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# Hopkins Lecture 1988

*Consulting Engineering Here and Abroad*



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[https://en.wikipedia.org/wiki/Ron\\_Carter\\_\(businessman\)](https://en.wikipedia.org/wiki/Ron_Carter_(businessman))

This copy of the Hopkins Lecture 1988 was given to Harry Hopkins son, David Hopkins, by Sir Ron Carter in December 2022 after a chance encounter.

## THE HOPKINS LECTURE

JULY 1988

### CONSULTING ENGINEERING HERE AND ABROAD

R P Carter

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We live in times of enormous change – the fundamentals of our economy have been re-examined and many altered. NZ of the future will be different to NZ of the past.

The annual Hopkins Lecture – in recognising the outstanding contribution to engineering made by Professor Hopkins – is intended to promote discussion by the profession and the public of engineering issues.

Recent lectures have dealt with economy, safety, the environment – still topical subjects. I have chosen as tonight's subject 'Consulting Engineering – Here and Abroad'. It seems timely to have a look at this vocation because recent events have decreed that henceforth it will have an enhanced role. This comes about as a direct consequence of the government's direction to former government engineering departments to pay their way – in short they have joined the ranks of the consulting engineer. In the future, works which were formerly, with due pride, seen to be the works of "Government" will now be the works of "consulting engineers".

Engineering is the art of applying knowledge, generally technical knowledge, and it is said to act at the interface between the philosopher and the artisan – between the perception of the need and the builder of the works is the engineer, is the consulting engineer.

He is an 'independent contractor' in a legal sense without affiliation to manufacturers, suppliers or contractors. He accepts as a professional obligation the need to recognise his own limitations, to act confidentially in his client's interests, to accept no other remuneration than the fee paid by his client. To carry out his engineering duties will often require him to have superior engineering judgement and scrupulous integrity.

In this address tonight I will endeavour to give an insight into significant aspects of the practice of consulting engineering, both here and abroad, and some of the changes and challenges that we currently face.

There isn't a person in this room that wouldn't relish the chance of making some change in his environment - albeit for a short while. I'm not saying you're dissatisfied with your lot - I know many of you are thinking to yourself - Not me - he doesn't know me - I'm as happy as Larry. But I'm not talking about major or permanent change, I'm talking more about the sort of thing I've just done.

Some years ago the partners in my firm, eyeing the academics and a few of our architect colleagues (who in their much more lucrative business could afford some REAL time off), decided we'd plan for some study leave. Not a year though - four weeks extra leave was what we came up with - that's enough for us, and not every seven years either, once every four years was our aim. So, being neither sabbatical nor lengthy we ended up with an extra long 'study holiday' once every four years.

I have just come back from mine and one experience I had has remained firmly in my mind. I think it is relevant to the way I approach my job and perhaps you will see its relevance to yours.

I was visiting Cambridge in England where, despite the increasing pressure of visitors, the authorities have made real improvements to the traffic circulation. It is now much easier to walk around those beautiful colleges and their precincts than it was twenty eight years before during my previous visit to that city.

Sections of the through roads have been limited for access to essential vehicles only and their surface repaved in concrete block slabs to create a pleasant scenic pedestrian environment. In the vicinity of Kings College – a bit nearer Clare College perhaps – the road surface changes from bitumen to concrete slab and there is a slight discontinuity of surface at this point. We three (my wife, my son and I) were walking in one direction and coming in the other was an electric powered wheel chair, the occupant of which was driving by means of a small joy stick. A helper accompanied him and walked close to the vehicle. The invalid was clearly very incapacitated. He was having difficulty in holding his head up and when the little car jolted across the join in the pavement the helper supported his head from the jarring effect. I felt grateful for my rather normal physical well being and, had it not been for a comment made by my son, the event would have passed unremembered. My son said "Do you know who the person in the wheel chair is?" – answer "No" – "He's recognised as one of the world's leading physicists – his name is Steven Hawking. He was on the campus at Berkeley recently to give three lectures. He believes that everything in the Universe can be explained so that it can be understood by an average mind. Apparently this person is so incapacitated that he speaks via a voice synthesiser and writes his speeches by a computer driven device that allows him to point to a word in a specially developed electronic vocabulary, the symbol is recognised by the machine and transformed into a spoken word. His only criticism of this incredible gadget is that it was built in the USA and speaks with an American accent."

