific institutions, Technical Research Centre, public authorities, financiers and the business community in the Helsinki region. It promotes commercialisation of business ideas that are based on high level knowledge. MTI, TEKES, and the Helsinki Region of Expertise (Culminatum) finance the Spinno training activities. Spinno employs about 15 - 18 people.

Once a new company is formed, Spinno BDC evaluates the business idea, assists in the development of a business plan on a nil-cost basis for the first 20 hours. About one-third are offered premises and incubator status. Spinno BDC can then assist in the procurement of financial support – including Government R&D grants (from TEKES), provision of financial advice and support through Spinno BDC's capital investment fund – Spinno-seed Ltd, and market and competitor analysis.

If the new firm exhibits positive growth, Spinno BDC can offer additional support to control the growth, international trade information, export strategies, international marketing analysis, and network membership. Mr Ylostalo also noted that Spinno has access to about 100 retired and experienced business people who provide a voluntary mentoring service to Spinno clientele.

Spinno creates 40-50 new high technology or knowledge-based companies per year. The main target groups are researchers, graduate students, and vocational school graduates working in scientific and technological areas.

Accommodation may initially be offered through OSP at the incubator stage. Spinno also arranges leave of absence for researchers to start the new company, and offers very flexible rules regarding transfer and payment of intellectual property as a way of fostering the start-ups.

Should a start-up company go through the first phase successfully, it is encouraged to move into Innopoli Ltd.

Innopoli Ltd currently has 250 resident firms, and an additional 250 on their "network", housed in an ultra-modern 222,000 square meter complex. It is the core organisation to all the activities described.

Innopoli Ltd offers all services under one roof to promote the generation and development of a fully-fledged new business. This includes an extensive network of professionals, academics and support programs including mentor-support and advice. This centre also fosters linkages with the neighbouring Business Park, Olartek, which generally becomes the home of the successful incubated companies after about a three-year period.

In Helsinki alone, OSP and Spinno have evaluated 600 applications, 230 have been accepted, and about 200 turned into new companies in the seven years 1991-1998. These new firms employ 800 people directly, and 1300 indirectly. Most of the new firms are in the manufacturing sector, and typically have taken 2 - 5 years to reach public listing.

It was stressed that the Oteneimi/Innopoli model offered a system, trusted by TEKES and the venture capital organisations. Mr Ylostalo estimates a 1:100 payback on Government funding using this approach.

Spinno works in conjunction with the company Culminatum Ltd also housed in Innopoli Ltd.

### *Culminatum Ltd Oy*

*Discussions with Mr Kari Ruoho, Managing Director and Mr Markus Lankinen, Project Manager*

Culminatum Ltd (share capital FIM 1 million, about \$A 279,000) administers an all-embracing Centre of Expertise/Regional Development Program for Finland, headquartered in Innopoli.

This Finnish model is based on the good will cooperation between the research industry and the universities, and has its basis in Law – the Regional Development Act 1994. The first program ran from 1994 - 98, the second from 1999 - 2006. There are now 14 regional centres, plus two horizontal centres based on tourism with a total running budget of FIM 30 million. The Centres generally involve a cooperation between firms, cities, technical centres, universities, research institutes, chambers of commerce, and public authorities, and like Spinno the objective is high technology development.

The Centres bring research, education, industrial expertise and authorities into close cooperation – “a cooperation which creates an innovative environment”. The Centres provide SMEs with knowledge and expertise from national and international sources. In that sense they mimic the Spinno activities. In addition, Culminatum Ltd implements regional development programs, regional and local consultancy services, knowledge and information management services, and administration and coordination services in regional and local projects.

Following a review ( a Canadian (Peter Kelly) working in London carried out this study), Culminatum has identified four impediment areas for innovation in Finland:

- structural overlap in innovation service provision;
- lack of management capabilities – little real world experience by emerging entrepreneurs;
- a typical ideas/equity gap – investments tend to be at later stage innovation; and

- societal problems – poor education in entrepreneurship, problems with tax system, no incentives to get rich, poor salesmanship.

Solutions forwarded to solve these problems include: a “first stop-shop” – where private and public sector people are brought together to mutually evaluate and develop a process for enhancing innovation; a “business idea competition” – which would serve to spread knowledge of the benefits accruing from start-ups; a “reward system” – for academic researchers to bring ideas forward; entrepreneurship as a feature of the educational system; study of impediments under the social structure.

### *The Helsinki Science Park*

*Discussions with Dr Kai Falck, Managing Director and Dr Paivi H Ryöppy, Development Manager*

Established in 1992, the Helsinki Science Park is the youngest in the Finnish system. The University of Helsinki is the main partner, the government contributing two-sevenths of the shareholding, and the Park itself one-seventh. Private industry also holds a major stake.

The University of Helsinki provides expertise in the form of the workforce, not providing invoices for many projects. Dr Falck went to some pains to point out that “incubators” are separate entities to Science Parks, the latter able to secure grants from MTI. Indeed, 50% of the Helsinki SP came from MTI, and over FIM 15 million per annum was available for Science Park investment, ie., about FIM 1.5 million per Park.

The Helsinki Science Park operates as a “Centre of Expertise” (see Culminatum) between the University and private industry. The areas of specialisation in this case being genetics and molecular biology. Seed-funding and start-up capital for the Park has amounted to FIM 35 million (\$A 12 million) to establish an R&D program, quality systems, national and international approvals, as well as studying social and ethical issues. They have engaged overseas expert personnel to educate participants in the Park on quality systems.

In contrast with Innopoli, the Helsinki Science Park has a stronger focus on R&D projects, joint ventures, and consortiums between different research units and companies in Finland and abroad. However, substantial business incubator services are also offered.

The Helsinki Science Park was responsible for the building of the Viikki Biocentre, a cooperative venture by the University of Helsinki, the Science Park, the Finnish government, the City of Helsinki, the Finnish National Fund for R&D (SITRA) and Finnish business. It was recently opened and boasts the ability to generate 20% of its income through industrial contracts – others contracts are anticipated to follow.

The Biocentre is an academic community of 1,500 students and 400 teachers. Space has been set aside for the Finnish biotechnology industry, and a business incubator is planned. The building currently houses Alkomohr Biotech Ltd and a research unit of Orion Corporation (USA). The Biocentre appears destined to be a major resource in biotechnology, medical and pharmaceutical technology, molecular biology, food technology, plant breeding, environmental technologies, agriculture and forestry. It therefore should attract attention from similar organisations in Australia.

#### *IP Issues*

Because of the IP law operational in Finland the Parks have no equity in the firms established in them. However, few emerging firms can afford the finances necessary for patenting. Thus, some Parks have developed with the universities a patenting and licensing system – based on the Stamford model. Under this system, the result is one-third ownership by the university, one-third by the individual and one-third by HUL – an investment entity part owned by the university and SITRA. If a scientist wishes to license the technology, the ownership is transferred to the university.

Dr Falck provided a further perspective on the Finnish incubator system. Funding for incubators can be obtained from a variety of sources in Finland:

- The MTI offers support which covers specified costs, namely rent for space at 45% maximum, salaries at

45% maximum for a fixed term, and 15% on investments excluding computers.

