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*IPENZ Informatory Note Series*

# **The role of engineers in developing national wealth**

*Note One*

**December 2000**

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## What Is a Knowledge Economy?

A nation may be said to be worth what that nation produces. Whereas forty years ago New Zealand workers were amongst the most productive in the world, we now rank about twenty-fifth. Our productivity is about half that of the leading economic producers. This means that our society cannot allocate as much resource to education, or to fighting disease, poverty and potential disaster as can more wealthy nations, and this has social consequences that are unsatisfactory to us.

Sir Angus Tait, the well-known New Zealand entrepreneur and technologist, has stated, "No wealth is created until somebody makes something". As a nation we are slowly making the transition towards a "knowledge" or "post-industrial" economy which is very different in nature to either that of a commodity trader, or that of a classical industrial nation. The knowledge economy is more correctly the *"knowledge that others don't have and for which they are prepared to pay to access the benefits of"* economy. It is an economy based on generation of intellectual property (IP), primarily from creative efforts in the arts, science, technology and engineering, but also from national heritage, and realisation of that intellectual property in practical ways by making products or services for which there is an existing or potential need.

Post-industrial organisations have low reliance on physical assets, raw material supply pricing and physical asset management. They typically invest 5-10% of turnover in research and development (compared to the NZ average of about 0.3%), and they have governance and management who understand the basis of the IP so that it can be nurtured and exploited. Excellent business skills are vital to support but not control decision making in such organisations.

In the knowledge economy national borders are much less important than in other economies. Materials and services can be traded and accessed without requiring physical co-location. All labour-intensive manufacturing or assembly operations are carried out at the point of cheapest labour supply, provided the materials are

transportable, so only fragile or perishable materials are processed close to home. It is an age in which wealth creation is achieved first and foremost by intellect and by ingenuity.

## New Zealand's Capability to Be a Knowledge Economy

Our biologically-based industries will survive only whilst their products encompass IP that their competitors do not have. The dairy industry is an excellent illustration of an industry that invests in a market-led research strategy which it funds itself with low reliance on Government. It has its own human resource development strategy, and it moves on – to new factories housing new –technologies – readily and easily.

Knowledge-rich manufacturing exists, and will continue to exist in New Zealand where companies have identified niche markets, and invest heavily (5-10% of turnover) in what used to be termed "research and development" (now better described as seeking to create new knowledge for competitive advantage) to keep ahead of their international competitors. Turnover must often exceed \$1 million per employee for such organisations to survive. Their workforces are largely tertiary educated.

Even our service industries are increasingly becoming knowledge-based – we have well developed capability for science-based special effects in sports and entertainment, eg. the well publicised graphics used for America's Cup coverage. Thus we have a base, but it is still tenuous.

## The Need for National Policy Actions

Small nations elsewhere (Singapore, Ireland, Finland, Israel) have created national plans to build their knowledge economy. Drawing on their experience the most relevant actions for New Zealand are to:

- Develop the national plan starting in the national political leader's office, and involving strategic use of funds
- Set out to attract knowledge-based enterprises (enterprise transfer) by competing against other nations with offers of financial or other incentives (also known as "reverse taxation")

- Simplify the compliance issues in our economy so that as little as possible of the effort and resources is siphoned to supporting financial and legal functions, and money can be freed for more risky investments
- Make considerable investment in the right kinds of education
- Provide leadership to change national values so that the risk-taking entrepreneurial professions are as attractive for young people as the “safe” professions that distribute rather than create wealth
- Develop a research and development structure for industry that promotes technology transfer and increases private investment in, and hence local ownership of, our research outputs (which in turn will make the research we conduct increasingly relevant to wealth creation rather than just being good quality research).