I was then, and still am, astounded. There was a person so physically disabled, yet having not only superior intellect, but the energy and determination to convey his thoughts to the world. What has been so vividly emphasised to me by this man is the clear separation of thought from the physical. He is a leader through the power of his mind.

What is the relevance of this experience to my topic tonight? It is simply this – I wish to emphasise the importance of the thought processes in the establishment of any activity. What we create is first what we think we can achieve – then we must put it into action.

Someone once said to me that the difference between the human animal and others is that the human can think about what they think – perhaps that is so. It is certainly true that human beings are blessed with a wonderful gift in the power of thought and I believe that we can achieve so much more than we presently do if we discipline ourselves to think through our plans and our intentions before putting them into practice. Our ability to rationalise and to prejudge the consequence of our plans depends upon the quality and quantity of the experience upon which we draw. I trust that the perceptions I have of consulting engineering to some extent will add to the pool of ideas on which you can draw and will help those who either are already consultants or who aspire to join this sector of the engineering profession – or who merely wish to understand us better.

As a magnet attracts iron filings the works of ancient (and not so ancient) civilisations draw people to marvel at their building achievements. Those of us who make our living from design or construction gain extra value, for we see not only the wonder of the built works, we can also envisage the effort, the skill and the design ability that were combined in their creation – and it is

almost always a humbling experience. The scale of construction successfully undertaken hundreds and even thousands of years ago – be it irrigation, highways, temples, fortresses or churches, whether in Central America, Africa, Asia or Europe – demonstrates an order of thought and a discipline in design which can only have been achieved by a process of preplanning, communicated to those who carried out the work through drawings of some form. In other words, they were conceived in the mind of some talented, highly skilled and experienced person – in short they were thought about, they were designed and those designs were communicated by a process not very different from that which we use today.

And these works took years to construct, sometimes centuries – often the work of more than one designer and yet the persons who placed the first stone in the foundation or the keystone in the arch did so with the certainty of his fulfilment of the original designer's intention. He had been shown what was required.

Usually it is the name of those who ruled and who authorised construction that is remembered today. Perhaps Egyptologists know who Cheops asked to design his pyramid – I haven't seen it recorded but that person or those persons existed. The records which do applaud designers not surprisingly show that they were highly regarded "individual" experts such as Leonardo, Michaelangelo, Sir Christopher Wren, Isabard Brunel, Thomas Telford. Be they architect or engineer they were personally involved in their creations – they did it themselves – they were commissioned as individuals. They were generally unique in their ability and hence they enjoyed a certain degree of independence. They had the opportunity to decide what they wanted to work upon and for whom they wanted to work.

These persons were the forerunners of the independant design professions of today. In some respects they were the forerunners of consulting engineering.

Today, in contrast with the past, construction is for the population at large not just an occasional commission for a pharaoh or an emperor. A vast range of work of diverse character is carried out annually for a great variety of clients. All of these works must be conceived, designed and constructed and, as far as the first two of these tasks are concerned, the majority of world-wide engineering projects in civil and structural engineering are performed by firms of consulting engineers.

Hence there has arisen the vocation of consulting engineering which is now an international business of considerable scale. To give some dimensions to it, the Association of Consulting Engineers UK recently assessed the current annual world wide value of civil and structural projects as 50 billion dollars - (which incidentally, due to the reduction in the world economy, is only about half the value that was constructed in 1980). The overseas component of the fee income of British consultants, annually, was over 1 billion dollars in 1984. The UK is thought to be the second largest supplier of consulting engineering after the USA. Australian consulting engineers recently estimated their total gross fee income as about \$600 million. In New Zealand members of the Association of Consulting Engineers number 404 and employ 2500 staff. To these numbers must be added the many people who do not work for ACENZ members. This large group is dominated by the design divisions of the former government departments - Ministry of Works, Electricorp, New Zealand Post Office, etc. These latter groups, which are now charged with finding business in the private sector, have caused a sudden dramatic increase in the resources available from the ranks of New Zealand consulting engineers. How many of those resources will continue to find permanent employment in consulting engineering in New Zealand is hard to quantify, but it seems certain that the impact of the governments actions will result in significant redundancies in addition to those which have already occurred. The reasons for this are simple and are :



