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**TURNING LOOSE THE INVISIBLE HAND:
NEW ZEALAND'S INFORMATION TECHNOLOGY POLICY**

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Executive Summary

Information technology (IT) policy in New Zealand has closely paralleled the broader economic policies which have prevailed in the country. Until the mid-1980s, economic policy was inward oriented, marked by high trade barriers and heavy government regulation. In 1984, the Labour government responded to a balance of payments crisis with a radical program of economic liberalization. By the end of the decade this process had fundamentally altered the New Zealand economy through deregulation, privatization, and public sector reform.

IT policy likewise moved from protectionism and centralized control to almost pure laissez faire. Tariffs on computer hardware were lowered from 40% to 10%. Government computing was moved from a central data processing bureau and placed under the control of individual departments. In terms of IT production, the government has refused to provide any significant incentives or subsidies to the fledgling software industry, feeling the industry should succeed or fail on its own.

Under laissez faire policies, New Zealand has become a heavy user of IT, ranking behind only Australia in the Asia-Pacific region for IT spending as a percent of GNP. It has also had some success as a producer and exporter of software. However, the hands off approach to the industry is likely to prove problematic in an international environment in which many countries have explicit strategies to improve their infrastructure for IT production and/or directly subsidize the industry. New Zealand is unlikely to become a hardware producer, but it has a number of endowments favoring software production, particularly its well-educated, English-speaking workforce. However, it faces obstacles such as a small domestic market, distance from international markets, and a shortage of venture capital. While software may be a potential growth industry in the ailing New Zealand economy, it is unclear whether the industry can thrive without at least some government support. Even the government now seems to be considering this possibility, and is considering the creation of an IT ministry.

Key words: New Zealand, IT infrastructure, IT policy, software industry, laissez faire, government computing

TURNING LOOSE THE INVISIBLE HAND: NEW ZEALAND'S INFORMATION TECHNOLOGY POLICY¹

I. INTRODUCTION

Information technology (IT)² policy in New Zealand has historically reflected the broader macroeconomic environment which has prevailed in the country. Before 1984, economic policy was heavily interventionist, with government ownership of many key industries in areas such as transportation, national resources, communications and real estate. Similarly, the IT sector was marked by government intervention in the form of protectionist import barriers and centralized control of government computing. In 1984, the Labour government of Prime Minister David Lange initiated a radical shift in economic policy dubbed "Rogernomics" after Finance Minister Roger Douglas, in which price controls were scrapped, tax shelters eliminated, tax rates lowered, subsidies to agriculture and industry cut and import barriers reduced. Also, state-owned enterprises were forced to compete in the market and eventually privatized, while many government departments were corporatized into state-owned commercial operations.

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²Information technology normally includes at least computers and telecommunications. In this analysis, we focus on computing and consider telecommunications as part of the infrastructure for computing. Similarly, we consider semiconductors, electronic components, and electronics generally as part of the industrial infrastructure of computing.

Policies toward the IT sector reflected these changes. In 1986 the Post Office, which had operated the telecommunications network, was eliminated and replaced with three state-owned enterprises. One of these, Telecom, was sold in 1990 to two U.S. regional telephone companies. During this period, new legislation was passed which deregulated the telecommunications sector, removing all monopoly privileges and opening all areas of operation to competition.

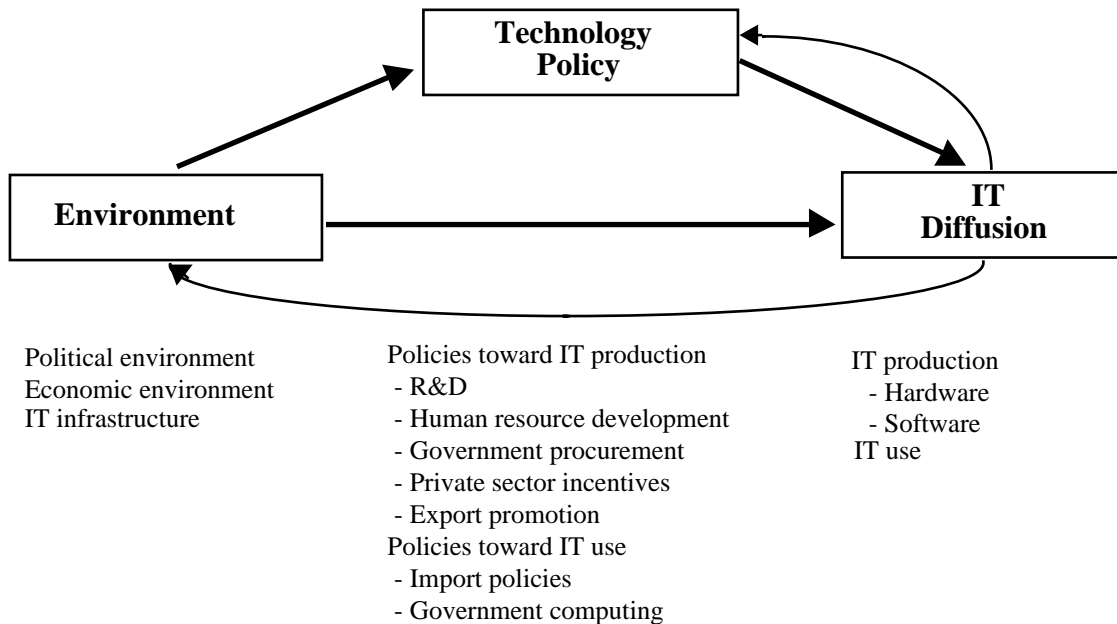
Within the computing sector, tariffs on computing equipment were dropped from 40% to 10% and all import license requirements were dropped. Government computing services were moved out from under the control of the Computer Services Division of the State Services Commission and managed in one of three ways. Some computer centers were corporatized into state-owned enterprises to be run like private corporations. Others were privatized, sold by the government to private corporations. Still others were left within their original ministries, but these ministries were themselves corporatized in their entirety, becoming state-owned enterprises.

In terms of government's relationship to the private sector, New Zealand presents a case of almost radical *laissez faire* policy. New Zealand followed the lead of the United States and Europe towards deregulation, and has shown no interest in developing any targeted industrial policies. Although the Labour Party was defeated in 1990, the new National Party government has promised a continuation of hands-off government. In fact, it has specifically stated its intention to not support the fledgling software industry with any government assistance, despite some calls from within the industry for it to do so. Given this strongly non-interventionist government approach to the IT sector, it is interesting to note that in 1988 New Zealand spent a higher percentage of its gross national product (GNP) on IT products and services than any other Asia-Pacific country except Australia (Kraemer, King & Gurbaxani, 1992). And while its few attempts to produce hardware have failed, its software industry has grown rapidly over the past decade. While its East Asian neighbors (and even Australia to an extent) are pursuing various government policies to promote computer use and production, New Zealand stands with Hong

Kong (Kraemer, Jarman & Dedrick, 1992) as cases of letting the "invisible hand" of the market determine the path of IT diffusion.

This paper analyzes the effects of government policy on the production and use of IT in New Zealand using an historical and quantitative approach. The framework used in the paper was developed for international comparative study of the globalization of the computer industry (Kraemer and Dedrick, 1991) and divides the analysis into three parts: environment, technology policy, and IT diffusion (see Figure 1). The framework posits that environmental factors constitute independent variables that affect technology diffusion in two ways: directly, and indirectly through the mediation of policy. In Figure 1, the bold straight lines represent direct, immediate effects, while the thin curved lines refer to feedback effects.

Figure 1. Model for Analysis



Section II of the paper provides an overview of the country's political and economic environments, and the quality of infrastructure needed to support IT production and use. Section III analyzes New Zealand's policies toward the production and use of IT. Section IV reviews the

historical development of computing in New Zealand, and the nature of IT production and use in the country today. Section V summarizes the analysis and draws implications for other countries.

II. ENVIRONMENT

The development of any economic sector is greatly affected by the political and economic environment in a country. This has been particularly true in the development of IT in New Zealand.

Political Environment

New Zealand is a parliamentary monarchy, governed by a unicameral House of Representatives of 97 members directly elected on a plurality basis for a three year term. The head of state is Queen Elizabeth II, who is represented in New Zealand by the governor general. The government is run by Cabinet, which is headed by the prime minister (EIU, 1990). The current government is controlled by the National Party, led by Prime Minister James Bolger. Political power in New Zealand has been dominated by two parties, Labour and National, for decades without any real threats to the democratic system. The country is considered one of the most politically stable in the Pacific Rim (*The Asia Letter*, 1986).