- A preferential loans system is also available also from MTI/TEKES.
- TEKES provides research grants covering up to 75% of costs, but it must be demonstrated that the other 25% funding is available. TEKES funding is often used as a seal of approval for other funds, eg, from SITRA.
- If people have knowledge and experience there are training programs for entrepreneurship from all of the universities in Helsinki – but generally Finland must be classed as “still amongst the beginners”.

## The Technical Research Centres (VTT)

### *Discussion with Ms Linda Hintze (Innopoli)*

The Technical Research Centres are funded by the MTI and TEKES, employ 3,000 researchers and earn about a third of their income from industry. One of the larger VTT Centres is based on the Helsinki University of Technology campus, opposite Innopoli Ltd.

Significantly, VTT are shareholders in a number of regional incubator programs and parks.

## SITRA – Finnish National Fund for Research and Development

### *Discussions with Mr Aatto Prihti, President*

SITRA operations are mainly financed through income from the approximately FIM 2.9 billion (\$ 40.8 billion) endowment capital and the return on the investment operations undertaken by the company. This endowment capital came from the sale of the public utilities in 1967 and provides about two-thirds of the yearly operational income. Today SITRA is an independent fund responsible to the Finnish Parliament.

SITRA's main goals are to facilitate Finland's social and economic adaptation to international change, to chart and present new strategic alternatives to increase the competitiveness of the Finnish economy, and to

identify, develop and test new instruments that impact on the country's competitiveness.

Mr Prihti stressed the importance of SITRA's international investments in private equity funds, with twenty three established since 1989 in the USA, Europe and the Nordic countries, but more recently in Central and Eastern Europe, and Russia.

*All of these fund investments have been of strategic importance to SITRA* – principally to gain experience and on-the-job training opportunities (notably from the USA), to create active networks, to help SITRA's portfolio companies in finding partners, to increase syndicate financing or co-management, and to improve the flow of international technology. Note: in Russia, SITRA manages US and foreign funds.

SITRA provides capital support in two major areas:

- Research, training and innovative operations – to build a bridge between research and political decision making, and to create new forms of business in collaboration with companies and experts in the field; and
- Corporate finance – SITRA provides finance for economically promising technology firms at start-up and early stages of growth – and to develop a venture capital market. SITRA mainly invests in share capital, but other equity or complementing forms of finance are also possible.

SITRA maintains a close relationship with TEKES, analysing the market prospects for a technology before making any investments in TEKES supported firms. The objective is to develop the firm for a few years, followed by a complete or partial exit with a defined and usually agreed plan. Special attention is also paid to overall management support.

SITRA funding may be classified as:

*Seed Finance* – investment in new, emerging companies based on research findings, and in technology start-ups. In 1998 SITRA made fifty investments to a total of \$A 29.6 million. The total portfolio covered 102 companies, the majority operating

in biotechnology, medicine, it and electronics. SITRA has a member on the Board on each company.

*Sector-related Finance* – Finnish Venture capital investments launched by SITRA in the late 1980's have made private capital investments based on business entrepreneurship. Thus, funds managers have established SITRA Bioventures to cover biochemistry, pharmaceuticals and diagnostic industries (\$A 20.8 million); SITRA Fenno that focuses on medium-range management buy-outs (\$A 0.3 million), and SITRA Technology (\$A 20 million) founded in collaboration with Finnish Industry Investment Ltd for financing start-up and growth-phase technology firms.

*Business Angels and Matching Service* – started in 1996 promotes contacts between private persons and interested venture capital investments and the entrepreneurs – based on confidential non-profit, and neutral information transfer.

According Mr Prihti, SITRA formed the view during 1999 that the existing Finnish venture capital companies were too small. SITRA therefore purchased them but continues to permit them to operate as separate entities.

Mr Prihti argued that for risk financing the critical consideration is having know-how. For Australia the advice would be to demonstrate "know-how" in Finland to attract investment.

### *Technology Transfer*

Another area of operation for SITRA is in technology transfer. SITRA's objective is to develop operative models for the commercial exploitation of research and emerging innovations both nationally and in collaboration with *regional operators*. SITRA is the sole owner of four regional management companies, and has a network of 16 regional management companies, which manage \$A 132.7 million in capital. SITRA is also involved in five technology transfer companies operating in the five major university cities of Finland. It owns about a third of each of these operations. SITRA has been particularly active in the northern Oulu region, being involved in long-standing cooperation with the Oulu Technology Parks, which focus on IT and biotechnology.

On a further note, Mr Prihti noted the problems facing small firms entering international markets alone, and recommended the formation of rings of complimentary firms.

## Finnish Industry Investment Limited (Teollisuussijoitus).

*Discussions with Mr Juha Marjosola,  
Managing Director*

Finnish Industry Investment Ltd (FII) is a State-owned investment company, which commenced operations in 1995. Its investment capital was generated from the privatisation of the State-owned utilities.

FII has a professional staff of 6 people, total assets of \$A 193 million, and total capital commitment of FIM 500 million (\$A 140 million). The company invests in venture capital funds (38%) and private equity funds (39%), regional venture capital funds (12%) and in direct investments (11%). The investments were divided among twenty funds, four direct investments and the majority shareholding in Start Fund of KERA, which itself has investments in 40 firms.

The company recorded a profit of about \$A 5 million in 1998.

## Lessons for Australia

Broad conclusions from Finland's experience are:

Finland has made considerable advances in generating a coordinated national innovation system. The high frequency of consultation, deliberation and effective linkage creation between Government, its programs, and industry has been productive.

The Finnish process begins with the recognition that in the knowledge-based economy, knowledge can be fostered to produce economic benefits.

The "spotter" system employed in incubators encourages flows of knowledge out of the laboratories into fledgling firms. Undoubtedly, the management of the incubator is critical to the success of such incubated firms – but it is the coordinated flow-on benefits that follow in Finland which are impressive. Namely entrepreneurial training, linkages to prestigious TEKES grants, and the informal imprimatur to investment through SITRA and Finnish Industry Investment Ltd for small and emerging firms.

It is significant that international *Technology Transfer* is the primary province of the investment houses and their links back through the research system.

The evaluation of Government programs to determine their impact on outputs – jobs, turnover and exports has become a significant tool, which adds to the integrity of performance of both the programs and the firms.

The lesson of using the sale of utilities to generate a substantial endowment fund for establishing Government investment agencies (SITRA and FII) cannot go unnoticed, but is probably not reproducible.

On the other hand, *most notable is the outward investment view* taken by SITRA – primarily as a mechanism to gain expertise for the Finnish venture capital market. It is the direct linkages to the United States that are held in highest regard, and this is intended to be emulated in the international cooperation platform of TEKES. Funds management in the Australian venture capital market could also benefit from the influx of US know-how in this field.

It is equally significant that investment in new ventures is generally shared amongst the institutions with the universities as the central player in most cases, and a particular emphasis on *regional development* plans – the economy and employment.

It is also evident that industry clustering plays a significant role in the economic growth of Finland and again has a regional basis.

Indeed, notionally at least, Australia might learn considerably from the simple membership listings of some of the Science Parks – involving universities, the Government, regional governments, financial capital funds, and firms. Or from the industrial supply chain clustering built up from the connections between the technology parks, firms and investment funds in addition to the firms involved.

