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**Celebrating Creativity:
Engineering in a Market Economy**

**Roger Kerr
EXECUTIVE DIRECTOR
NEW ZEALAND BUSINESS ROUNDTABLE**

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CELEBRATING CREATIVITY: ENGINEERING IN A MARKET ECONOMY

It is a much appreciated honour to be invited to present this lecture, and to be speaking to a profession whose activities lie so much at the heart of a modern market economy. Coming from an organisation representing business, in particular the major corporate sector, I confess to having some fellow feeling with the engineering profession. Engineers did not do too badly in the recent *National Business Review* poll of public respect for various professions; they received a middling score. If business people had been included, I suspect they would have come lower. But both groups can perhaps be justified in feeling somewhat undervalued by society at large.

It is characteristic of New Zealanders that we tend to really celebrate excellence only in the sporting and cultural fields. We are happy to honour people like Sir Peter Blake and Dame Kiri Te Kanawa and we should - their outstanding achievements deserve to be acclaimed. Yet in business, in science and in technology there appears to be much less willingness to celebrate - or even recognise - the fact that we have many people of world class standing in this country. Engineers are among them, yet how many members of the public know the names of our leading engineers? Have we got our priorities right when television announcers, talkback hosts and entertainers enjoy far higher public recognition?

The general image of the engineer is of a rather boring person, a dry-as-dust technician, whose activities are often enough a threat to the environment. That image is a travesty when one considers the sheer level of creativity involved in engineering. In many cultures, over many different periods of history, engineers have left technical wonders that impress us even today - from Roman aqueducts to the temples of pre-Columbian America. In most cases we can only guess at how highly valued in their own societies were the people whose technical knowledge made such feats possible.

But one important point should be remembered about those societies: most were not democracies, and the skills of the designers were not necessarily placed at the service of the people at large. The Egyptian Pharaoh, Cheops, might have wanted to build a pyramid bigger than those of his predecessors, but it is far from obvious that this vast undertaking was a good use of resources in ancient Egypt. And I doubt if Cheops put the matter to the test of a referendum.

Today, in contrast, we live in a world where technology is harnessed to supplying the needs and wants of our fellow citizens. Technology is at the service of a capitalist culture - which, despite all the attempts to deny it, is a fundamentally democratic culture. The last two centuries have been a time of material progress quite unprecedented in human history. For thousands of years, growth in living standards for the vast majority of people on earth had been either non-existent or extremely slow. Then, in the late eighteenth century, we embarked on an extraordinary period - in which we are still living - of sustained technological progress. One definition of an engineer is a person who uses the resources of nature to meet human needs. On that definition, engineers were at the very forefront of the industrial revolution.

It was no accident that this revolution started when and where it did. Late eighteenth century England was a society open to new ideas and willing to accommodate change. To the entrepreneurs of the time it offered a new and favourable

environment: relatively unrestricted trade, an established rule of law in which private property rights were becoming more secure and contracts could be made with confidence, and a high measure of political stability. The marriage of scientific advancement with the freedom and stable framework provided by a market economy made possible the industrial revolution - that huge burst of creative commercial endeavour of the past two centuries. Better machinery, better materials, better production techniques and better systems of distribution transformed the quality of life of millions.

I use the word 'creative' advisedly. The creativity of capitalism is too often undervalued, or even overlooked completely, by people who should know better. English historian Paul Johnson, who visited New Zealand recently, has put it well:

The titans of early industry did not see themselves - as they are often now presented - as the destroyers of beauty but as its creators. Bringing good wages to a family hitherto living at subsistence level was to them creative. To mark the fact they hired fine artists and designers to embellish mills and mines and forges. The passionate love of good, clean design which Thomas Telford put into his bridges and toll-houses, locks and road-furniture - much of which happily still survives - amounts to a major artistic achievement. And the first Stephenson, though illiterate until his son, who had been to school, taught him to read and write, took constant trouble to make his engines beautiful. But he also made his business pay, through hard headed entrepreneurial skills, knowing full well that any businessman who cannot meet his wage bill at the end of the week is no good to anyone.

No one argues for some kind of 'unfettered' capitalism. From the Enlightenment on, thinkers have affirmed the need for a proper set of rules to govern commerce, and a proper role for government. But if this century has taught us anything, it is that free and competitive markets beat planning and controls hands down when it comes to reducing poverty and creating wealth. An economic system is not an end in itself; it is a means of harnessing resources and human creativity in the service of people.