New Zealand's small population and its centralized system of government contrasts with Australia, which has a two chamber parliament and a federal system of government with strong state governments competing for power. This difference should make it easier for the central government in New Zealand to design and implement coherent economic and industrial policies. In fact, the Labour Party concentrated economic policymaking in the hands of a few members of the inner cabinet in order to carry out a radical reform of the economy in the 1980s, as will be discussed below (Schwartz, 1991)

The population of New Zealand is just 3.3 million. The people are predominantly of European descent, but about 8.6% are native Maoris and about 2.9% are Pacific Islanders or other non-Europeans. New Zealand has a strong egalitarian culture, although the long economic decline of the past 20 years has increased the gaps between rich and poor. Maoris are still behind Europeans in indicators such as education, income, and health levels. In 1971, the per capital

income of Maoris was 53% that of non-Maoris, due mainly to the concentration of Maoris in lower income occupations (Gould, 1982).

Economic Environment

In the years after World War II, New Zealand rode the crest of strong worldwide economic growth, benefiting from its favored trade relationship with the United Kingdom and from strong demand for its major export, wool. By the 1950s, New Zealand ranked eighth in the world in per capita income. During that time, prosperity was the normal condition, and a generous social welfare system helped create a highly egalitarian society (Dordick, 1989).

However, beginning in the early 1970s, New Zealand entered such an extended period of economic stagnation that its per capita income of US\$10,832 now ranks only 23rd in the world, even behind recent upstarts, Singapore and Hong Kong (New Zealand Trade Development Board, 1990). While its Asian neighbors were rapidly industrializing and selling manufactured products to the world, New Zealand followed an inward oriented industrial policy with heavy protection for domestic manufacturing and subsidies for agriculture.

Government intervention in the economy was extensive and expensive. Until 1984, New Zealand had the highest tariff rates on manufactured goods in the Organization for Economic Cooperation and Development (OECD) and was the only developed country to maintain a comprehensive system of quantity controls on imports (OECD, 1989a). These trade barriers helped create inefficient industries serving a domestic market much too small to achieve economies of scale in production. Given a protected home market and a strong currency supported by agricultural exports, manufacturers did not have incentives to export. It is also argued that wages were too high for industry to be competitive internationally and the wage-fixing system was too rigid to adjust quickly to changing economic conditions (OECD 1989a).

The costs of these policies became obvious the 1970s and early 1980s, when the government attempted to cushion the economy from the effects of two oil shocks and declining terms of trade (the ratio of the price of the country's exports to the price of its imports) by running large budget deficits and a loose monetary policy. The fiscal deficit reached 9% of GNP by 1984 and real interest rates were often negative in the late 1970s and early 1980s. Inflation

averaged over 11% annually from 1980-87, and gross debt stood at 73% of GDP by 1985, with debt service accounting for 20% of government revenues (OECD 1989a).

The New Zealand economy had long been marked by state ownership of many productive activities, and this continued through the mid 1980s, when public sector commercial activities accounted for about 12% of GDP (OECD, 1989a). Those activities, which included telephone, postal and computing services, electricity, steel and petroleum production, and forestry and coal operations, were often substantial money losers and required subsidies which drained the government budget. Some of the biggest losers were the "Think Big" projects initiated by the Muldoon government in the early 1980s. These were mostly energy-based projects involving substantial government investment, based on the belief that world oil prices would continue to rise and make New Zealand's natural gas fields competitive. When oil prices fell, the government was left exposed to large losses. According to Easton (1989), the failure of "Think Big" helped discredit the notion of government as partner in commercial enterprises and opened the door for future commercialization of government enterprises.

The combination of unfavorable external conditions and questionable policy responses led to a long downturn in the New Zealand economy. GDP per capita growth averaged only 0.2% per year from 1974-84. Labor productivity actually declined at 0.7% and total factor productivity at 1.7% per year in the same years. The loose monetary and fiscal policies spurred domestic demand at the same time as export prices were falling, and the current external (trade) deficit rose to 9.5% of GDP by 1985. The twin deficits (fiscal and trade) were financed by external borrowing, and overseas debt rose from 20% of GDP in 1980 to 60% in 1984 (OECD 1989a).

In 1984, the Labour Party came to power and faced an immediate balance of payments crisis. Prime Minister David Lange and Finance Minister Roger Douglas responded first with monetary and fiscal adjustments to deal with the liquidity crisis. The New Zealand dollar was devalued by 20% to stem the outflow of foreign exchange. All controls on interest rates were revoked and the money supply was tightened. The next move was to liberalize financial markets

to allow easier adjustment to changing external conditions. In 1985, the New Zealand dollar was floated, and has floated cleanly since. Fiscal deficits were reduced through a combination of new taxes and cuts in subsidies.

Along with these macroeconomic moves, the government also embarked on a much more profound experiment in microeconomic restructuring. In a period of six years, the country was converted from one of the most regulated, protected, welfare-state economies in the western world into what one article dubbed "Adam Smith's Islands" (*Economist*, March 5, 1988). Major reforms were carried out in trade, financial and labor markets, as seen in Figure 2.

Figure 2. Economic Reforms of the Labour Government, 1984-1990

Financial Markets

- Removal of controls on international capital flows and domestic credit, 1984
- Removal of barriers to entry into banking, 1987

Wages and Prices

- Controls abolished, 1984
- Rents and energy prices deregulated, 1985-87

Labor Market

- Labor Relations Act to encourage decentralized bargaining and amalgamation of unions, 1987
- State Sector Act put public sector employment on comparable base to private sector, 1988
- Employers given right to initiate enterprise bargaining, 1990

Trade

- Export subsidies for agriculture and industry phased out, 1985-on
- Import licensing and quotas phased out in most industries, 1988
- Plans announced in 1990 to reduce most tariffs to 10% by 1996
- Free trade agreement signed with Australia

Regulation

- Trucking deregulated, airlines partially deregulated
- Deregulation of telecommunications, 1987

Taxes and Transfers

- Corporate taxes cut from 45% to 33%
 - Top personal rate cut from 66% to 33%
 - Flat 12.5% tax on goods and services (GST), abolition of indirect taxes
 - Increases in Social Welfare payments to low-income families
-

-Workers guaranteed \$70 more per week than welfare recipients (incentive to work)

Sources: OECD 1989a, and various articles

Public sector reforms

Equally sweeping changes were made in the public sector which the government felt was contributing to fiscal deficits and acting as a drag on economic productivity due to its size and inefficiency.

The first step taken was to separate the functions of government departments between regulatory and commercial activities. Regulatory and oversight activities remained within the department, while commercial activities were corporatized into state-owned enterprises (SOE). The enterprises thus formed included Government Property Services, Airways Corp., Forest Corp., Landcorp, New Zealand Post, the Post Office Bank, Electricorp, Telecom and Coalcorp (OECD 1989a). The Ministry of Works was transformed into the WORKS and Development Services Corporation. These enterprises, along with existing SOEs such as New Zealand Steel and Air New Zealand were driven to operate as profit-maximizing businesses. They were freed from civil service hiring practices and managers were given control over inputs, pricing and marketing decisions.

The SOEs were generally successful in improving productivity and lowering operating losses, often by large reductions in work force. By 1988, eight of the nine SOEs mentioned above were reported to be operating profitably (OECD 1989a). At first, the government only planned to take the process this far, but after re-election in 1987, the Labour Party announced a privatization plan aimed at reducing the large public debt. Through sales of assets, the government hoped to cut NZ\$14 billion off the total debt. This was to come about by applying proceeds of the sales to debt repayment and by reducing subsidies to enterprises still losing money. Some of the asset sales carried out are shown in Figure 3.