Unfortunately, the Finnish examples provide no clear picture of the “ideal” incubator model. BUT they do offer an interesting contrast between on the one hand the Viikki Biocentre – *A Research Cluster*, and the Innopoli/Oteniemä – *An Incubator for Emerging Firms* – both based at universities, but providing markedly different patterns of association and linkage, in the former case to international companies as well as indigenous ones.

The strategic plans offered on a triennial basis through the Finnish Science and Technology Council provide the *blueprint* for continued integration and development of the Finnish system and could readily be emulated in Australia if it can be agreed that this is considered a viable “way to go”.

The considerable achievements of the Finnish Government in stimulating the economy to reach the highest levels of R&D expenditure from the private sector, and public/private combined will need to be carried forward in new growth firms. However, setting the target may be the key?

Dr Alan J. Jones

*Director*

*Innovation Systems Research*

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# Israeli Government Support for Technology – Based Firms

## Background

Israel has the second highest number of start ups after the US. The electronics industry in Israel is worth \$8 billion. Data and telecommunications are the fastest growing part of the industry. The industry overall has grown 15% a year over the last 11 years. 44,000 people are employed in the electronic industry, of which around 15,000 are engineers and scientists. There are more than 40 venture capital funds in Israel with over \$3 billion raised in the last three years.

Israel has a population of 4.8 million people of whom 80 per cent are Jews and around 20 per cent are Arab or Christian. It had a GDP in 1997-98 of around \$US100 billion and now has 60-70% of the GDP of the Arab region. Thanks to high-technology industries, it is a local superpower. But for much of its short history, Israel's economy was based on agriculture and processing of minerals and diamonds.

Due to long standing hostilities between neighbours, Israel has devoted a disproportionately large element of Government spending to defence in general and defence science in particular. For many years, Israel has also recognised the importance of spending on education. These factors have provided Israel with some advantages over other advanced economies intent on gaining a major share of the emerging global knowledge-based economy:

- Israel has a higher per capita expenditure on R&D than most countries; and
- it has one of the best educated workforces in the world.

In addition, Israel has strong links to the US economy.

However, for many years, this combination of advantages did not lead to significant growth in numbers of Israeli technology-based start-up companies, nor to much commercialisation of Israeli technology (other than some elements of defence technology). Instead, Israel's economic performance was mediocre and it was plagued by recurring current account deficits and comparatively high levels of inflation.

Prior to the 1990's Israel was characterised by a high level of R&D spending but low levels of commercialisation of domestic intellectual property, partly due to:

- a lack of suitable patient capital, together with an apparent shortage of investable local start-up firms; and
- a related shortage of managers needed to grow technology start-ups into successful global firms.

In common with the stock markets in most small economies, the Tel Aviv stock exchange was not useful for funding technology stocks. This was both because of risk aversion by local investors who did not regard small technology firms as good investment propositions, and because of a lack of local capacity to adequately value new technologies. In addition, there was little or no venture capital available.

This situation changed completely in the early 1990's as a result of the confluence of three major factors:

### *1. Defence Science Spin-offs*

Much of Israel's success has been based on the commercialisation of military technology, particularly in radio-communications and telecommunications. In the late 1980s a gradually improving peace process

caused many in Israel to question the continued wisdom of excessive defence spending. This was combined with a dawning realisation that no small country – not even one as determined as Israel – could continue to fund grandiose defence projects (such as Israel’s own tactical fighter). This resulted in a significant winding back in defence research budgets. Tens of thousands of defence scientists and engineers were coming onto the private job market in the early 1990s and since there were few jobs for them, many went overseas. Many of those who remained in Israel established technology start up companies. It is notable that much of the core intellectual property for these start-ups was defence related. The Israeli government seems to turn a blind eye to this.

## 2. *The Collapse of the Soviet Union*

This led to an influx of many hundreds of thousands of highly qualified Soviet Jews. The number of qualified engineers and physicians in Israel doubled in four years, with 10% of the population Russian. In the process many of the long-standing scientific strengths of the old Soviet Union quickly became – at least in part – the scientific strengths of Israel. Many of these scientists and engineers could not find work commensurate with their training and many hundreds of these immigrants have created start-up companies based on the intellectual property of the former Soviet Union and triggered initiatives in incubators and venture capital.

## 3. *Public Policy Interventions*

Beginning in 1991, the Israeli Government embarked on a series of conspicuously successful public policy initiatives. These helped to:

- establish a vibrant venture capital market which is now growing very rapidly;
- encourage the establishment and growth of thousands of technology-based start-up companies (an estimated 3,500 since 1991);
- increase the already significant commitment by Israeli firms to R&D;

- encourage extensive overseas investment in Israeli technology-based firms including substantial investment by US pension funds; and
- achieve growing numbers of overseas sales of Israeli technology firms including a record of listings on the NASDAQ (second only to the United States itself).

These specific initiatives are discussed in detail below:

### a. *Venture Capital: The Yozma Fund*

In 1990 there was only one venture capital Fund in Israel – Athena Investments, with \$US30m under management. By early 1999, there are estimated to be at least 85<sup>1</sup> Venture Capital Funds in Israel with more than \$US3 billion under management. Much of the credit for this explosive growth in venture capital is given to the Yozma Fund.

Yozma<sup>2</sup> was an initiative of the Ministry of Finance to create a Government-owned company with \$US100m to invest. Its mission was to help to grow Israeli technology firms by increasing the supply of risk capital for these firms.

- The Former Chief Scientist – Yigal Ehrlich – was placed in charge of the new venture.
- Yozma operated in a private sector manner despite its Government ownership.

Yozma achieved its objectives in two ways:

- first, when it was unable to encourage Israeli investors to invest in Israeli technology firms, Yozma invested some \$US15m directly into these firms itself; and
- secondly, it established a series of 10 venture capital funds where Yozma — on behalf of the Government — was a major co-investor with a range of overseas investors (the Government investing 40% and 60% coming from foreign funds). The first of these involved German investors, the second British and subsequent funds also involved US and Asian investors<sup>3</sup>.

<sup>1</sup> Because of the rapid growth in the number of venture capital firms in Israel and the steady increase in investment in these funds, all printed estimates of the size venture capital industry are out of date within weeks of being published.

<sup>2</sup> Meaning “enterprise” or “initiative” in Hebrew.

<sup>3</sup> While much is made in the media of the connections between Israel and the US investment community, it is interesting to note that the first Yozma joint venture fund involved German investors, while the second involved British.

Yozma ignored Israeli investors when setting up the joint venture funds. It did this first because it wanted to increase overseas investment in Israeli technology and secondly, because overseas investors brought with them skilled funds managers combined with excellent links to overseas equity markets — a critical condition for successful exit from early stage investments in technology firms.

Yozma established eight joint venture funds in its first three years. Subsequently, the Government and Yozma established two more:

- the first, a biotechnology specialist fund, may have reflected growing Israeli concern that while 40% of research in higher education is spent on biotechnology, Israel has few commercial outcomes in this area; and
- the second new fund – and the last to be established by Yozma – was a joint fund with Singapore, Vertex Holdings, and reflected the growing strength of relations between the two countries.