- . The government has perceived that New Zealand's infrastructure is at a stage where the amount of new work required is small and that maintenance of the present structure is the priority; ie government work has reduced.
- . There were perceived inefficiencies in the public sector which suggested fewer staff could do the same work. Privatisation is expected to effect this reduction.
- . The government will no longer support significant research or development programmes if these programmes cannot show a direct financial return.
- . Coupled with this was first the major down turn in industrial activity and now commercial activity.

As a countermeasure to the introduction of the public sector into the private market place, the government has also reduced its earlier requirements that departments of state must use the government's engineering agencies so that at least the private consultants now have some further opportunities available to them.

The scene is therefore one of reduced employment opportunities, coupled with increased numbers seeking the work that is available.

In time a balance will be achieved but not without pain. What is important is that the government adheres to the policy it has set, in particular to the time limits that it has set for a guaranteed flow of government business into the government owned engineering consultancies.

New Zealand is not alone in its endeavours to increase efficiency in the service sector. In fact many countries are well ahead of us – notably Britain and its European partners in the EEC. Like NZ, other countries are striving to reduce public debt and the private sector is being asked to play an increasing role. Even to the extent that in certain areas they are taking over responsibility for the provision of infrastructure – The most significant example nearby is the proposed Sydney Harbour tunnel which will operate as a toll facility.

These circumstances clearly lead to a situation of considerable change and, whilst I have witnessed a number of changed economic circumstances in the 30 years I have been involved in consulting, there has never been a situation as critical as we have right now. We are in tough and turbulent times – change is afoot but with change comes not only danger but also opportunity. Our first requirement is to manage change. Paradoxically, my perception of the prime requirement to manage change is to do so by a process which is, in itself, stable. In other words, to handle change it is necessary to have a well structured organisation which is both flexible in its ability to seize opportunities and proactive in the sense that it can anticipate what may be required of it in the future and can plan for it.

How then should we plan to improve the resilience of our consulting practices? There are three key areas to consider. We must be sure that we identify the full extent of the market for our services, next we may choose to diversify to be able to balance cyclic changes across a broader market base and further we must operate more effectively and efficiently to be the preferred source of engineering skill.

Before we can consider diversification, or even restructure for efficiency, we must understand who we are trying to serve. This must vary, as each consulting engineer will want and indeed must work in the area where he has special skills, creativity and flair. It seems most sensible for New Zealand engineers to look at areas where other NZ business effort will be directed, for example, if industry is looking to further processing of our raw materials, we must ask what steps should we follow to increase our level of skill in that business? What is our particular niche within that broad sector? We should see that the opportunities we seek and our resources will match. We must make sure that we understand the business target both professionally and personally. And because consulting engineering deals with subject matter than can't be touched until the service is complete, we must build up long term trusting relationships with our clients to generate the level of confidence on which that relationship will depend. It is important for us to learn how clients perceive our services and what service they would like us to provide. We should ask ourselves how can we improve their business.

Having identified our market, we must set about the task of matching our skills and resources to suit. If our aim is greater stability, diversity will help in achieving that goal, even if it is at the short term expense of profitability.

Diversity provides a great stabilising effect on any organisation working in a small market. The dilemma many New Zealand companies face is that their work requires a level of expertise that is world-class and yet they lack the continuity of work to keep the expert interested in his job and gainfully employed, especially if they confine their interest to a narrow field. Diversity in areas of operation within the market and in the regions in which one operates provides an answer to this problem provided that one has the depth of management needed to complement the complex business management structure implicit with diversity.

To operate a diverse business it is essential for a number of key principles to be followed. Each area of diverse skill must have its own market identified and its region of operation established. Each skill area will need to be led by a respected expert who will not only be responsible for the excellence of the technology but also for its marketing and its cost effectiveness. Keeping all facets of the business operating effectively, in a well directed and highly motivated fashion, it is a constant challenge – not to be underestimated.