Figure 3. Sales of State Assets

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- Petrocorp, to Fletcher Challenge for NZ\$327 million
 - Development Finance Corporation, a merchant bank, to a consortium for NZ\$111.3 million
 - Health Computing Services, to Paxus Computer Services for NZ\$4.5 million
 - New Zealand Air, for NZ\$660 million to a consortium of foreign airlines
 - Telecom, to two Bell Regional holding companies, Ameritech and Bell Atlantic for US\$2.46 billion
 - The state's interest in three international airports
 - Post Office Bank Ltd., for NZ\$665 million
-

Source: OECD, 1989a, p.52 and various articles

Agencies and departments still within the government have also been forced to "rationalize" their operations. The Treasury Department and the relevant minister(s) set performance standards for each department and agency, based on past performance, comparison with other countries, and policy goals. Full-cost-recovery pricing for goods and services has been applied to various ministries and departments (including Agriculture and Fisheries, Conservation, Customs, Lands, Survey and Land Information) to cover part of operating costs and ostensibly to provide better services.

Outcomes of economic reforms

New Zealand has undergone a reform program which has fundamentally changed the economic system and removed a number of market distortions. However, the economic returns have been spotty at best. Fiscal deficits were virtually eliminated and the trade balance actually moved into a surplus in 1988. Inflation accelerated after price and wage controls were lifted, but came down to 5.7% in 1989. The real problems have been growth, which surged initially, but has been virtually nil since the 1987 stock market crash, and unemployment, which hit 9.9% in 1991 (PECC, 1991).

The record of the late 1980s and early 1990s is shown in Table 1.

Table 1. New Zealand's Economic Performance, 1985-1990

	1985	1986	1987	1988	1989	1990	1991
Real GDP growth (%)	3.5	-0.8	3.5	-1.4	1.2	0.4	-2.1
Inflation (%)	6.2	13.2	15.8	6.4	5.7	4.3	2.6
Unemployment (%)			5.0	7.4	9.9	10.6	
Current Account Balance (% of GDP)		-6.2	-5.5	-6.1	-1.0		

Sources: Economist Intelligence Unit, 1990 and 1992; New Zealand. Institute of Economic Research, 1990; PECC 1990, 1991a, and 1992.

The economic downturn accelerated in 1990, as the effects of the Persian Gulf crisis and the worldwide economic slowdown reached New Zealand. Despite soaring unemployment, there have been no efforts to spur growth through fiscal or monetary measures, due to budget considerations and fears of inflation. And the government has rejected calls by the Labour Party and the prime minister's own Enterprise Council for tax incentives to spur investment and R&D (EIU, 1992). Instead, the government is moving to reform the one area generally left alone by the Labour Party--labor regulation. Some observers (such as the conservative *Economist*, e.g. November 3, 1990) have claimed that Rogernomics did not go far enough, and that freeing up labor markets would be the key to igniting growth in New Zealand. The National Party is testing that hypothesis by dismantling the centralized wage-fixing system and allowing individual contracts between workers and employers.

It remains to be seen how much longer the government will wait for market forces to revitalize the economy, or how long voters will be patient in waiting for the benefits of *laissez faire* economics to be seen in growth and employment. A recovery began to take hold in 1992, but if it falters, pressure will increase greatly for a more active growth strategy.

IT Infrastructure

The production and use of information technologies requires the support of an infrastructure consisting of several key elements. For IT use, the requirements include a dependable power supply, an adequate telecommunications network, and skilled workers capable

of operating computer systems and adapting those systems to specific local needs. The production of IT products and services requires those factors, plus several others. One requirement is a pool of IT professionals such as computer programmers, systems analysts and electronics engineers. IT production also requires people skilled in production engineering, quality control, marketing, finance, and other manufacturing and management areas. Another requirement is the research and development capabilities to design new products and production processes and to apply existing technologies to new applications. It is also important to have complementary industries such as consumer and industrial electronics. Finally, for both production and use it is necessary to have financial markets capable of providing sufficient capital to support investment in IT.

Human resources

New Zealand's population is well educated at the basic level, with an adult literacy rate estimated at 99%. Having English as a native language is another advantage in working with information technology. Table 2 illustrates New Zealand's performance in several other human resource indicators compared to other countries in the region (UNDP, 1990).

Table 2. Human Resource Indicators for Selected Pacific Rim Nations

	Rate of Adult Literacy	Rate of Secondary Enrollment	Educational Expense as % of GNP	Number of Scientists and Engineers	Scientist and Engineers per 10,000 population
Australia	99%	96%	5.1	38,568	23.4
New Zealand	99	84	4.8	4,091	13.6
U.S.A.	96	99	5.3	949,200	39.5
Japan	99	97	5.0	416,850	33.8
Korea	99	95	4.9	63,115	14.9
Taiwan	n.a.	75	n.a.	25,612	18.1
Singapore	86	71	5.2	5,876	23.0
Hong Kong	88	69	n.a.	n.a.	n.a.

Malaysia	74	54	7.9	5,537	3.0
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Sources: UNDP, 1990; PECC, 1991b

New Zealand does well in terms of literacy, but is behind the other developed countries in terms of secondary enrollment and education expenditure. New Zealand is well behind the developed countries and even behind the newly-industrializing countries (NIC) in scientific and engineering capabilities. These facts suggest that New Zealand does have the human resources needed to support IT use (a fact born out by the high levels of IT investment in the country), but may lack the resources to support increased IT production. There are complaints that the quality of education has declined over the last 20 years, and that the country is educating too many lawyers and accountants and not enough engineers and agricultural specialists. Another complaint is that educational institutions do not train technical specialists in the latest technologies or provide the skills demanded by industry (Crocombe, Enright & Porter, 1991).

Science, technology, and R&D infrastructure

New Zealand's total research investment for 1990/91 is estimated at NZ\$324 million by government, NZ\$100 million by universities and NZ\$200 million by the business sector (M. Doig, personal correspondence, 1991). As a percentage of GDP, total R&D expenditures are relatively low, only half the level of South Korea and one-third the level of the United States and Japan, as illustrated in Table 3. Also, the majority (68%) of R&D in New Zealand is carried out by the public sector, with little private sector R&D activity present.

Table 3. R&D Spending and Personnel

Country		R&D as % of GDP	% of R&D by Public sector	% of R&D by Private sector
USA	('90)	2.70	44.0	51.0
Japan	('89)	2.91	18.6	81.3
Australia	('88-'89)	1.24	60.0	40.0
New Zealand	('89-'90)	0.94	68.0	32.0
Singapore	('88)	0.90	39.8	60.2
Korea	('89)	1.92	17.9	82.9

Taiwan	('88)	1.22	56.6	43.4
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Source: PECC, 1991b

Government R&D. The administration of government research funds changed dramatically in the 1990/91 fiscal year. Previously, each ministry had money allocated to it by Parliament for research, which it could spend as it chose. After a series of science reviews in the early 1980s, a Science and Technology Advisory Committee (STAC) was set up in 1987. STAC developed recommendations which served as the basis for the new science policy regime. These included: 1) separation of control over the areas of policy advice, funds allocation, and operational R&D; 2) competition among research units for funding; 3) creation of the Ministry of Research, Science and Technology (MoRST) and of an independent foundation to allocate funds; and 4) moving research agencies to a more commercial basis (MoRST, April 1990).

The MoRST and the Foundation for Research, Science and Technology were created in 1990, along with an Ad Hoc Cabinet Committee on Research, Science and Technology. The Ad Hoc Committee decides on the distribution of research funds according to broad categories of science "outputs." MoRST provides advice to the Ad Hoc Committee on national science priorities, and reviews and assesses research, science and technology activities and opportunities. The Foundation receives funds from Parliament, which it allocates to various "science providers" to carry out the research mandates of the Ad Hoc Committee. The Foundation will allocate all funding from 1992/93 on, including funds now allocated by the Ad Hoc Committee (M. Doig, personal correspondence, 1991). Foundation board members are not just scientists, but represent various public and private interests. Science providers include the Department of Scientific and Industrial Research (DSIR), various government departments, and other research bodies.

The key elements of the new regime are (MoRST, April 1990):

- Focus on outputs rather than inputs. The government "buys" science and technology from research organizations, rather than just providing funding.
- Contestable funding. Research units compete for contracts to provide these science outputs.

- Emphasis on the importance of partnership between private and public sectors.

The critical element of science policy in the new environment is the idea that government spending should be justifiable by some bottom-line measure. The move toward commercialization of research units means that the units must attract enough research contracts to support their operations. The government does not tell them how to manage their own operations (A. West, interview, 1990).