The conditions of investment by Yozma were identical to that for private investors, as were the profit sharing arrangements. Foreign investors were given an option to buy the Government's portion of the fund after 5 years. The purchase price was set as the amount the Government had put in, plus interest on that amount for 5 years, plus a royalty to the Government of 7% of future profits. Private investors do have an interest in buying the Government out early to increase their overall return on investment, and 8 out of 10 funds were bought out with very high returns.

#### *b. Related Measures*

The Yozma initiative was supported by action in two key areas of tax. First, US pension funds were given temporary exemption from Israeli tax. This measure – which gave US pension funds the same tax treatment which they enjoyed in the USA – appears to have led to a substantial influx of US pension fund money into Israeli venture capital funds in the mid-1990s. Second, an exemption was introduced to Capital Gains Tax administration whereby if an investor's

shares in a start-up company are exited by way of a listing on the Tel Aviv Stock Exchange or on an overseas stock exchange, then the transaction is exempt from capital gains tax.

Yozma was so successful in encouraging the growth of venture capital in Israel, that after only a few years the government decided to end the program. It has done this by first selling all of the direct equity investments made by Yozma and secondly by withdrawing its capital from the joint venture funds as they exit individual investments.

- Advice from the Ministry of Finance in Jerusalem is that Israel has no plans to have any additional Yozma funds in the future.
- However, in recent years there has been slowly growing pressure for the Government to consider further initiatives to support further growth of early stage venture capital. This arises because many of the existing venture capital funds in Israel are rapidly attracting larger inflows of investor capital. As the funds grow larger, they tend to look for larger scale deals. As a result, media reports suggest that there are growing concerns that Israel may soon, once again, face shortages of early stage venture capital.

The venture capital funds which initially sprang up in Israel in the 1990's differed from US venture capital funds in several important ways:

- first, they tended to be very small by US standards. Until recently, the average size of an Israeli venture fund was around \$US 20m;
- secondly, most of the investors were non-Israeli;
- thirdly, because Israel had no existing cadre of trained funds managers, the Israeli funds tend to have a high number of managers who are learning the business while managing their first fund. This makes them cautious and they tend spread risk by syndicating most of their deals – it is not uncommon for up to six venture funds to be involved in a single deal; and

- finally, because of the nature of Israeli society and the strong mutual linkages between people based on military service, the due diligence process in Israel appears to be less formal and less structured than that commonly followed in the USA.

### *c. The Programs of the Office of the Chief Scientist*

Within the Ministry of Trade and Industry, the Office of the Chief Scientist (OCS) controls an annual budget of around \$US 400m. The majority of these funds are employed in repayable grants to industry to encourage R&D, together with strategic R&D programs and the technological incubators program. In the past, these programs comprised a mixture of loans, grants, and grants which were repayable if the company was successful in commercialising its R&D. In 1998 Israel moved onto a support regime under which all R&D support is repayable if it is successful.

#### *c.1 Grants for Business R&D*

The OCS seeks to develop Israel's competitive edge in technology by focussing on three key areas:

- entrepreneurship;
- risk sharing; and
- the MAGNET program.

The scale of the OCS budget means that, in practice, most Israeli technology based firms will receive a grant to develop their R&D at some stage. As indicated above, in recent years the OCS has moved away from providing simple grants and towards greater use of repayable R&D grants where the project is a success. For grants to individual companies, royalties are paid as follows:

- 3 per cent of revenues during the first three years;
- 4 per cent over the next three years; and
- 5 per cent in the seventh year, and any year thereafter

Royalties are normally limited to the original value of the grant in US dollars. However, for some grants, a higher royalty will be sought (sometimes up to the value of 150 per cent of the value of the original grant). This will usually be sought in the event of the approval of the transfer abroad of some of the production rights. The prevailing philosophy of these

repayable grants is that the Government is sharing risk with the firms.

#### *c.2 Strategic R&D – The MAGNET program*

The MAGNET program was established to encourage the introduction and/or development of key new technologies which were likely to be strategically important to Israel's future economic prosperity. Each project involves a research institution (usually a university) and several firms (up to 15 on one project).

The Government provides a non-repayable grant of 66 per cent of the total project cost. To date 8 strategic projects have been funded under this program

The intellectual property rights of a MAGNET program belong to the party which developed it, but other members of the consortium have a licence to exploit the technology for the development of its own products. The authorisation to sell the technology to third parties is conditional on the approval of the other members and the Chief Scientist.

#### *c.3 The Technological Incubators Program*

The program was established in 1991 in response to the large numbers of highly skilled engineers, physicians and scientists who flooded into Israel in the years following the collapse of the Soviet Union. Its initial objective was to provide an environment in which Israeli technologies could be turned into successful start-up companies.

There are currently 26 incubators in Israel, with around 2-250 firms in residence in the incubators at any one time. The incubators are not-for-profit companies and are often associated with universities, industry associations; private research institutions or with municipal government.

Each incubator receives around \$US 300,000 per annum to partially offset its operating costs

Each firm in the incubator receives up to \$US 300,000 over two years. Of this, 85 per cent comes from the Office of the Chief Scientist and 15 per cent from a private investor. If no private investor can be found to put up 15 per cent, then the Government will not

usually put up its 85 per cent. The administrator of the incubator receive a grant of \$180,000 per year to run the incubator. This is in addition to the grants paid to the companies in the incubator.

The money is provided on a draw-down basis as the firm meets milestones which have been negotiated with the incubator management. While the money is paid to the firm, it is channelled through the incubator management who thus exert very high levels of effective control over key decision-making by the new firm.

The selection of firms is by the incubator managers acting in concert with an advisory panel.

Each firm entering an incubator must surrender some of its equity which is then divided as follows:

- 50 per cent goes to the entrepreneur;
- up to 20 per cent goes to the private investor;
- up to 10 per cent is reserved for key members of the firm's new management team; and
- up to 20 per cent is taken by the incubator itself and some of this may be provided to the incubator managers.

The net effect of this equity arrangement is to achieve very close alignment between all of the stakeholders.

The incubator management works closely with the small firm to:

- establish adequate intellectual property protection;
- prove the technology;
- develop a working prototype;
- form the core management team;
- conduct around \$US 40,000 worth of market research to ascertain if there is any market; and
- develop a credible business plan which will attract equity investors.

After 2 years the money stops and the company must make its own way although some remain in the incubator for up to another year.

The results are impressive by world standards:

- to date the program has produced over 470 technology start-up firms.

It is difficult to directly measure the success of the Israeli program against similar programs in other countries. This is because other countries' incubator programs count "surviving firms" as success. Israel does not. It only counts firms which have gone on to raise equity capital as success:

- a small firm which remains forever a small firm is of no interest to the Israelis;
- 50 per cent of graduating companies have raised a total of \$US 200m in equity capital as of December 1998.

The program is not cheap, with the Office of The Chief Scientist spending around \$US 32m per annum on this program. This level of expenditure has been relatively constant over the past four years.