It is likely that the common denominator for each of these activities will be a form of centralised financial and management control.

It is in the matter of diversity that one of the principal differences between New Zealand and overseas consulting engineering firms can be seen.

In contrast, firms abroad tend to focus their attention more upon a particular class of work, to become more experienced in depth but less adept in the breadth of the business opportunities available. New Zealand firms will often be more diverse in their experience but will often need to join with international firms where advanced technology is required.

In holding these views, I was encouraged quite recently to read two articles in overseas journals identifying the trend in consulting practice to be favouring the development of three distinct types of firm. Large firms with a diverse geographical base and a wide range of technical skills. Design subcontractors who turn out low cost detailed design for the large design consultancies and small specialist consulting firms which concentrate on particular technical skills.

Having assessed the market and decided on the extent of service we wish to offer, the third area of challenge for us is to improve our cost effectiveness.

Because the raw material with which consulting engineers work is information it follows that the more proficient in recording, storing and retrieving information we can become the more cost effective we will be.

On the subject of information I was interested to read recently of the work of Professor Stonier of the University of Bradford, who postulates that "If you know enough you can alter the path of human development". Stonier has addressed his mind to a wide range of topics including the future of civilisation and the economic development of the West.

The title of his recent book "The Wealth of Information" follows the title given to Adam Smith's fundamental work on economics written in 1776, "The Wealth of Nations". Stonier proposes that Britain must develop its economy by the use of "post-industrial thinking". Just as in Adam Smith's time Britain was moving from an agrarian to an industrial society, Stonier says Britain today is moving from an industrial to a post-industrial society. "Information", he says, "is the decisive commodity, displacing land, labour and capital as the most important input into modern productive systems".

Stonier equates information to wealth by postulating that wealth is created when a non-resource, knowledge, is converted into a resource, wealth, by transforming it into information.

Clearly, electronic data processing – the computer – can and does have a great part to play in the process. A computer can perform complex calculations in a manner hitherto not feasible and it can also process repetitive information much more rapidly and accurately than manual techniques. However, just as the tailor must cut his coat to suit the cloth, so must a consulting firm ensure that his utilisation of computers is appropriate to the scale and complexity of his business. In smaller offices with very diverse types of work the degree to which computers are used should be less than in very large companies with predominantly the same type of work. Hence we see a considerable difference between NZ and overseas firms in the speed at which computers are incorporated as office tools – particularly in the area of computer-aided design. CAD is unsuited to work which is not highly repetitive. Generally, insufficient repetition will occur on a single project to justify the considerable cost of installing a computer system and loading it with all the descriptive data of the project and the menus which are relevant to the type of work. As a result, the large overseas firms which specialise in a class of work make more use of the computer in design than is current in New Zealand where one-off work predominates. However, the increase in speed and the corresponding reduction in size and cost of computers is now resulting in the wider application of desk-top hardware in New Zealand and we are certainly well along the learning curve.

There is also an increasing capability of computers to be linked to one another and draw upon one another's data base and computing power. At present small computers located in New Zealand can generate tapes or discs for processing offshore. These advances allow New Zealand industries to have the benefit of close personal dialogue with New Zealand consultants whilst still having complex analyses prepared on more advanced software and hardware located offshore. Examples of this combination of local and foreign skills can be found in current work for the pulp and paper industry and the oil industry, to name just two.

Whilst the largest computers are generally beyond the capacity of New Zealand firms to own and operate, there is one key aspect of computer application well within New Zealand capabilities and that is in the development of software. New Zealand computer firms are winning offshore software development contracts. This is an area of potential work for New Zealand consulting engineers with ability and an interest in this technology.

In summary, New Zealand consulting firms must strive to keep abreast of the application of computer technology to their business with a concurrent requirement to use the techniques wherever they offer equivalent or improved economic advantage; that is their use must be cost effective. At present the commitment of 5% of turnover into computer development within a consulting firm would appear to be required.

The appropriate use of computers to more efficiently process information is just one way to improve our efficiency. There are others. Whilst demands for economic efficiency can sometimes give rise to a uniquely superior design solution with direct economic benefit to the owner, there is much more to be gained through the improvement of our skills in managing projects.