The government's allocation process has distributed science outputs into 40 categories based on economic or social outputs rather than by scientific categories as before. Thus, rather than allocating money to biology, chemistry or meteorology, funds are distributed by categories such as sheep production, electronics and instruments, information and communications, and urban and rural planning.

The total for research under the "output" allocation scheme was NZ\$255 million in 1990/91. This research is defined as "public good" research. The largest categories are listed in Table 4.

Table 4. Distribution of R&D Funds by Output

Output	Allocation (NZ\$ millions)
Horticulture	\$30.9
Forage Plants	22.3
Geological Structures and Processes	19.3
Sheep Production	16.6
Marine and Fresh Waters	16.5
Land Use, Flora and Fauna	13.6
Arable and other Plants	13.0

Source: MoRST, undated

As Table 4 indicates, New Zealand is still focusing largely on upgrading and adding value to its traditional primary sector activities through research and development. By comparison, but not shown in Table 4, Electronics and Instruments received NZ\$7.5 million, while Information and

Communications received just under NZ\$1 million. This amount is minuscule compared to the amounts being spent on IT-related R&D by the East Asian governments. For instance, Taiwan has announced a US\$6.9 billion five-year development plan for the information industry, with funding from the government and private industry (*IT Asia*, July 1992, p. 1).

The distribution of research funds to major departments and research units is shown in Table 5.

Table 5. Distribution of R&D Funds by Institution

Research Institution	Allocation (NZ\$ million)
DSIR	\$138.1
MAFTech (agriculture)	74.5
MOF (forestry)	21.7
Research Associates	12.9

Source: MoRST, undated

DSIR (Department of Scientific and Industrial Research) is New Zealand's flagship research organization, both in terms of funding and prestige. It operates units throughout the country, all connected by an electronic data interchange (EDI) network. Other important research centers are the universities and various research institutes. The latter tend to be "centers of excellence" whose output is targeted at specific industry sectors or disciplines. The government is restructuring the DSIR and the research divisions of Ministry of Agriculture and Fisheries (MAF), Ministry of Forestry (MOF) and the Meteorologic Service into ten "Crown Research Institutes" as of July 1, 1992 (M. Doig, personal correspondence, 1991).

Support for Private Sector R&D. New Zealand provides little support to private companies for R&D. Very few government research grants go to the private sector and there are no tax incentives for R&D. One exception is the Technology for Business Growth (TBG) committee, established in 1990 by the Foundation for Research, Science and Technology, which provides grants to companies for specific technology development projects. TBG funded 85 projects in its first year, 13 of which were computer-industry related. These 13 projects received

NZ\$1.56 million for an average of NZ\$120,000 per grant (Brown, 1991a). The low levels of private sector R&D and the lack of government policies to stimulate such efforts do not bode well for the future of New Zealand industry in world markets. This is especially true of an R&D-intensive industry such as IT.

Telecommunications

Until 1986, telecommunications services were provided by the Post Office, which was the monopoly provider of transmission, equipment and services. The Post Office was also one of the earliest and largest users of computers. However, the Post Office was also accused of being unresponsive to the needs of IT users in setting up networks (Dordick, 1989).

In 1977, the government set up a Communications Advisory Council (CAC) to advise the government on telecommunications matters. During the 1980s, the CAC issued several reports analyzing the state of telecommunications in New Zealand and how the existing system was affecting economic productivity. The CAC concluded that new technologies such as a packet-switched data transfer system, integrated services digital network (ISDN) services, videotext and viewdata had to be adopted to modernize the system (Dordick, 1989).

The monopoly role of the Post Office came to be seen more and more as an obstacle to IT use and in 1985, the New Zealand Computer Society (NZCS) carried out a review of telecommunications. Representing IT producers and users, the NZCS stated that the regulatory and monopoly powers of the Post Office could inhibit application of IT. The NZCS also encouraged the development of the Telecommunications Users Association of New Zealand (TUANZ) led by the major computer suppliers. The NZCS and TUANZ argued that the Post Office should be required to compete fairly, and not be allowed to set specifications unilaterally for network protocols (Dordick, 1989).

As the effects of Rogernomics and public sector reform reached the telecommunications sector, the changes soon went far beyond the suggestions of the NZCS or the CAC. In 1987, the State-Owned Enterprises Act went into effect, establishing nine state corporations. These included three spawned from the Post Office's commercial operations: New Zealand Post, Post

Office Bank, and Telecom. The Act stated that SOEs should operate under "competitive neutrality." Telecom was allowed to maintain its telecommunications network monopoly, but was exposed to competition in other areas. The Act required Telecom to operate on a commercial basis and seek to maximize profits, and required the government to pay the cost of unprofitable services, such as rural services, which it wished Telecom to provide (Dordick, 1989).

The Telecommunications Act of 1987 and the Telecommunications Amendment of 1988 completed the deregulation of telecommunications in New Zealand. The 1987 Act required that competitors be given access to the Telecom network through leased lines and set a timetable for the introduction of competition in the areas of telex services and residential wiring (October 1987), commercial wiring and telephones (May 1988), and PABXs (April 1989). The 1988 Amendment repealed all protection of the Telecom network and required Telecom to provide access to competitors for rights-of-way to all lands, including government land (Dordick, 1989).

As Dordick (1989) points out, during a period of 27 months (April 1987 through July 1989), telecommunications in New Zealand were "transformed from a traditional government PTT monopoly to the most deregulated telecommunications system in any developed nation."

After re-election in 1987, the Labour government went forward with the privatization of a number of state-owned enterprises. The largest was the 1990 sale of Telecom to two U.S. companies, Ameritech and Bell Atlantic, for US\$2.46 billion (Carnevale and Hilder, 1990). The company will operate in the generally free market environment already established, although there are several Acts of Parliament which put some limits on telecommunications services.

Deregulation is claimed by some to have led to substantial improvements in telecommunications services. Colin James (1990) reports that "long distance call costs have been halved, equipment has been modernized at breakneck speed and delays in installation services slashed from up to six weeks to a day or two." Telephone penetration is now 80 instruments per 100 population, a figure which is one of the highest in the world. Long distance calls cost a maximum of NZ\$.94 per minute domestically. Twelve value added network (VAN)

providers have sprung up since the outset of deregulation, leasing access to Telecom's network (P. Blain and A. Briscoe, interview, 1990). However, international calling rates are not under New Zealand's control, and at rates of NZ\$2.72 per minute to the United States, constitute a disadvantage to a nation so dependent on telecommunications as a link to the international economy.

Telecom is now also faced with a competing network being created by Clear Communications, a joint venture of MCI Communications, Bell Canada International, Todd Corporation, Television New Zealand and the Railways Corporation (*ITANZ Bulletin*, May/June 1990). Clear Communications operates microwave and fiber optic networks along railway rights-of-way, with links to MCI and AUSSAT for international transmission. Even more competitive is the customer premises equipment market, where 40 to 50 companies are competing with Telecom (P. Blain and A. Briscoe, interview).

Telecommunications technology is world class today in New Zealand. Ninety percent of the network was digital by the end of 1990, and a long-standing relationship with NEC has given Telecom access to NEC's latest technology. Electronic Data Interchange (EDI) is already in place, mainly for government uses such as the Tradegate system used by Customs for port management. Value-added services such as automated teller machine (ATM) networks, business networks, teletext, and electronic funds transfer point of purchase (EFTPOS) are offered by Telecom subsidiaries.

It appears that deregulation has had beneficial effects on the quality of telecommunications services. It is too early to judge the effects of privatization on the quality and cost of service, but it is believed by some observers that the new owners plan to use New Zealand as a testing ground for new technologies before introducing them in the U.S. If this is true, New Zealand should have access to state-of-the-art telecommunications equipment in the years to come. It is less clear what the long-term effects will be on prices and the quality of the overall system.

III. NEW ZEALAND IT POLICY

New Zealand has never had a formal IT strategy. In the 1970s and early 1980s, government policy followed the general pattern of trade protectionism. Barriers to IT use included import permit requirements and a 40% tariff on equipment. This was not really a case of an import substitution strategy, since New Zealand had almost no production capability in computer hardware. The reason for trade barriers in IT was probably the concern over trade deficits and the possible loss of jobs due to the application of IT (Kaiser, 1985).