#### *c.4 International R&D*

Israel has for many years placed a very strong emphasis on developing joint business R&D with a range of other countries. Its chief mechanism for achieving this has been a series of bi-nation R&D funds of which the BIRD-F program with the USA is the oldest and most famous. Under this program the two governments have each contributed around \$US 55m to a central pooled fund. The interest earned from this money, together with the proceeds from sale of shares in earlier projects enables the BIRD-F to invest around \$US 12m per annum in joint R&D projects between the two countries. While BIRD-F is owned by government, it is managed by private sector managers at arms-length from government.

Israel has a range of newer, and usually smaller funds with countries as diverse as Canada, Holland, the EU as a whole, Korea and Singapore. These range in size from \$US 6 to 12 million and all appear to have yielded some successful joint R&D projects. As is normal with Israeli government support for R&D, the underlying objective is to achieve commercial outcomes.

The most recent development in this area was the decision, announced in the recent UK Budget context, that Israel and Britain were establishing a five year, 15 million pound sterling joint R&D fund. The main significance of this announcement is that it is the first such joint arrangement entered into by the British government.

### *Investment promotion and attraction*

This is a major role of the Ministry for Trade and Industry and an area in which Israel has achieved conspicuous success as it strives to diversify its economic base.

The Ministry employs 36 economic counsellors in Israel's embassies and consulate around the world. In addition, it also draws on an extensive international network of Israeli Chambers of Commerce. Israel adopts an account management approach to Multi-national corporations including both those which have already invested in Israel together with those whom it is interested in attracting.

Israel employs two major investment attraction tools:

- Capital grants: under this arrangement, investors who establish new plants in designated development areas (usually outside of Tel Aviv) receive a grant equivalent to 24 per cent of the cost of the capital required to build and commission the new plant. This subsidy rate has fallen in recent years from a former level of 36 per cent and is destined to be reduced to 20 per cent in the year 2000. It is intended to stabilise the subsidy at this level for the foreseeable future.
- Tax holidays: in common with many other countries (e.g. Singapore), Israel provides tax holidays of up to 10 years for qualifying investments by overseas companies in new plant in designated areas.

The combined cost to the Israeli tax payers of these two measures in 1997 was just under \$US 1 billion, which is roughly equivalent to one per cent of Israel's GDP.

## Recent Developments

There are growing calls within Israel for a reappraisal of the programs of the Chief Scientist, together with further Government support for venture capital. These are based partly on a perception that the initiatives introduced in 1991 have been quite successful, together with a questioning as to whether Israel necessarily needs to continue to spend so much public money in this area. Specific issues which are being considered include:

- the scope to increase private sector investment in the Technological Incubators program, and the extent to which the incubators themselves could be transformed into "for-profit" businesses with reduced burden on the public purse; and
- the growing interest of Trans-National Corporations in becoming private investors in incubators (e.g. Dow Chemical at the Ashkelon Incubator) is relevant here.

In relation to venture capital, there are growing calls for some reappraisal of the role of Government. While it is widely acknowledged that the Yozma fund was a success, there is growing evidence that as Israeli venture capital funds grow in size, they will tend – as US funds have done – to focus more on larger, later-stage deals. Consequently, there are fears that a shortage of funds for smaller, earlier stage deals may emerge and that this may warrant some further Government intervention.

- Related issues here include growing questions about the profitability of many of the venture capital funds that have been established in Israel together with some pause in the rapid rate of use by Israel of the NASDAQ as an exit mechanism.

## The Private Sector

The following are brief case studies of private firms in Israel:

- Clal is a large Israeli investment company shifting its portfolio towards telecommunications and IT venture capital activities, with particular focus on telecommunications, semiconductor equipment; enterprise software and biotechnology. The company receives 30 to 40 investment proposals each month. Clal's latest fund involves \$25 million of its own money, with the rest coming from foreign investors, particularly from the US and Japan;
- The RAD Group operates in the high technology and data communications areas, with a turnover of \$320 million in 1998. The group has started 20 companies, three having been sold, two floated and 15 remaining in the group at varying stages of development;
- Har-Hotzvim Technology Entrepreneurship Centre (HHTEC) is a private sector incubator, founded by industrialists who were also involved in bringing Intel to Israel. It has had 30 companies involved in the program to date, 10 of which remain active and 18 of which have graduated. HHTEC specialises in medical and biotechnology, telecommunications, and computers and electronics. It assists its companies to obtain finance from a number of sources, including the Office of the Chief Scientist and an "angels" club known as the HiTec Investors Group.

## Lessons from Israel's Experience

Israel's experience in growing a large number of high-technology small firms has several importance lessons for other countries.

*Having the building blocks in place for economic growth is not enough*

Many of the factors which are commonly cited to explain Israel's phenomenal growth in technology-based firms were in place for years – in some cases decades – prior to the take-off in growth which occurred after 1991. However, little progress was

achieved in this period and the Israeli economy was marked by periods of poor management and significant levels of domestic inflation.

*Israel's strong skills-base has played a crucial role*

Many world scale IT manufacturers, such as Intel and Motorola, have substantial facilities in Israel because they can hire large numbers of skilled engineers. Productivity in the Israeli electronics industry has risen sharply due to employing a higher proportion of skilled people, with sales per employee rising from \$60,000 to \$180,000 over the last 11 years.

The Australian company Ipex chose to establish its European base in Israel. The reasons were that:

- Israel has 145 scientists and engineers per 10,000 employees (the highest ration in the world);
- there is a large pool of software and electronic engineers;
- there is a low turnover of R&D personnel;
- remuneration levels are low;
- the universities are of high quality; and
- the Government's incubator program is attractive.

*In the absence of some external shock, focussed public policy will sometimes be required to kick-start the growth of technology firms*

With hindsight, the combination of public policy initiatives employed by Israel appears inspired and insightful. What must be recognised, however, is that the Israelis themselves were very sceptical of the prospects of success for these initiatives since things they had tried in the past (e.g., earlier attempts to grow a venture capital industry) had been failures.

*Each nation must play to its strengths and recognise its national limitations*

This sounds so obvious as to be banal. But Israel has real strength in high tech start-ups combined with high levels of local education and entrepreneurial spirit. This enables it to create many high tech small firms.

However, Israel itself has little to offer a medium sized company trying to grow rapidly. Such companies are far better placed in the European or more importantly the US markets. It is significant that Israeli

public policy has facilitated such movement rather than trying to place unrealistic demands upon Israeli start-ups to commercialise their products from Israel. This is a trap which many small, newly industrialising countries can easily fall into.

From the perspective of attempting to maximise national economic benefit, it is likely to be far better to develop hundreds of new technology firms, grow them, and then sell the firms overseas. This is likely to be more beneficial than it is to struggle to try and establish a handful of sub-scale export industries from a small, isolated home market such as Israel's. In this context, an Israeli strategy of deliberately attempting to use its technology to build a broad range of export-oriented manufacturing industries would be likely to have only limited success. Instead, Israel is rapidly growing an export-oriented research and development industry where the Israeli companies are the export product.

*Rapid growth in the high-tech economy carries with it some risks*

Since 1991, Israel's high technology economy has grown very rapidly with more than 3500 high tech start-ups many of which have attracted venture capital. A growing number of these have been sold overseas either publicly or privately. Wage costs in some areas of the IT industry in Israel now rival those in the USA.