Although improved project management skill may not appear as glamorous as the development of a novel piece of engineering it is easy to be mistaken and think that such achievement will be easier to accomplish than the introduction of a technological advancement. In my experience this is not so – it is easy to take for granted the established systems of control into which a technological advancement is set; for example, to apply an advanced concept in concrete technology one can rely on a whole set of norms which control concrete and steel properties and workmanship standards. By comparison, the development and installation of new management techniques works, not with the measurable and predictable physical properties of materials and forces, but with the unpredictable

behaviour of people. It is this need to control the variables of human behaviour, together with the often complex inter-relationships of these variables which makes project management difficult.

Although project management is a topical subject it is one to which more lip service is given than action. There remains a dearth of people skilled in this area. I perceive project management as an area of intellectual involvement particularly suited to the knowledge and skills of consulting engineers and where much more can be done.

What are the arguments for consulting engineers taking a lead role in project management? Firstly, I acknowledge that a very diverse range of skills is required to manage a project from concept to commissioning. The four predominant skills are in finance, design, procurement and construction.

To see the niche that consulting engineers might fill it is useful to examine the fashion in which the industry is provided with those four basic services.

The consulting engineer typically provides the majority of the design engineering, some financial management, little, if any, construction management and some procurement.

The constructor provides some design engineering, some financial management, most, if not all, of the construction management and a large amount of the procurement.

The owner often provides some conceptual design engineering, much of the financial management, little, if any, construction management and often a part of the procurement.



If the skills of the these three parties are perfectly matched they will execute a project with maximum efficiency. The extent to which they mismatch will result in a waste of resources – waste of time, waste of money, waste of effort.

In recent years there has been a significant shift in the market towards "design and build" activities provided by constructors who will contract to provide all four services. This trend has not threatened architects and engineers to the extent that they originally feared as, for the most part, constructors have retained firms of architects and engineers for design. It has, however, diminished the role of owners with the attendant consequence of reducing the owner's opportunity to control standards. Design and build has rewarded constructors with better profits and removed from owners the benefit of competitively priced tenders in return for earlier completion – although this is not universally true. Because projects managed well by consulting engineers that possess the necessary skills can result in times which are just as short or even shorter than design and build, it is possible to offer an owner a third alternative. This third alternative is for the consulting engineer to provide a project management service as well as the design and supervision role.

In passing, I observe that this service is the one provided by most multinational contractors who have worked in New Zealand. This illustrates that there is an unfulfilled demand for local organisations with these skills.

Now to money –

– no description of consulting engineering can be considered complete without some comments on financial matters. First fees.

In these days of a free market economy perhaps it has been a blessing in disguise that consulting engineers have never had the market protection provided to other professions. Unlike many countries, New Zealand's laws and regulations have few restrictions as to who can practice the profession of engineering. Further we have seen most of the major projects in New Zealand designed offshore with the resultant slow progress in the development of the engineering skills which heavy industry requires. On top of this, with the enactment last year of the Commerce Bill, mandatory fee scales were made illegal.

Prior to the passing of the Commerce Bill consulting engineers were operating under a fee scale which allowed considerable flexibility in the determination of work scope and hence cost. At present the situation in regard to fees is unstable. This has been brought about by both the depressed economy and the advent of two large groups entering the market. I have already mentioned the efforts of the consulting division of the Works and Development Services Corporation and other government owned agencies. I also note that the surge in construction of commercial buildings in the major cities has brought some of the large Australian consultants to New Zealand. Both these entities are using the price freedom to win work. There is concern that the financial base available to these groups will be sufficient to enable them to survive for some time at fees which are less than the cost of performing the work.

A concern was also raised by A R Flint in the 1987 Hopkins Lecture -- he alerted the profession to the possibility of an increased safety risk due to under-engineered solutions when fees became too low.

But it is not only in the area of fees where consulting firms are under pressure. Changes are occurring in the composition and ownership of firms. A depressed world economy has caused governments and industry alike to eliminate waste and seek more efficient ways to work. Consulting work is seen by many major

industrial and financing organisations as a useful adjunct to their standard operations and a way to defray overheads. This trend, which has been apparent for at least twenty years, is prevalent abroad as well as in New Zealand. Our present government sees revenue from consulting as a way to reduce the cost burden of government departments.