After coming to power in 1984, the Labour government treated information technology as a capital input which could improve the efficiency and competitiveness of other sectors, and didn't worry about the sectoral trade balance. It did not made any significant efforts to promote IT production or use, preferring to let the market make such determinations, but did remove import permit requirements and lowered the import tax from 40% to 10%.

Policies Toward IT Production

R&D initiatives

The government has taken a limited role in IT research and development, except for some activities on the part of the Department of Scientific and Industrial Research (DSIR). However, one new source of government support has been the previously mentioned Technology for Business Growth (TBG) grants. One recipient, Hydra Software, developed a drainage modeling package which the company claims would have never gotten off the ground without TBG assistance, because the venture capital industry would not support software technology. Another recipient, Tait Electronics, has developed signal processing technology which it has successfully sold to Southeast Asian clients (Brown, 1991a).

One of the more interesting efforts at developing high-technology industries has been carried out by local government and the private sector in Christchurch, Canterbury, on New Zealand's South Island. The Canterbury Technology Park was developed as a site where high-tech companies could locate and interact with local academic and research institutions. The University of Canterbury has strong engineering and science faculties, with active research in

areas such as robotics. The local government wanted to create employment and worked with the Trust Bank of Canterbury and local business to develop the park. The principal success of the park was getting Unisys/LINC to locate its research and development facilities and its Cardinal Network there. Several other small high-tech firms have followed (Canterbury Technology Park, undated).

Also in the Christchurch area, Lincoln University created Lincoln International Inc. to tie together several local research organizations and commercialize their products. These organizations include a local DSIR unit, Lincoln University, the Agricultural Engineering Institute and MAF Technology. The Agricultural Engineering Institute and MAF Technology have started a subsidiary, AEI Software, which produces computer-assisted design packages for designing irrigation systems. Its two products, Turfcad and Irricad have been exported to Australia and the U.S. with help from the Trade Development Board's Individual Exporter Program (P. John, interview, 1990).

It would be an exaggeration to portray Christchurch as a beehive of high-tech activity, but the efforts of local government, academic institutions and business have created some interesting high-tech ventures in the area. It may be that in New Zealand, such institutions can fill some of the roles played by the central government in other countries to support IT and high-tech in general. To some extent, this was the case in Silicon Valley itself, where the efforts of Stanford University and the private sector were crucial to spawning the area's microelectronics industries. However, even there, support from the federal government for R&D and government procurement of IT products were absolutely vital to the early growth of the industry.

Human resource development

A comprehensive study of New Zealand's IT education capacity was carried out in 1991 by New Zealand Futures Trust (McVitty, 1991). The study found that overall, IT education was improving in the country, but that there needs to be closer cooperation between industry and educational institutions to keep curriculum up to date with changes in technology. The study called on the government to fund core training in IT from elementary to advanced education

levels, while also calling on the industry to support more scholarships and work-study programs in IT (Kaye, 1991). So far no specific government programs have been announced to upgrade IT education.

Export support

Another form of assistance available to IT producers has been the support of the Trade Development Board (TDB), which provides services to exporters through its overseas offices. The TDB has been especially helpful to some software exporters in their efforts to crack the U.S. market (P. John, interview, 1990). TDB also operates its own sophisticated network of computers linking all of its overseas offices.

Private sector incentives

A call for even stronger government action was made by industry spokesperson Trevor Eagle in a forum chaired by Prime Minister Jim Bolger. Eagle called on the government and industry to collaborate more on R&D projects aimed at developing products for export. He also called for mandatory local sourcing in government software contracts, and for incentives to keep software producers from moving offshore (Newman, 1991b). The Information Technology Association of New Zealand (ITANZ) has called for a government IT agency to coordinate government usage, particularly departmental adoption of government OSI profile (GOSIP).

The National government has so far generally insisted in maintaining a hands-off approach to the IT industry. For instance, Minister of Commerce Maurice Williamson has touted software as a new growth sector, but has refused to consider any government promotion for the industry. And Minister of Commerce and Overseas Trade, Philip Burdon has stated that the government "cannot and will not provide a funding base for exporting software or technology." He has, however, continued funding the Trade Development Board, despite rumors that it would be dismantled. Burdon also said that the government would concentrate on developing infrastructure and promoting computer literacy, rather than directly subsidizing IT (Newman, 1991a).

Government procurement

In one break from its free market stance, the government has given its support to a "buy New Zealand" policy and established an Industrial Supply Office (ISO) in the Ministry of Commerce. The ISO will keep records of New Zealand products relevant to government departments' needs. The Ministry of Commerce has also published a booklet for circulation to all government departments titled "Government Purchasing Guidelines—An Opportunity for Local Industry" (Kaye, 1991).

Review of IT production capabilities

In 1990, the Trade Development Board sponsored a team of researchers under the direction of Michael Porter of Harvard Business School to apply Porter's theories of the competitive advantages of nations (Porter, 1990) to New Zealand. One area where the team identified New Zealand as having a possible competitive advantage was in software production. The team's report (Crocombe, Enright & Porter, 1991) noted the existence of positive factors such as "Kiwi ingenuity," reasonable technical skills, the presence of major hardware vendors and pockets of sophisticated demand by some competitive industries, such as agriculture. It also pointed out liabilities such as limited marketing and business skills, poor IT education in the universities, and limited risk capital.

The project points out that the companies have sufficient technical expertise, although they are not developing it themselves; rather they generally hire people with experience in the computer industry, either with manufacturers, bureaus, or offshore companies. The lack of linkages between universities and software companies was cited as a cause for the lack of direct hiring of university graduates. The education system is not considered responsive to the needs of industry, and graduates often do not have the skills needed by employers in the software industry.

Perhaps the biggest problem faced by the industry is the lack of venture capital, a fundamental need for the start-up and growth phases of software companies. Banks are uncomfortable lending to companies without hard assets or a positive cash flow (Crocombe, Enright & Porter, 1991). The Development Finance Corporation (DFC) once served as a source

of venture capital, but with financial deregulation in the 1980s, it got involved in commercial banking and suffered large losses (R. Henry, interview). The fledgling venture capital industry was wiped out by the stock market crash of 1987, and since then, there has been almost no venture capital available. Independent software houses have tended to depend on the financial resources of their founders, a source which is rarely sufficient to get past the early start-up stages and survive the early years of negative cash flows common in this business.

Suggestions made to the software producers by the Porter project for improving competitiveness are shown in Figure 5.

Figure 5. Suggestions to Software Producers from Porter Project

- Better linkages with hardware vendors and educational institutions
 - Courses on software marketing and management
 - Liaisons with educational institutions for course development
 - An industry risk finance facility
 - Visits from offshore venture capitalists
 - Software Trading House
 - Improve industry and market information with an industry association data base
-

Source: Porter group, presentation to software industry, 1990

One outgrowth of the Porter project has been the creation of the Porter Software Development Taskgroup in 1991. The group's suggestions are aimed mainly at the industry itself, but there is an increasing clamor for more industry/government cooperation. For instance, the Taskgroup has supported a "buy New Zealand" policy for IT. Also, DSIR director general Mike Collins has called on the IT industry to take the initiative in identifying research priorities in IT and push for government support. He has announced his intention to establish a steering committee to look at creating an effective national R&D policy for IT. He says that this will fit with the Porter project report on upgrading New Zealand's competitive advantage (Brown, 1991b).

It is clear that while the government is giving some recognition to the potential of the IT sector, and the software industry in particular, it is not about to abandon its *laissez faire* approach

to economic policy. There are no plans even for policies common under generally conservative governments in other countries, such as tax breaks for R&D, or accelerated depreciation for IT investments. There certainly appears to be no possibility under the present government of an industrial policy such as those of Japan, Korea, or even Australia (Dedrick and Kraemer, under review), to target and support IT as a strategic industry.

Policies Toward IT Use

Private sector computing

Other than reducing imports on computers and office equipment, the government has made little if any effort to promote IT use in the private sector. There are no tax incentives or accelerated depreciation schemes to encourage IT investment, nor are there efforts to create public awareness of the value of IT, as in East Asian countries (Kraemer, King & Gurbaxani, 1992; Gurbaxani, et. al., 1990; Kraemer and Dedrick, 1992).

Government computing

Computers were first introduced to the New Zealand public sector in 1960 when the Treasury Department installed an IBM 650 Data Center. By 1969, nine departments had their own computer systems. The Treasury and Education Departments and the Department of Scientific and Industrial Research also operated computer bureaus which served a number of other agencies (Shailes, 1985).