Johnson could equally well be referring to New Zealand when he laments that too often capitalism is presented by educators as a 'horribly materialistic activity characterised by greed and dishonesty'. The fact is that capitalism as an economic system is grounded in the creative powers of the mind, or 'caput.' As Johnson urges:

... we must develop the habit, at various levels of our society, and especially in our education process, of presenting capitalism as a creative activity, akin in its own way to writing symphonies or novels, or painting great landscapes.

In New Zealand in 1996 there is plenty to celebrate about the creativity of our market economy. The reforms of the past decade have transformed New Zealand from the basket case of 1984 into an open, dynamic and internationally competitive economy which faces the world with confidence. We can celebrate too, the quality of New Zealand engineering and some of its recent accomplishments. The work on the Sky City Casino and Tower, the upgrade of the Cook Strait HVDC link, and the successful stabilisation of the Clyde dam landslip are just three examples of world-class projects. All of them have been on time and budget - a far cry from many horror stories in the past. Internationally our engineers can - and increasingly do - compete with the best. Engineering consulting is now a big part of our export of services to many parts of the world.

And of course engineers are not just involved in infrastructure and construction activities - more and more they are part of the high technology production systems that are at the heart of a modern economy. In today's manufacturing and service industries, we depend on engineering skills to make the changes needed to keep us ahead in international competition. Generating new customer demand for meat, beer or electronic products requires continuous product and process innovation. The challenge for New Zealand management is to harness the technological and creative abilities of the new generation of engineers to produce the products and meet the quality standards which world markets demand.

We can take great satisfaction from the way in which the role of the engineer has been transformed with the economic reforms of the past 12 years. Prior to 1984, engineering was dominated by government departments which were an integral part of the inefficient and heavily-regulated economy that was old New Zealand. It is difficult for anyone under the age of about 30 to really visualise the difference between that era and New Zealand today.

Ours was a producer-driven economy - closer to an Eastern European model than any other country in the OECD. We were run from Wellington by the omnipresent hand of the central planner. And the planning was often of the crudest kind. Primitive economic assumptions were made, or none at all. Political decisions often dictated where resources would go, and which projects would get approval. Marginal seats often seemed to be more important for investment decisions than marginal costs and benefits. We built our own versions of the pyramid of Cheops - we gave them names like the Clyde dam and the think big energy projects.

Engineers were very much part of old New Zealand. In those days the Ministry of Works and Development was a central planning agency and a major construction business. An MWD roadman leaning on a shovel was one of our more potent national symbols. The Ministry had its model of where investment in New Zealand should go, and it sat at the head of the old town and country planning system. The Ministry was powerful, and widely respected for its engineering expertise. Other dominant players in the economy were the old New Zealand Electricity Department and the Post Office. Together these three departments and local authorities employed over half New Zealand's engineers.

Engineers thus played a major role in the command-and-build economy that was old New Zealand. Many worked on projects they knew to be of dubious value. If I have a criticism of the engineering profession of that time, it is that too few of its members raised questions about the sanity of the economic framework they were working in. There was a tendency simply to accept that framework as given, and get on with the technical job at hand. I need hardly add that engineers were far from the only people who could be put in the dock. Many economists who should have known better provided dismal policy advice, and some continue to do so, 12 years on.

One feature of the entire culture of old New Zealand was a tendency to believe that costs did not matter. The structures within which capable and well-intentioned people worked were not oriented towards costs and efficiency. Costs could so often be passed on to other parties, whether they were taxpayers, consumers or indeed other producers. Cost overruns were legion. Politicians embarked on non-viable projects for reasons such as employment creation. Of course they failed miserably in their endeavours because other sectors bore the costs, and their job-creating capability was stifled.

Since 1984 that landscape has changed enormously. The creation of the Electricity Corporation out of the old Electricity Department brought a much more commercial approach to electricity generation and transmission, while the corporatisation and downsizing of the Ministry of Works and Development has shown that a heavy central government presence is not needed for New Zealand's infrastructural needs to be met. The private sector is more than capable of meeting those requirements. Indeed, Works Corporation could easily be privatised, and would probably already be in private hands were it not, I gather, for the high redundancy costs which would apparently be incurred. I for one hope that the government still intends to see Works Corporation in the private sector, and that it has a plan to that end.

While we have made considerable progress in turning over to the private sector activities that rightly belong there, it would be wrong to imagine this process is complete. At the central government level, many assets that should be privatised remain in state hands. And local government, with a few exceptions, is further behind the play than central government.