In USA, Canada and Europe a number of engineering consultancies have been bought by investment companies and industries. In Germany and Switzerland banking houses own large civil consulting engineering practices. In Japan, Britain and France major transport operators work internationally as consultants on highway, railway and airport work. Their presence in the international market is very apparent. The reasons for this are many and are not purely to reduce overhead. On the contrary.

In almost all cases such organisations see consultancy as the entree to major investment or construction opportunity.

International consultancy can also have significant political benefit – for example East European government agencies are apparent in the Middle East and South East Asian market place and offer very attractive packages.

Because consulting commissions – successfully carried out – can reduce an overhead burden by using staff which might otherwise have insufficient work, we have a circumstance which encourages marginal costing and even fee dumping.

And, of course, earnings from consultancy can provide a welcome source of hard currency for some countries.

Despite these pressures, privately owned consulting engineers have maintained a wide degree of support in the market place for the independence of the advice they offer; the fact that they have no vested interest in the supply of plant or the construction of the work they design is accepted as a prerequisite of unbiased advice.

However, to maintain an international consultancy even on a relatively modest basis is expensive. The demand for capital is neverending and the profits from one year are quickly absorbed into funding next year's business development - international travel, the ever-more detailed proposals, demands for work done at risk, ie if the job does not proceed no fee is paid. These are all part of the international scenario.

Couple this pressure with the need for retiring owners of private firms to find a buyer for their shares in a business when most of the funds are locked up in the form of working capital, and there is created a great incentive for private consultants to bring in a passive investor. Generally, such an investor will have motives other than pure engineering for his involvement and I have mentioned many of these above.

Is there a trend? - Certainly, one can say that the entry of industry and governments into consultancy is not going to stop. But there are also examples of industry finding such businesses hard to run and management buy-outs have resulted in firms reverting to private ownership, albeit backed by bank financing. There are also examples of governments wishing to divest themselves of the consultancies they have created.

I have, in passing, referred to consulting engineering as an international activity. Is there a genuine potential for an increased volume of international consulting work coming to New Zealand firms? The answer to that is, in my opinion, a qualified yes. Certainly, the technology we employ in New Zealand and the

standard of engineering is able to compete. New Zealand has particular skill in finding elegant and simple solutions to projects of small scale. Against this it must be recognised that a number of other factors that make it difficult to win work. These include the desire by most developing countries to acquire their own skills in design and development - particularly for infrastructure which is an area where New Zealand engineers are very strong. Many western countries have large bilateral aid programmes which only provide work for their own nationals or the citizens of the recipient. Major industries tend to use consulting firms from their country of origin. In contrast to New Zealand, many of our competitors come from countries which do not tax the salaries of their staff when they are overseas for more than six months. These factors considerably restrict the market open to us.

To succeed abroad New Zealand firms must take time to understand the various cultures and the differing business arrangements which prevail. Typically, there is a need for more emphasis on trust, friendship and mutual confidence than in New Zealand and this takes time, on the spot, to achieve. This arises because many executives in developing countries are still relatively inexperienced in the use of detailed, explicitly written contracts but mostly they are very experienced in judging people. Hence they put more emphasis on this understanding.

Notwithstanding the difficulties in winning work, I see offshore activity as a worthwhile adjunct to a New Zealand practice. It can help modify the fluctuation of work volume that occurs when one relies on any one market; it provides staff with opportunities to travel and broaden their experience without them being lost from the firm; it gives experience in self reliance which is hard to replicate at home, and it can provide a source of foreign exchange to the benefit of the New Zealand economy.

As to the future, the vocation of consulting engineering will never be for the person who hesitates to face new problems or who fails to keep abreast of the best solutions developed elsewhere. We are fortunate to work in the area where international opinion expects the best opportunities for growth in the world economy – namely the application of high technology. Consulting engineers should participate in this growth.

Whilst consulting engineering will continue to be a very demanding occupation it also offers the satisfaction of a full and rewarding career.