In 1970, the Government Computer Center (GCC) was formed as an independent unit within the Department of Internal Affairs. GCC took over the Treasury and Education computers and acquired a new system as well. GCC provided computer services for most government departments and was subject to the policy control of the EDP Coordinating Committee, chaired by the Chairman of the State Services Commission (SSC). In June 1972, the SSC was given responsibility for the operation of the GCC as well as for policy control. The government established the Computer Services Division (CSD) within the SSC to carry out those missions. CSD was made responsible for most government data processing at that time. Its responsibilities included (Shailes, 1985):

- Advising the government on computing matters;
- Coordinating EDP in the public service through operation of the GCC, performing central purchasing activities, emphasizing strategic planning and maintaining adherence to a standard methodology for managing projects;

- Providing EDP services including full application, design and development skills, support services, and local and remote computing facilities.

Government computing was highly centralized under CSD's control, and departments who wished to operate their own system faced a tough fight with the government to get permission (T. Pohlen, interview). However, several departments did operate computer systems apart from CSD, including the Ministry of Defense, the Post Office, the Department of Health, the New Zealand Railways Corporation and the Ministry of Works and Development (Shailes, 1985). The latter operated the Vogel Computer Center, established in 1966, which did engineering and scientific work for other departments under contract to the SSC, as well as providing the parent ministry's computing services.

Government computing grew rapidly in the early 1980s. In 1979, government EDP spending totaled NZ\$1 million for 11 items, and by 1983, spending was up to NZ\$42 million on 212 items, plus another NZ\$10 million each for the Railways and the Post Office (T. Pohlen interview, 1990). As of 1985, the public sector overall employed about 3,000 data processing staff, one-fourth of the country's total.

Government IT policy in New Zealand was radically altered in the late 1980s, in keeping with the overall economic and administrative reforms of the time. As the reform process took place, government computing services were moved out from under the control of the CSD and organized into three types of arrangements.

1. Corporatized computing, where the government turned computer centers into state-owned enterprises, free from government personnel and procurement practices. The most important example of corporatized computing is Government Computing Services (GCS) which replaced the CSD. Originally formed in 1984 as a service bureau, GCS was made into a state-owned enterprise in 1988.

2. Privatized computing, where the government sold computer centers to private corporations. An example was the sale of the troubled Health Computing Services to Paxus Computer Services for NZ\$4.5 million.

3. Agency computing, where the government corporatized entire ministries and left their computer centers within the new corporation. The most notable example was the Ministry of Works, which was divided into two parts. The regulatory branch stayed in the government while the commercial activities were placed under control of the new WORKS Corporation. That corporation was composed of four subsidiaries including Vogel Computing. Vogel was finally sold to its managers in 1991 (A. Fletcher, correspondence, 1991).

Results of policy changes

Government agencies now have the choice of using GCS, buying their own equipment, or using a private bureau service. Decision making is decentralized, with no direction from above regarding IT choices. Each department has autonomy for choosing the means for achieving efficiency goals set by its Minister and the Treasury Department. Many see computerization as a means of increasing efficiency and effectiveness. Also, new requirements for accountability necessitate effective management information systems. For these reasons, proposals for investment in IT are likely to be approved by department managers.

Since deregulation, many departments have transferred their computing from large CSD-controlled systems to smaller in-house systems. Generally the new enterprises which replaced the old departments or agencies are separated into several operating divisions (such as the four divisions within WORKS Corporation). The tendency was for each division to set up its own separate computer system. However, the enterprises found that they had some common functions (e.g. payroll and accounting) which could be best carried out at a centralized location. In this case, one of the divisions might be given the task of coordinating those functions within its system and linking the divisions into a network for those functions only (T. Pohlen interview, 1990).

The role of personal computers has also increased and been upgraded. The new enterprises generally have smaller computer systems than the original department and they use PCs for load sharing to provide flexibility without carrying unnecessary central capacity. Also,

the demand for accountability and cost justification has led to the linking of PCs through a host computer to improve their effectiveness and make their productivity more measurable.

GCS has become the number two firm in the New Zealand IT market with NZ\$145.4 million in revenues in 1990/91, surpassed only by IBM with revenues of NZ\$265 million (Jackson, 1991b). In its first year as a separate enterprise (1988/89) it earned a remarkable 39% return on shareholders' funds after taxes. This was probably due to the rate structure inherited from the previous CSD regime which was based on CSD's position as a monopoly provider of services to a number of government agencies. In 1989/90, GCS lowered its rates and spent more on R&D, and its rate of return dropped to 18%, although sales rose from NZ\$96 million to NZ\$118.8 million (GCS, 1990).

GCS faced some serious problems in 1990, when it lost contracts with the Valuation Department for assessment of real estate and Inland Revenue for office automation. The company's strategy is now to aggressively market its services to the private sector, after initially concentrating on holding on to government customers. It emphasizes its commitment to Open Systems Interface (OSI) standards which enable it to connect a wide range of terminals and PCs through its Private Packet Switched Network (GCS, 1990). One observer noted that this might be a case of trying to turn a liability into an asset, since GCS inherited a jumble of hardware architectures from the government, including IBM and Unisys mainframes.

Vogel Computing has had a different experience since corporatization. It was supposed to compete for contracts with other government agencies, but got little business outside its parent WORKS Corporation. In 1991, Vogel was sold to three of its managers. The new Vogel Corporation is now a private sector company serving insurance, bank, and oil company clients and the Consultancy Services section of the WORKS Corporation. Vogel specializes in engineering, scientific and project management applications.

Government spending on IT grew rapidly in the 1980s, and is estimated at about NZ\$300-400 million in 1990 (M. Gustofson, interview, 1990). However, spending is likely to level off under the new government, which is cutting expenditures to reduce the budget deficit. Several

observers expect a period of consolidation, with efforts focusing on integration of PCs and mainframes to achieve greater efficiency and productivity with existing hardware (T. Pohlen, A. Fletcher interviews, 1990).

It is also likely that more agencies will turn back to bureaus for at least some of their services. Competition for this business is becoming quite intense, as GCS and Vogel have been joined by hardware makers such as IBM, Fujitsu, and Unisys, as well as major accounting firms such as Arthur Andersen in the computing services market.

IV. HISTORICAL DEVELOPMENT OF COMPUTING IN NEW ZEALAND

IT Production

Hardware

Very little computer hardware is produced in New Zealand. A few specialized microcomputer-based products are produced and exported, including petrol pumps, electric fences, motor speed controls, microprocessor-controlled appliances and mobile radio systems. There is no local manufacture of computer systems, although in the past a few companies produced personal computers. However, there are some firms operating as "systems integrators," importing components and assembling them in New Zealand. According to a survey by International Research Bureau, 16% of the PC market was supplied by these companies in 1990 (Newman, 1991c).

Software and services

Software production has been growing rapidly since the mid-1980s, and is becoming a significant export product. Production has grown from less than NZ\$50 million in 1984 to NZ\$250 million in 1989. Exports grew even faster, from NZ\$7 million in 1984 to NZ\$90 million in 1989 (Compass Group, 1988a).

The software industry can be roughly divided into two groups of companies. The first group of about 30 larger firms accounts for 70% of industry revenue and 90% of exports, while

the second group of about 270 small firms accounts for the remaining 30% of revenues and 10% of exports (Crocombe, Enright & Porter, 1991). The large firms are generally allied with a major hardware producer or linked to a larger parent firm, while the small firms are generally independents.

The best-known local product is the LINC system, sold by Unisys, which owns the rights to the LINC software. LINC is a fourth generation software development language which allows business problems to be stated in business terms and converted automatically to the technical vocabulary of the computer. LINC's revenues totaled NZ\$22 million in 1989, all of which was from exports through Unisys (Crocombe, Enright & Porter, 1991). The present difficulties at Unisys may put LINC in a precarious situation, since its revenues come entirely through producing one product for Unisys hardware. LINC's parent company, Aoraki Corporation, has also established Cardinal Network, which offers data processing services based on the LINC software.

Another important software firm is AWA New Zealand, a subsidiary of AWA Australia. AWA produces agricultural applications in both packaged and customized forms as well as applications for horticultural processing, meat processing and produce packhouses. Many of these products have been developed in joint ventures with the Ministry of Agriculture and Fisheries (MAF), DSIR, and Alliance Meats (Crocombe, Enright & Porter, 1991). In 1990, AWA New Zealand was bought out by local management and has since exited some of its software activities.