The role of local government is more confined than that of central government: essentially it is to ensure an appropriate supply of local 'public goods'. Public goods are those goods which the community needs but which, for various reasons, it would not be profitable for private firms to supply under normal market conditions. It should not be the role of either central or local government to supply private goods, since they can be more efficiently produced by the market than by any bureaucracy. Yet local authorities still own and operate a large range of activities producing private goods - from ports to rental housing, and from forestry to rubbish collection. All of these activities belong in the private sector. Central government has rightly concluded that it does not need to own insurance companies, banks, airlines and a host of other businesses delivering private goods and services. The logic is no different for local government.

Even in the case of public goods, the proper role of local government is to ensure that the appropriate public goods are provided, and in sufficient quantities. It will not necessarily be the most efficient answer for local authorities to produce such goods themselves. More often, contracting out their provision will be the best option. While contracting out has increased in recent years, there remains scope for a great deal more. A recent report by the Industry Commission in Australia estimated that the economy-wide efficiency gains from wider use of competitive tendering and contracting in delivering government services could result in annual gains of between 0.3 and 1.7 percent of GDP. If comparable efficiency benefits were available in New Zealand, they could be worth as much as \$1.5 billion annually.

One major activity that is currently a local authority responsibility is the provision of water and waste water services. The value of the total assets of the water industry throughout New Zealand comes to around \$6 billion - greater than the network of Telecom, and roughly equivalent to our entire electricity transmission and distribution system. It is thus a far from insignificant industry, and poor use of its assets will impose large costs on New Zealanders.

At the moment, however, the water industry is operating well below its potential. A major study which CS First Boston undertook for the Business Roundtable has documented the problems. Water quality is low in some areas, even to the point of posing health hazards. During summer, water restrictions are common. Many pipelines are in poor condition, and water losses from pipelines are high by international standards. System failures can result in untreated effluent being

discharged into coastal waters. In water-short areas, water permits are sometimes assigned to low-valued uses. At the political level, decision-making processes can be stalled for years while major capital expenditure decisions are deferred. Some estimates suggest that around \$2 billion of new investment will be needed in the Auckland region alone over the next 20 years, and it is vital that sound and timely decisions are made.

Whether judged in terms of environmental outcomes or of cost-effectiveness, the water industry is underperforming. Given the way in which it is structured, however, we should not be surprised. There is very little incentive for local authorities to operate services in a cost effective manner. There is also little incentive for consumers to use water efficiently.

The CS First Boston study makes a number of recommendations, and their logic is hard to contest. It urges greater use of tradeable permits in water-short areas. It recommends corporatising water services and introducing marginal cost-based pricing for domestic consumers. The best place for the corporatised businesses would eventually be in the private sector, under a relatively light regulatory regime involving the Commerce Act 1986 and information disclosure requirements. Where local authorities did elect to retain ownership, franchising and contracting-out should be explored.

In the context of the post-1984 economic reforms, the concepts in the study break little new ground. They are standard, mainstream economics. Many in local government are now thinking on similar lines, although when they were first mooted the president of the Local Government Association described them as "nonsense". Some politicians are still pandering to populist and ideological pressures on these issues, and central government is not doing all it could to facilitate change. There is still resistance in many quarters to the idea that such services should have a commercial focus, and that proper pricing is needed if resources are to be used efficiently. Not too long ago those same ideas seemed radical for the electricity industry. A hundred reasons were being given as to why corporatisation of electricity supply would never work but it did, and virtually all New Zealanders have benefited. The test is not just lower costs and average real prices but reduced losses, greater reliability and a deferral of investment through vast improvements in system efficiency.

There is another instructive aspect to the water industry study: the implementation of its recommendations would have clear environmental benefits. It would lead to reduced wastage and lower consumption, through more efficient pricing and allocation mechanisms, and through the establishment of proper commercial objectives. Often good commercial policies are good environmental policies. Using market prices encourages the efficient use of resources; it also ensures - from the environmentalist's point of view - that resources are not over-used, because they are priced at their true market value.

This can also be seen when we consider the complex subject of roading reform. Our roading network is a huge asset, with a value recently estimated by the Ministry of Transport at \$25 billion or around 30 percent of annual GDP. Decisions on road design, operation and pricing have major impacts on business profitability, location decisions, city density, the environment and broader lifestyle choices. Given the existing institutional structure of our roading industry, there is no reason to believe that these decisions are currently being made with a high level of sophistication.

The management and operation of our roading network is shared between Transit New Zealand and local authorities. It is a highly bureaucratic system. Both Transit New Zealand and local authorities have limited information about consumer preferences and are subject to many pressures to take non-commercial decisions. The main use-related charges are the tax on petrol for cars and the system of road-user charges for heavier vehicles, which was a major innovation in its time. However, these pricing mechanisms are still very crude, and give poor information on consumers' willingness to pay for improvements to the roading system. For instance, it is possible that consumers might favour a situation where roads had a lower carrying capacity but the traffic volumes could be regulated by charging peak-time prices. Without the ability to charge directly for road use, however, there is no way of finding this out. Direct charges would allow consumer preferences to be revealed on congestion, safety, surface quality, gradients, bends and other features of a roading network.