However, the remainder of the Israeli economy does not appear to have enjoyed the same prosperity. Hence an economic dichotomy has emerged between the high technology economy (which only employs about 200,000 Israelis) and the more traditional economy which employs the rest and which has been stagnating for some years.

*Israel's formula for success does not work for all sectors*

Israel has been remarkably successful in developing start-up companies in a broad range of technologies. But it remains true that the vast bulk of the really successful Israeli firms have been in IT, electronics and – to a much lesser extent – in medical devices. Despite the fact that more than 40 per cent of all university research in Israel is in bioscience, Israel can point to very few successes in commercialising Israeli bioscience.

The implication here is that Israel needs to find an altogether different formula if it is to create the circumstances where its undoubted strength in bioscience research can be translated into large numbers of successful spin-off companies.

*Some of Israel's public policy initiatives represent world's best practice and should be transferable to other countries*

The Israeli Technological Incubators appears to be amongst the best structured and most successful (in terms of numbers of graduates and levels of equity capital raised by graduates) in the world. The underlying concepts and program structure are straightforward and could be readily emulated.

Small economies have much to gain from establishing and maintaining excellent international connections and networks including those based on joint R&D funds.

*There is clearly a case for continuing to re-visit the question of the appropriate role for Government*

The current debate in Israel about further Government support for venture capital highlights the fact that there is no 'magic bullet' in relation to Government initiatives in this area and that there may be a case for some permanent, or at least recurring government intervention. This last issue has been well recognised in the USA in the form of the long-standing Small Business Investment Company program.

Keith Besgrove  
*Innovation Branch*

# Norwegian Government Measures to Support Technology

## Background

Part of the Scandinavian peninsula, Norway is the fifth largest country in Europe. Although population density is low, the population of almost 4.5 million tends to be concentrated in a few urban centres, of which Oslo (1 million) is by far the largest. About 70 per cent of the Norwegian land mass consists of mountains and wasteland. The society is culturally uniform, with few very wealthy or very poor individuals. Norway is not a member of the European Community, but has a general trade agreement with it, and a number of special agreements, such as on fisheries.

With GDP per capita of 27,497, Norway boasts one of the highest living standards in the world and much of this is due to North Sea oil and gas which contributes about 14% of GDP. Norway has a mixed economy of State-owned and privately owned corporations. The trend is toward privatisation of public enterprises, particularly the utilities.

On a sectoral basis, the Norwegian economy is less oriented toward manufacturing (11%) than Australia (14%) and services (65.9% compared with 70.6%). The availability of cheap hydroelectric power has resulted in a large electrochemical and ore smelting industry but there are no substantial industrial districts. Public service industries constitute approximately 15% of GDP. Norway has relatively few large firms and these are mostly operating within traditional low technology industries.

Norway runs a trade surplus, with exports equivalent to 44% of the gross domestic product. Petroleum exports have grown the most rapidly and now comprise 35% of all Norwegian exports. Mining, manufacturing and primary industry exports have all increased during the last 5 years, while the service sector has remained constant. The northern parts of the former Soviet Union are regarded as offering good opportunities for Norwegian firms.

Trade coverage ratios (the balance of exports over imports) show the Norwegian economy to be specialising in the low- and medium-low technology industries (0.91 and 1.07 respectively) rather than the high- (0.33) and medium-high (0.51).

A net importer of technological know how, Norway is protecting its technological innovations strongly overseas (24,000 patent applications abroad in 1996).

Projections indicate the North Sea oil resources may be depleted in about 10 years, with the gas potentially lasting 30 years. Norwegian policy aims to reduce economic dependency on the oil and gas industry, and increase in export-oriented industries. Norway is deliberately using the period before the depletion of the oil and gas to reorient its economy toward knowledge intensive industries where it is considered high wages are a less important factor and can therefore be sustained.

The impact of the 1986 fall in oil prices on the economy led to some reevaluation of the policy and it was reshaped so that it now also includes raising the knowledge intensity of manufacturing and the more traditional industries.

Revenue from the North Sea resources have been used to expand R&D and higher education, to sustain regional activity and to engage in major technology development programs. It is considered critical to renew the company base by creating new companies and providing support for their growth. Corollary issues are ensuring competence in the service sector and the take up of IT by firms. Norwegians have high rates of computer and internet usage.

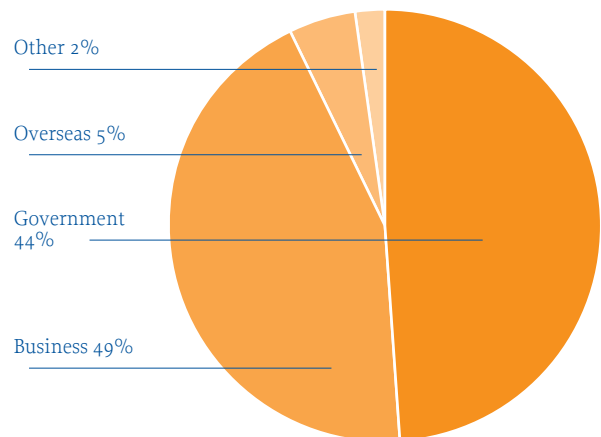
While Government policies have targeted the development of new industries, Norwegian “low R&D intensity” industries are benefiting from the application of knowledge and research. For example, fish farming is becoming increasingly important and is linked to some of the most advanced areas of industrial innovation, including materials science, acoustics, optics and signal processing.

Norway has a cluster centred around shipping and the IT sector may generate another. The Norwegian IT sector has one of the highest R&D intensities in the world.

Government policy is generally considered positive to FDI, and although no general investment incentive scheme exists, some incentives (such as cheap industrial sites) may be offered at the local level. A 1995 Act places some restriction on substantial foreign investment in Norwegian companies that have either more than 50 employees, a turnover of more than 50 million nok, or have received major support for R&D.

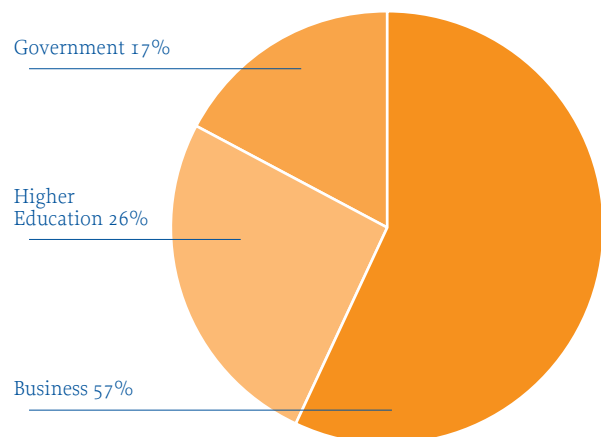
## R&D and Innovation

### Funding of Norwegian R&D



Expenditure on R&D in Norway was 1.56% of GDP in 1997, of which 50% is provided by the business sector, 44% by the Government and 5% from overseas. On an expenditure basis, business performs 57% of the R&D while the higher education sector accounts for 26% and government institutes 17%.

### R&D Performance



Norwegian R&D policy formulation is based on a sector principle, with each ministry having responsibility to promote and fund research activities within their own areas, in line with specific sector policy objectives. The Ministry of Education, Research and Church Affairs provides the most significant funding of industrially related R&D and innovation through the Norwegian Research Council.