A third important software producer is Fact International, a producer of manufacturing applications. Fact had sales of NZ\$16 million in 1990, 40% of which came from exports. Fact offers a fully integrated manufacturing, distribution and financial management system tailored to fit customers' needs. In 1990 Fact was taken over by Geac Corp. of Canada, but has maintained its New Zealand operations.

A major player in the New Zealand IT market is Paxus, an Australian-based firm which operates in both the software and services markets. Paxus provides software and bureau services

to insurance companies, running on IBM hardware. The software division of Paxus had sales of NZ\$61 million in 1990, with exports of NZ\$6.7 million (Crocombe, Enright & Porter, 1991). In 1988, Paxus purchased the New Zealand government's Health Computing Service for NZ\$4.5 million.

One element each of these companies has in common is one or more strategic alliances with a strong parent company, a major hardware manufacturer, or a major customer (including government agencies). This is often mentioned as a key to success for New Zealand software firms, given the limited local market, distance from foreign markets, and lack of venture capital to finance small producers. An example of a company that went the independent route and failed is Progeni, once the biggest and best known software producer in New Zealand.

Progeni, founded in the early 1970s, developed software generator tools, including PROGENI TOOLS, a program to improve the productivity of computer programmers (Kaiser, 1985; Bell, 1985). It also produced an IBM PC clone for a time. Progeni exported to the U.S., Australia and China and survived for 15 years until the Bank of New Zealand called in a NZ\$4 million loan and the company was forced into receivership in 1989 (F. March, interview, 1990). This illustrates the precarious position of small independent producers without strategic alliances.

Software production is seen as a potentially important industry for New Zealand. It has a well-educated, English-speaking work force. Its software developers are apparently of internationally competitive quality and it already has achieved some success in the field. It also has a wide diffusion of hardware and of information networks, and has sophisticated IT users in the agricultural, financial and some service sectors. Its disadvantages include distance from world markets, a small domestic market, lack of overseas marketing and other management skills, lack of venture capital supplies, and an overly decentralized industry structure.

As discussed above, the government has given some support to the industry, but its allegiance to *laissez faire* has prevented any major effort. Competing in a world where many countries are subsidizing their software industries, New Zealand will at least serve as an

interesting control case to compare various industry promotion strategies to one of non-intervention.

IT Use

The first important move into the information age in New Zealand's private sector occurred in 1963 with the introduction of the IBM 360 into a few companies. They were mostly used to substitute for clerical work in accounting. Lacking experience and skills in computer operation and information management, many companies had bad experiences with their first computers and ended up turning to bureaus for their computing needs. By the early 1970s, much of the country's private sector computing was concentrated in bureaus (mirroring the public sector).

Computerization of the banking industry began in earnest in 1967, driven by the switch to decimal currency conversion. IBM 360s were installed in the Bank of New Zealand's Wellington and Auckland offices at this time. Late in 1967 the banking consortium to become known as Databank Systems Limited was formed and by 1969, every branch of every trading bank in the country was linked to this jointly owned computer system supported by centers in Wellington, Auckland, Hamilton, Palmerston North, Christchurch and Dunedin (Archibald, 1985). In 1976, the Post Office Savings Bank commissioned an ICL-developed on-line branch banking system with some 600 teller terminals on line in 300 branches throughout New Zealand (D. Murphy, personal correspondence, 1991).

The diffusion of computing was hampered in the 1970s and early 1980s by a 40% import tax imposed on office machinery in 1975 by the Labour Government, which feared job losses due to automation (Bell, 1985). By the time of the introduction of IBM's PC in 1983, there was a large pent-up demand for computing in those businesses, and in 1984, the tax was reduced to 10% and foreign exchange controls were eliminated. This set off a buying spree as the personal computer gained acceptance and its use spread rapidly.

The New Zealand IT market totaled NZ\$1,216.9 million (or US\$730.2 million) in 1987, not including communications equipment, and NZ\$1,379.8 (US\$827.8) in 1988 (Compass

Group, 1988b and 1989; Kraemer, King & Gurbaxani 1992). The breakdown of the market by product classification in 1987 is shown in Table 6 (figures in NZ\$).

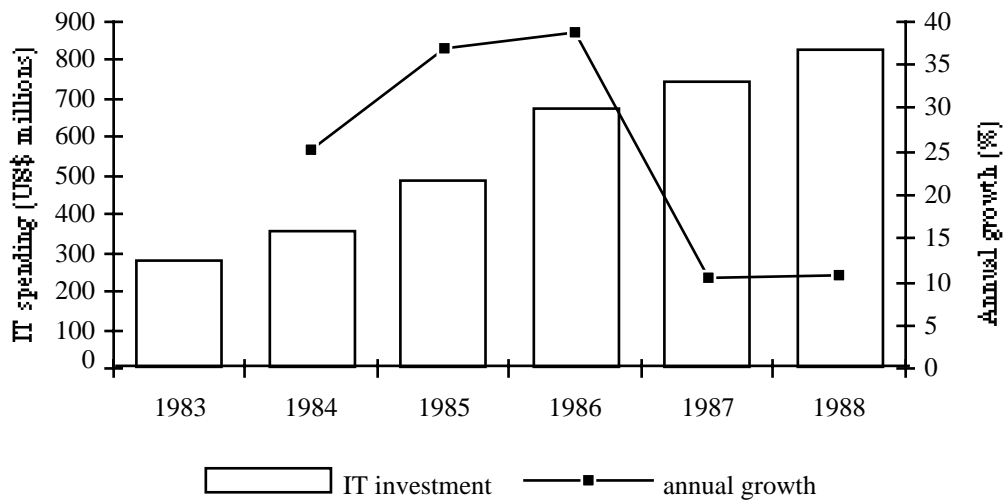
Table 6. New Zealand IT Market by Product Classification in NZ\$

Hardware	IT Market	Subtotal	Total
Systems over \$25,000	384.7		
Microcomputers and word processors	272.7		
Peripherals	176.7		
		834.1	
Software	164.3		
		164.3	
Services			
Bureau processing	119.8		
Hardware maintenance	98.7		
		218.5	
			1216.9

Source: Compass Group, 1988a,b

IT expenditures grew rapidly through the mid-1980s as shown in Figure 6. The compound annual growth rate of the New Zealand market (in constant 1982 U.S. dollars) from 1984-1988 was 19.4%, a figure which topped the Asia-Pacific region.

Figure 6. New Zealand IT Expenditures, 1983-1988



This rapid growth, especially from 1984 to 1986, illustrates, at least in part, the effects of lower tariffs on computers, and of broader policies such as the removal of foreign exchange controls. It suggests that such policy moves may have a greater impact than specific programs to promote IT use. Table 7 compares the compound annual growth rate of New Zealand with some of its neighbors.

Table 7. Growth Rates of IT Expenditures for Selected Pacific Rim Countries

Country	Compound Annual Percent Growth Rate of IT Expenditures, 1984-1988
New Zealand	19.4%
Australia	11.9
South Korea	10.8
Taiwan	10.8
Hong Kong	7.8
Singapore	3.8

Source: Kraemer, King and Gurbaxani, 1992.

To measure the degree of IT diffusion in a country, we use IT expenditures as a percentage of GDP. Here, as seen in Table 8, New Zealand was only second to Australia in 1987.

Table 8. IT Expenditures as Share of GDP for Asia-Pacific Countries

Country	IT Expenditure as % of GDP (1987)
Australia	2.84
New Zealand	2.34
Singapore	1.31
Hong Kong	1.11
South Korea	0.63
Taiwan	0.60

Source: Kraemer, King & Gurbaxani, 1992.

IT spending appears to have slowed considerably in 1991, as the effects of the economic recession began to hit the industry hard, especially on the hardware side. International Data Corporation (IDC) projected a 6% drop in hardware sales from 1990 levels, while software and services were expected to be up 10.7% (Jackson, 1991b).

IT use is considered an important means of increasing the competitiveness of other sectors of the economy. Applications have been developed to add value to New Zealand's already productive agricultural sector, and the banking, finance and tourist industries are considered sophisticated users of IT. The manufacturing sector was a slower starter, as its protected status gave it little incentive to improve productivity before the mid-1980s.