Roading is a challenge because it has some monopoly characteristics and because of the transaction costs of more accurate charging systems. At present, technology is not sufficiently well developed to make direct charging for roads feasible in this country. That may soon change. A recent study of the options for roading reform, commissioned by the Business Roundtable, concluded that the appropriate technology for direct charging is fast developing. Various electronic billing systems are already in operation overseas. We can expect this technology to improve and to become cheaper. The study recommends moving to direct billing if and when this becomes feasible.

It also argues that roading reform should be focused on the corporatisation of the roading network, in conjunction with electronic billing. This would give those building and operating roads both the incentive and the means to maintain and expand the roading network in the most efficient manner. There would also be greater scope for private sector involvement, through franchising, shareholding, or build-own-operate schemes.

Corporatisation would not be a straightforward task. Some roads would confer a significant degree of monopoly power on an operator. Some rural roads would not be economic to maintain to their current standard, if operated by a profit maximiser imposing user charges. There would be a variety of options for dealing with such problems. The conclusion drawn by some that applying commercial principles would cause user charges to skyrocket is wrong. Charges should not be based on a backward-looking approach which aims to recover some predetermined return on past investments; they should be forward-looking and based on marginal costs. Given the success of corporatisation and more efficient pricing in rail transport, ports, electricity and telecommunications, there is every reason to expect better services at lower resource costs from applying the same approach to roading.

Both roading and water are examples of industries suffering from excessive politicisation in their institutional arrangements. Decisions are made centrally, which means they are subject to opportunistic lobbying by interest groups seeking favours at the expense of others, and to a political decision making process which will sometimes be slow and ponderous. When the process is stalled, bottlenecks can occur that are in nobody's interest. For example, it took an enormous length of time for the Wellington City Council to make a decision on a sewage treatment scheme for our capital city, and even so it is doubtful whether it got it right. While councillors dithered and argued, the environment and the needs of Wellington ratepayers suffered.

In market systems, those sorts of bottlenecks are much rarer. Markets have shown themselves capable of solving enormously complex problems. Because market transactions only take place if both parties to an exchange benefit, they are less divisive than winner-take-all political decisions. Their greatest strength is the freedom they give to creative people to come up with new ideas that benefit their fellow citizens. Yet people are sometimes reticent about defending the market. Nowhere is this more apparent than on environmental issues. Too often debates on the environment end up caricaturing the facts. Many lazily assume that economic development, and the advance of technology, are automatically bad for the environment - and even for people.

Sometimes trade-offs *do* need to be made between economic development and environmental concerns. We *do* need sound rules to ensure people face the full social costs of their private decisions - polluters should pay. There *are* some environmental problems that can't be dealt with by national governments alone and that warrant international cooperation. But it is quite wrong to believe that all economic development is bad for the environment, or that the limits of the natural environment place an upper limit on economic growth. It is also wrong to assume that trade-offs are always best resolved at the centre through political decision making. Such assumptions have repeatedly been demonstrated to be false.

We can already look back on a considerable history of environmental doom-mongering, very little of which has been substantiated by subsequent events. In Victorian England, many believed economic growth would grind to a halt because Britain would run out of natural resources like coal. Economic growth did continue, and the air in London today is cleaner than it was in the time of Dickens. In our own century there have been numerous predictions that the world was running out of resources or becoming uniformly more polluted. These too have been consistently contradicted by events.

The environmental doom-mongers have ignored human ingenuity and the potential for technological progress. There is no reason why technological progress cannot go on indefinitely, provided we preserve the features of our present culture that make it possible. Far from there being an automatic trade-off between development and the environment, the opposite is closer to the truth: more technologically-advanced countries tend to be those with the cleanest environments. Their technology can be applied to meeting environmental concerns. More affluent countries are also generally prepared to spend a greater proportion of their larger gross domestic product on ensuring a tolerable environment. Wealthier usually means cleaner.

These are very important truths, yet so often they get lost in environmental debates. These attract a disproportionate number of people purveying bad science, pseudo-science and just plain moonshine. Informed people with a less apocalyptic view of the world are often hesitant about getting involved in them because they are afraid of being painted as 'anti-green'. That is a shame. All of us in this room want a good environment; none of us is anti-environment. And we know that we need a public debate that is focused on the real issues and trade-offs, not one based on Greenpeace fiction. There is no need to capitulate and succumb to 'technical correctness' in the face of irrational argument.