*There is strong evidence from other economies of the need for policy change. In 1999 New Zealand was the most expensive place in the OECD (after tax) in which to undertake private research and development. According to the Information Technology Advisory Group’s “Knowledge Economy” paper (available at [www.knowledge.gen.nz](http://www.knowledge.gen.nz)), for a small to medium enterprise, it cost \$1.13 in New Zealand to produce an effective one dollar’s worth of research. In Italy it cost 41 cents after tax adjustments, and in Australia 89 cents.*

Ireland shows the effect of targeted policy for enterprise transfer. Incentives were created for trans-border corporations to build bases in Ireland. At the same time the Irish Government provided free education in professional engineering and technology to create a larger available workforce which could provide input for these companies. After working for these companies for a year or two, many of the knowledge workers left the imported enterprises and began their own businesses. Over 500 firms were assisted at start up by the Irish Government, thus creating a second generation “wealth wave”. Ireland now exports the equivalent of 68% of its GDP, compared with New Zealand at 35%. Enterprise

transfer differs from overseas investment because of the initial transfer of skilled knowledge workers into the target country.

The technical knowledge base of our population is a major (but not the only) human resource supporting wealth creation. The paper referenced above shows that this base comprises just 19 technical graduates (computer science, maths and engineering) per 1000 people in New Zealand compared with Australia at 66, Japan at 100 and Finland at 160.

According to Ministry of Education data, over 22% of formal programmes of study completed in 1997 in New Zealand comprised commercial and business courses, 10% each was in the humanities and education, whilst engineering was 3.9%. Where Sweden has six engineers, Japan four and Australia two in their population, we have one. In the 1990s we had the second highest concentration of both lawyers and accountants, illustrating our detailed compliance systems.

The market for more graduates will come from expanding the innovation “spend”, deflecting bright New Zealanders from seeking employment supporting complex compliance systems.

#### **Changes in National “Values” are Vital**

It is vital that Government continues to show its strong valuing of wealth-creating activities by long-term involvement of the most senior Cabinet Ministers in setting policy for such activities. These people, through their standing, will ensure the development of new attitudes in the wider community – that being an innovator, whether using scientific, engineering or artistic creativity, is something the whole country values.

At the moment our best brains shy away from the risks of entrepreneurial careers, seeking the safety net of other professions that do not earn for the country. Collectively we have a responsibility to change our attitudes so that parents advising their children consider encouraging them to start their own businesses exploiting home-

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developed intellectual property, and not necessarily seek a safe career employed by someone else.

Such actions will create the demand for education in wealth-creating disciplines, requiring resources to be moved away from the more compliance-related disciplines.

#### **National Policy Action Areas**

If we are to learn from the actions and mistakes of others, and take positive actions to build wealth creation in New Zealand, there needs to be a national plan, agreed with all political stakeholders by which we:

- Create an environment that fosters private sector research and development expenditure, drawing the benefits from the Government spend and ensuring that new IP can be smoothly transferred to organisations with the skill bases and investment resources to realise the benefits of the IP for New Zealanders
- Foster enterprise transfer to bring wealth-creating organisations to this country to conduct some of their business, but in a manner that is compatible with our social, environmental and sustainability goals
- Develop the spirit and values of entrepreneurship through our educational system, balancing it with social and environmental responsibility and general educational needs, but recognising that being well educated in itself is not enough to join the knowledge economy.

#### **The Role of Engineers and Technologists in Wealth Creation**

The knowledge economy requires skills in product and process development, teamwork, communication and project management. Tertiary educated engineers and technologists have a real advantage over other graduates – they are given skills in these areas, and, additionally, their education includes systems approaches. Thus they transfer well to project management roles, then, with some topping up of business skills, onto more senior management and strategy roles, and ultimately to governance in knowledge-based industries.

In the UK a survey of the top 100 countries in the Financial Times Stock Exchange Index showed that the

most common first degree amongst the 1000 directors of these companies was the engineering degree, held by 16.4% of those in governance. Fifteen percent had science degrees, 14.5% degrees in economics, 9.9% in history, and 9.9% in law.

Singapore has a population of 3.5 million people and produces 3,500 engineering graduates a year compared to New Zealand's 1000. Singapore has seen substantial growth with few natural resources. In 1999 about 50% of the cabinet were professional engineers. In 1982 Singapore's gross national product was USD15 billion whilst New Zealand's was USD25 billion. By 1996 New Zealand GNP had grown to USD57 billion (doubling the 1982 value) whilst Singapore had reached USD93 billion – a six-fold increase.

The 8000 engineers and technologists who are members of IPENZ have stated their availability to contribute for the nation. The engineers of New Zealand “built” our infrastructure in past years. Now they wish to contribute to building our national wealth-creating economy .

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