Agriculture. New Zealand's agricultural sector has used IT for a number of applications, such as: obtaining market information; grading of wool, meat, and produce to obtain higher prices for specialized products; planning and management of farm activities; and accounting. Application of IT has helped increase the productivity of New Zealand's most competitive sector. The fact that many farms are still served by party line telephone service has limited the spread of network technologies which might be very useful in providing timely information (Dordick, 1987).

A number of specialized software applications have been developed to serve the needs of New Zealand's farmers. The Kellogg Farm Management Unit was set up in 1980 at Lincoln University with a grant from the W.K. Kellogg Foundation to develop computer-based management aids for farm producers. Its most successful products are the Financial Recording System and the Livestock Recording System (Sheehan, 1990). Another example is the Fortex system of bar-coding each animal on the farm before shipping to allow identification of the meat right through to the supermarket according to its source and various characteristics (D. Murphy, personal correspondence). Other programs produced locally for use by New Zealand's farmers include Feedplan and Cashplan from Feedplan Systems, Cash Manager and Concept Stud Manager from Primesoft (Sheehan, 1990), and Kiwi-mod, a kiwifruit loading model from the

government's Levin Horticultural Research Center (*New Zealand Computer Interface*, October 1990).

Interestingly, in the agricultural sector, it is the collaboration of private sector software producers and users, government agencies, foundations, and academic institutions which has led to the production of sophisticated IT applications for local users. This sort of decentralized effort has helped spur the creation of a domestic software industry and improved the productivity of the agricultural sector through the use of IT. Some of New Zealand's agricultural management applications are already being exported to developing countries such as India. This experience suggests a model for supporting IT development which is market conforming and works by enhancing New Zealand's existing competitive advantages. As such, relatively small government investments can have maximum impact.

Manufacturing. A survey conducted by Bowie and Bollard (1987) found that in 1986, just over half of the manufacturers surveyed used microelectronics technologies in their manufacturing processes (process users), while only 12% made products incorporating microelectronics (product users). Between 1981 and 1986, the number of firms commencing product use was five times the number in the preceding five years, and the number of new process users was four times the number from the earlier period. Spending on IT by New Zealand manufacturers as a percentage of GDP in 1987 compared to its neighbors is shown in Table 9.

Table 9. IT Expenditures in Manufacturing

Country	IT expenditures for manufacturing as % of GDP
Australia	0.39
New Zealand	0.31
Singapore	0.31
South Korea	0.18
Taiwan	0.17

Source: Confidential

Products embodying computer technology are concentrated in the electrical, electronic, engineering, chemical, coal, rubber and petroleum industries. Firms employing IT for process applications are spread across the spectrum of the manufacturing industry. Among process users, 67% use microelectronics for control of individual machines, 51% for control of individual items, 21% for centralized machine control, and 22% for integrated process control. Equipment used includes programmable logic controllers (40% of process-users), computer-aided design (27%), machine controllers (21%), and computer numerically controlled machine tools (17%). Robots were used by 3%, but that was expected to increase to 12% by 1988 (Bowie and Bollard, 1987).

Services and finance. As in many countries, the banking and insurance industries have been leading users of IT. ATMs are widespread, and the wholesale and retail distribution channels are quite highly computerized. Bar coding is common in food retailing, and department stores use electronic cash registers linked to computerized inventory and accounting systems. At the wholesale level, one distributor has equipped each of its truck drivers with hand-held computers to record orders and call them in via data transmission over the telephone lines (D. Murphy, interview). The tourist industry is also a substantial user of IT, with computerized reservation systems used by travel agents, hotels, and airlines.

Networks. There are a number of data networks in place in New Zealand, in both the private and public sectors. Some of these are shown in Figure 7.

Figure 7. Private and Public Sector Data Networks

- Wanganui Computer Center and network: serves police, justice and traffic departments.
 - Databank network: linking trading banks
 - Government Computing network: Links Government Computing Center mainframes
 - Trustee Bank networks
 - New Zealand Bibliographic Network: links public, university and government libraries
 - Air New Zealand network
 - Fletcher Challenge: links operations of one of New Zealand's largest corporations
 - Kiwinet: an on-line database system for libraries and lawyers
 - Baynet: a business network similar to Dunn & Bradstreet's
 - E-mail networks:
 1. Universities
 2. Starnet: Telecom and freightways
 3. Lawnet: Lawyers' network
-

Sources: Dordick, 1989; H. Meehan interview, 1990

V. SUMMARY & IMPLICATIONS

While many former communist countries are now embracing free market economics and many developing countries are moving to liberalize their economies, New Zealand provides a case study of a country which has taken free market ideology to the extreme. The results so far have not been encouraging in terms of economic performance. However, most people interviewed in New Zealand agreed that many of the changes have been for the better, and that the old system of protectionism and extensive government ownership needed to be reformed. The question is whether New Zealand can succeed in the future depending on exports of primary products which have limited growth potential and which face market barriers in much of the world.

New Zealand has been attempting to remove distortions to the market and become as efficient as possible in producing its traditional agricultural products. It has succeeded in adding value through applied R&D and in some cases through the use of information technology.

However, it has no control over the international economy, and agriculture is heavily protected in the developed countries, while there is increasing competition from developing countries.

It may be that the only way to restore economic growth is by creating or enhancing New Zealand's competitive advantage in new industries such as software, which have high growth potential. However, creating competitive advantage has been successful mainly in Japan and the East Asian NICs, with the help of a good deal of government intervention. It is clear that so far, market forces alone are not sufficient to shift the economy towards higher growth, high value added industries. This is due to a number of reasons, including the risk involved in investing in new sectors, the often large initial investments required to make such a shift, the lack of workers with the skills and experience in the new industries, and the lack of access to critical technology.

Beyond these obstacles which are common to most countries entering high-tech industries, New Zealand faces some special problems of its own. These include the small domestic market and the distance from major foreign markets. There is also the problem that wages in New Zealand are higher than those of other countries at similar levels of economic development (Singapore and Hong Kong, for example). Also, New Zealand's history of primary goods exports and a protected domestic market have created conservative investors, firms and capital markets not oriented towards technology-based industries which require risky investments and high levels of R&D.

These problems are especially acute in the IT industry, which requires patient risk capital, access to leading edge technologies, and close ties to international markets. The best prospects for New Zealand in IT production are in specialty products developed for the domestic market which can be exported (such as products for agricultural users) and alliances with multinationals (such as the LINC-Unisys alliance). The software industry especially has shown good growth and fits New Zealand's existing industry structure of primarily small firms. Software production does not require the large investments and manufacturing capabilities required for hardware production, and thus can more easily surmount the limitations faced by New Zealand.

In a victory for free market champions, IBM's worldwide consulting group announced in 1992 that it would bypass Australia and Singapore and make New Zealand the distribution point for delivering new technologies to Asia. The choice of New Zealand was said to be due in part to the deregulation of the New Zealand economy (Jackson, 1992). This supports Minister of Commerce and Overseas Trade Philip Burdon's claim that, "There is evidence the technology industry can make it on its own without any special favours from government" (Newman, 1991a).

It is not clear whether enough multinationals will be lured to New Zealand to create a domestic IT industry, or whether New Zealand's own companies can succeed without support from the government to help overcome the problems discussed above. With so many Asian countries trying to attract multinational investment, it is hard to imagine a major inflow of capital in the IT sector in New Zealand. The government could support local producers by subsidizing venture capital funds, providing tax credits for private sector R&D, increasing overseas support to exporters, and increasing funding for IT education. The government could also shift some of its own research funds away from agriculture and toward IT, although it would undoubtedly have to buck some strong political forces to do so. While the government has rejected calls for such policies in the past, it is interesting to note that the creation of a new ministry of IT is now reportedly being considered by Minister of Communications Maurice Williamson (Kaye, 1992).

The IT sector will serve as a good barometer of the government's direction on industrial and technology policy, and of the results of that policy. It may be that allowing the free play of market forces will lead to the growth of a competitive IT industry. IT is also important for its application to other industries, and a return to protectionism would be undesirable, even for the purpose of nurturing the local IT industry. But it may turn out that without some government intervention, New Zealand will fail to develop an IT industry, or many other high growth industries, and will continue its long economic decline.

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