For that reason, I believe engineers should stand up and be counted on environmental issues more often than they have done in the past. I for one would be interested in hearing more comment from groups such as IPENZ on issues like the Resource Management Act 1991 (RMA). This Act is still a young piece of legislation. Is it doing

the job required of it, or is it unnecessarily restricting legitimate development projects? I am told it might be very difficult if not impossible to obtain a resource consent to build Wellington airport today on its present site under the RMA. Given the alternatives, would that really be in the best interests of the country or the region? I have also heard it said that the Manapouri hydro development would be impossible under the Act. In the case of Manapouri, the government of the day - rightly in my view - bowed to pressure from environmentalists not to raise the lake as originally intended. The scheme that eventually went ahead was vastly more environmentally friendly. Manapouri today looks like any other South Island lake, and the hydro scheme is an impressive piece of technology in its own right. Is it true that the project in this form could not be constructed today, and how much national income would we sacrifice by blocking it? Without assets like Wellington airport and Manapouri, and many similar cases that come to mind, our standard of living would be vastly lower. If we don't keep building sensibly, future generations will suffer.

The public would also benefit from hearing engineers speak out on other issues. An example is the recent collapse of the Cave Creek viewing platform. It is a scandal that accountability for this tragedy has still not been sheeted home. The report of the Commission of Inquiry was a model of political correctness. "No individual or particular collection of individuals was singly or jointly responsible," it said. The system was to blame. Yet another judge has added to the New Zealand 'no fault' syndrome.

The fact is, however, that systems don't construct platforms, and the tragedy wasn't an act of God. The prime minister cut through the nonsense when he said that 20 dollars worth of bolts would have fixed the problem. He sounded a bit like Dan Quayle on the subject of Murphy Brown, but like Dan Quayle he was right. There is no excuse for such shoddy workmanship, nor do excuses about funding cut any ice. If funds weren't available to build a safe platform, it shouldn't have been built - full stop.

Clive Matthewson has said the real questions have not been asked, for example who was responsible for breaking the law with respect to the Building Act 1991, and why was there no system in place requiring the design and construction of the platform to be approved by a professional engineer? Ten months on, no one has been charged with a single breach of the law. What signal does that send to people? Why do we have rules about safety when they are not enforced, even in the event of extreme breaches with disastrous consequences? Particularly when safety procedures are difficult to monitor from the outside, liability should fall heavily on those inside who break the rules.

The State Services Commissioner has said that accountability in the public sector is not yet as rigorous as in the private sector. The proper response is: Why not? The State Services Commission has had more than six years to develop proper performance monitoring and appraisal systems for chief executives, as required by the State Sector Act 1988. Everyone knows its performance in this regard has been woeful. Cave Creek simply exposed to public view the flabbiness that is still all too common in many government departments. Under the legislation, the responsibility for Cave Creek does not primarily lie with the minister: it lies with the chief executive of the department and those down the line, and with the State Services Commissioner.

Your profession is uniquely qualified to comment on the engineering aspects of this episode. Professional bodies like IPENZ are especially well equipped for such a role.

I was pleased to see your executive director expressed similar views to mine. Mr Mitchell said in a statement:

A professional engineer involved in a structural failure of the Cave Creek type would have been subject to immediate disciplinary action which would almost certainly mean the loss of livelihood for the person concerned. Why should ministers or top management deem themselves to be immune from this?

These points need to be made again, and loudly.

More generally, all of us have a responsibility as professionals and private citizens to make a contribution to public affairs. With the end of collectivist systems and the advent of democratic capitalism, power and responsibility have become decentralised. As President Clinton has recently put it - although in his case expediency may have triumphed over conviction - "the era of big government is over." In New Zealand we risk going against the grain with the change to MMP, which gives more power to national political parties, but the trend toward less politics is probably irresistible. More and more people have come to appreciate the wisdom of Dr Johnson's verse:

How small, of all that human hearts endure,
That part which laws or kings can cause or cure.

What must replace big government is civil society, with people acting outside the political domain through institutions such as families, voluntary organisations, professional bodies and businesses. We need, so to speak, a thousand points of light. Engineers, at least in the private sector, have tended to be independent, robust, entrepreneurial people, not given to politicking or seeking government favours. They should be well placed to adapt to this environment and help the country move forward. I hope we will hear more from the profession in future, and that it will not shrink from standing up on controversial issues when the need arises. Criticism is the price one pays for challenging the shibboleths and sophistries of our time. There are worse fates.