## Norwegian Research Council

The Council bears overall responsibility for the national research strategy and has an annual budget of 2 billion NOK to support universities and science. It identifies important fields of research, allocates funds to the universities, research institutes and hospitals, evaluates R&D and offers strategic advice to Government on science and technology issues. Funding is divided among 6 research divisions – bioproduction and processing; industry and energy; culture and society; medicine and health; environment and development; and science and technology. Industry and energy is the largest, medicine and health the smallest.

The research funding encourages collaboration and building on strength rather than the generation of knowledge for specified socioeconomic objectives.

In addition to providing support for academic research projects, the Council supports industry-oriented projects, up to a ceiling of 50% of the total cost.

Without being a member of the EU community, Norway nevertheless participates in the EUREKA and Framework programs and is a nett beneficiary. Norway also participates in the big projects such as the European Space Agency and contributes to some international large basic research organisations. Overall the policy is for involvement in international science projects provided that they will result in wealth creation for Norway, that is, the research outcomes will be commercialised in Norway.

## Higher Education Sector

There are 4 universities in Norway and about 30 colleges. While efforts are being made to increase the benefit to the economy from university research, ownership of research results by university researchers is considered a significant impediment. Results tend not to be patented at all, and there is little incentive for the universities to take care of intellectual property/research outcomes. The universities also tend not to have commercialisation offices.

A number of reforms have been proposed recently, including:

- amendments to statutes and regulations to better contribute to commercial exploitation of the R&D results in universities and colleges;
- research funding is to place greater emphasis on basic research;
- research strategies for promoting specialisation and concentration are being strengthened; and
- the establishment of a system of Norwegian Centres of Excellence is under discussion.

## Research Institute Sector

The institute sector is diverse, comprising 60 or so research institutes. Limited core funding is provided (about 5-10%) and the institutes obtain the balance through participation in the Research Council's public research programs (50%), undertaking specific projects for the Government (15-20%) and firms (20-25%). IP is owned by the institutes.

## Support for Innovation and Company Development

The Norwegian Industrial and Regional Development Fund (SND) is the central institution for public funding of industrial and regional development. With an annual budget of 2.5 billion NOK, it funds business development, particularly SMEs and businesses outside the large metropolitan areas and also has several programs providing support to innovation.

Enterprise development focuses on improving the ability of SMEs to take advantage of the capabilities of the public sector, undertake product and enterprise improvement and take up IT:

- In close cooperation with private banks and finance institutions, SND offers loans, grants and guarantees to firms. The total budget for 1997 was 3.2 billion NOK and accumulated lending was about 10 billion NOK. The demand far exceeds the available supply of finance.

- Low risk loans are provided for innovation, and development projects at market rates while venture capital loans are available at a higher interest rate, to top up project funding as well as investments in fixed assets. SMEs in outlying districts are given priority.
- Equity is taken in companies to provide venture capital or to secure loans. In 1997 the SND had taken an equity in 165 companies not listed on the stock exchange, with a shareholding of between 1 and 69%. In addition to equity capital, the SND offers management advice, particularly assistance in building a competent board of directors.
- The two investment funds, the Northwest Russia fund and the Eastern and Central European fund focus on economic opportunities in the former Soviet Union. The funds provide grants for activities leading up to substantial projects (surveys, planning and launch activities) and priority is given to the support of projects expected to have a positive impact on trade and industry in the regions.
- Programs targeting product development provide grants to companies which undertake the development in collaboration with the Norwegian public sector or supplier companies. Special emphasis is placed on developing products for export markets and collaboration with foreign companies is not excluded.
- A complementary Network Business Program encourages the development of cooperation between organisations to enhance individual company technology, product development, marketing and purchasing proficiencies with a view to enhancing their ability to jointly operate in the market.
- Support for increasing technology competency in SMEs is provided through a mobility Program said to be similar to the Irish Tech Start. The program provides 70-80% of the salary of young graduates from a university or regional college for 1 year. The support is not restricted to R&D activities, though it is limited to an identified need to raise a specific competency within the firm.

In addition, greater IT competency of firms is encouraged through the BIT program.

Programs supporting the commercialisation of public sector research outcomes focus on:

- improving the mobility of academic researchers by paying their salaries for one year while they undertake research within established firms;
- technology spotters which match up the technology needs of SMEs with research institutes. Some financial support is provided for small projects;
- fostering the development of collaboration between companies and R&D communities on a regional basis;
- small grants are provided to academic entrepreneurs to establish firms. Support is made available for expert advice on project planning, development of the business concept and establishment. In addition, support is provided to cover costs related to the initial stages of an innovation project through to a saleable product; and
- the Office for Inventors (total budget 12 million NOK) offers advice and scholarships to inventors, including some support for patent applications and prototype building.

Additional support is provided through 7 science parks and a number of business parks. Some of them have received support from the Government. The largest science park is in Oslo which is run on a for-profit basis.

## The Oslo Research Park (Forskningsparken), Norway

The Oslo Research Park (ORP) is based on the Research Park model exemplified by the Cambridge Innovation Centre (UK). Its functions are twofold:

- assistance in the formation of knowledge based industries; and
- provision of professional licensing and sales services for research-based ideas and results.

Located in a building on the campus of Oslo University, it is within 700 meters of 12 applied research and higher education institutions which account for 1/3 of Norway's R&D expenditure, 6,000 researchers and 30,000 students. Starting in 1989 with a complement of 12 resident companies, the ORP was the first of the 6 Science Parks to be established in Norway.

The ORP building is owned by a private company which leases the space (16,000 sq meters) to a company, Oslo Research Park Limited (ORPL), formed by Oslo university, the municipality, some applied research institutes and businesses. By in turn leasing the space to companies and research institutes at a profit, ORPL obtains a revenue stream which is the backbone of the finance for its activities. Additional sources of revenue include local government projects and the SND which pays the ORPL for each company it assists in establishment.

In 1999, the ORP houses a number of small applied research institutions and approximately 50 technology companies, which employ a total of 300 people. The relationship between most of the organisations and the ORP is essentially one of landlord and tenant. Typically half the space in the ORPL building is let to applied research institutes and the rest to start up companies – the ORPL provides some assistance to 1/3 to 1/2 of these.

Current residents are in the informatics and software industries (50%), healthcare and biotechnology (25%) with the remainder in materials science, electronics and services. During the 10 years since 1989, the Park has assisted 111 tenant companies which employ about 900 people. To place the ORP's activities in some

perspective, typically between 3,500 and 4,000 new companies start up in the Oslo area each year, though few of these are technology companies.

A larger number of companies assisted by ORPL are located outside the building and they make use of the Park's post boxes and address, as well as facilities including FAX, modem, receptionist and meeting rooms. Some of the companies have access to the applied research institutes in the building or nearby.

### *Start-up Companies in the Park*

On an annual basis, ORPL receives 75 disclosures of business ideas. Although about 1/3 of these are of interest to the Park, financial limitations mean it is able to help on average only 10-15 of these companies become established.

Companies and entrepreneurs seeking entry to the Park are typically working in one of the local higher education or applied research institutions. Before formal entry to the Park, the universities encourage staff wishing to investigate the commercial potential of ideas to work part time at the Park (usually with a fractional university salary) to develop a business plan and explore the market potential. Such support is considered worthwhile even if the would-be entrepreneur does not succeed, because he or she will act as an ambassador for commercialisation of science.

The process for determining formal entry to the Park seems rather ad hoc and is heavily based on the experience of ORPL management in nurturing startups in the Park. Significant factors considered include the appropriateness the entrepreneur and his business idea to the Park, his ability to pay the lease and utilise the expertise of the Park residents, the likelihood of the business' survival and the potential to add synergy to the Park's environment.

It is considered very difficult to generate formal diagnostics that will pick "winners", though the conclusion of a Battelle Report that the entrepreneur can explain 50% of the success of startup technology companies, the market 25%, and factors such as the technology, employees and company organisation, seem to be taken into account. ORPL's management is strongly

of the opinion that it is important to target enthusiastic, driven would-be entrepreneurs with strong business ideas because this creates a critical mass, excitement and a learning culture that helps to sustain creativity and determination in the face of the inevitable setbacks and difficulties in establishing a business.

With a view to encouraging resident companies to strive to earn income, the lease payments to ORPL are on commercial terms and become payable almost immediately on entry. Companies unable to pay are initially reviewed to determine the cause and ascertain the entrepreneur's commitment, the strength of the technology and whether the difficulties can be resolved. If deemed appropriate, some help will be given to surmount them. Of the 111 companies which have passed through the Park, only 3 were unable to meet their payments and had their tenancies terminated.

The Park's management adopts a neutral stance over the size of companies resident in the Park, relying on the cost of staying in the park being a sufficient inducement to leave. Space is provided on a uniform cost per sq metre (\$1700 pa) and small 1-2 person companies find residency in the Park cost effective because of the Park's infrastructure. Larger companies find it relatively expensive and tend to leave when they reach 5-6 employees. At this point, the Park finds they have their own brand name and like to develop their own culture.

The contract governing the lease arrangements is also used to define the responsibilities of ORPL and is considered a critical tool for managing the Park:

- Relevant information is collected at this point and the contract stipulates what and when additional information will be collected. This information forms a database which the incubator management mines to learn from his and the company's experience.
- Examination of the contract itself and performance of both parties at specified times provides an opportunity to negotiate different arrangements such as offices within the incubator, or for a termination of residence. The management considers proposed changes in terms of how they or the firm will add synergy to the

operation of the park. Continuing a firm's residence in a park is viewed in the context of whether it would be better to provide the opportunity for another firm to join the Park.

- The contracts are designed to create interactivity between the tenant and incubator. Notably, training provided by ORPL staff is supplemented by that of the experience and capabilities of other park residents.

### *Park Services to its Tenants*

ORPL employees 10 people who provide limited assistance in all the transactions the start up firm needs to undertake, from the research phase, to when it becomes an established firm. Being dependent on the revenue of the leases to support most of its activities, the ORPL can afford to engage few consultants to supplement the expertise of its own employees and is able to offer only occasional training. Use is made of volunteer services wherever possible and the Park is highly dependent on the personal networks of its employees to initiate this.

Services currently provided by ORPL centre on:

- support for conferences and publicity occasions that encourage the entrepreneurs to promote themselves and overcome their research culture of personal reticence;
- providing a neutral conduit for making contacts, particularly with venture capitalists and customers. The Park recognises that its companies' reputations benefit from association with the Park and endeavours to ensure that the credibility is maintained;
- marketing the Park and its residents to raise its profile in the research and business communities, with a view to increase the likelihood that business opportunities will be identified; and
- helping researchers with the process of licensing their technology.

Within the Park, entrepreneurs tend to form networks which provide assistance in the process of learning to build the companies as well as provide technical support and additional personnel for projects. Significant factors contributing to their formation include the Park's entry policy of seeking synergies with the current tenants, the physical layout and facilities of the building which encourage interactions, and the meetings arranged by the Park.

The ORPL is investing in an increasing proportion (now 20%) of the companies which have been resident in the Park. Guided by the investment experience of a Board member, the investments are on a commercial basis and are in the range \$17,000 to \$170,000, which turns out to be equivalent to between 5 and 35% of the total financing for those companies. Initially the Park did not take equity but it found that it became a better learning organisation because it was forced to make decisions with consequences.

The Park management monitors changes in the availability of venture capital from outside the Park and adjusts its policies to take account of significant changes. Notably, it detected a tendency to greater risk aversion starting in 1997, and consequently increased its propensity to invest in resident companies.

The Park has identified a number of additional activities it would like to support more extensively if more funding were available, including:

- the establishment of a good network of people in industry who could provide training on a volunteer basis, particularly in marketing;
- use of expert consultants under contract;
- meetings so that the companies can learn and make good contacts;
- financial support and an additional 10-15 offices which would be available for short periods (3 months for example) to provide potential entrepreneurs with the opportunity to work on his business plan, do marketing surveys, contact customers; and
- substantially upgraded communication infrastructure.

## Identifying and Commercialising Research and Ideas from the Research Sector

Norway considers obtaining better commercial outcomes from its science base to be critical to its future and a major issue is the lack of commercial culture in universities. ORPL undertakes a variety of outreach activities to bring about the change, starting with students, who are encouraged to visit the Park and undertake studies on it.

Other outreach activities target researchers' ideas and research outcomes with commercial potential. While patent rights in the applied research institutes belong to the organisations, researchers own the rights in universities and traditionally few patents are sought for university research outcomes. To address this, the Park uses several "spotters" (park employees and people under contract) to identify people and or projects of potential interest.

- To identify creative individuals and potential entrepreneurs, the ORPL and universities offer small prizes, advertise on internet pages, network extensively around the research organisations and offer incentives for expertise and equipment. These have induced a significant behaviour change and the researchers are now starting to identify the commercial potential of their ideas.
- The Park may offer to take an idea and make a business out of it, in return for incentives and/or contracts. A limited market survey is undertaken initially, followed by a business plan. Up to 200 hours of the Park's experts' time may be spent and the results are linked to the claims of any patents taken out for the innovation. After expenses for travelling, and contract development have been deducted, the profit on the final transaction is split equally between the researcher, the university and ORPL.
- An idea is exposed to strategic customers as early as possible because the interaction provides critical insight on the capability of the technology, highlights whether the patent needs to be adjusted and raises key challenges on what other customers might need. Resolving these issues may lead to other customers.

# Lessons for Australia

In view of the lack of commitment of Norwegian universities and colleges to commercialising research outcomes, the Norwegian experience of technology parks offers significant lessons for Australia:

- Establishment of a technology park can make a material difference to the success in commercialising public sector research outcomes and overcome a lack of academic expertise in commercialisation. The Norwegian model has been to run such parks as a commercial enterprises in their own right after some initial community investment. Although placing strong market drivers on the parks is generally beneficial, substantial community funding is needed if the parks are to offer sufficient management training services to would be entrepreneurs.
- Through judicious programs, the parks can also influence the culture of academic institutions. The Norwegians have used technology spotters, prizes and small grants to allow budding entrepreneurs the opportunity to explore the business potential of their ideas and research outcomes.

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