# Development of an Electronic Industry

SLADE MEMORIAL LECTURE 1975
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## Introduction

I should begin by saying something about the man whose memory we honour. When Ralph Slade died, ten years ago, he was the Managing Director of the Electronic Development and Applications Company. He was born in Christchurch, and graduated from the University of Otago where he had worked under the late Professor Jack. Professor Jack was an early pioneer in radio in New Zealand, and his interest inspired the late Ralph Slade to undertake pioneering work in this area also. In 1924 Ralph Slade became the first amateur to transmit morse to England.

His working life began when he joined the New Zealand Post Office as a cadet; but after a few years in the Post Office he resigned to join the Philips Organisation where he spent the remaining 36 years of his life.

During the Second World War he was Director of Radio Production in the Ministry of Supply, and it will be common knowledge to this audience that during the War New Zealand produced some military sets which, at the time, were as good as any in the world. Some, indeed, were in use long after the War.

In 1954, and arising out of his devotion to the advancement of the electronics industry, Philips created a sister-company called the Electronics Development & Application Company (EDAC), and Ralph Slade was appointed as its first Managing Director - a post he held until his death 11 years later.

In addition to his business interests, he was a member of the N.Z. Electronics Institute, the New Zealand Amateur Radio Transmitters Association, the Manufacturers' Association, the Manufacturers' Research Committee, and was a member of the Council of the Department of Scientific and Industrial _ Research.

In addition to these and many other interests, he was also a member of the Technical Advisory Committee of the Dominion Physical Laboratory (now the Physics & Engineering Laboratory), and that is where I first met him. I cannot claim to have known him well because at that time I was a very junior member of staff; but I respected and looked up to him as a leader in the business world, and a leader in a very important field of technology.

That is a very brief history of a man who made a notable contribution to the development of the New Zealand Radio and Electronics industry. His premature death deprived New Zealand of someone who was making a very important contribution to our industrial development.

It would be nice to be able to say that, building on the foundations which he laid, the electronics industry blossomed after his death. Unfortunately, in my opinion, one cannot really say this. Certainly there has been notable development in the field of "consumer" electronics (radio, T.V., and record players); but the professional electronics industry which was, perhaps, Ralph Slade's special interest, has not prospered as I think he would have hoped.

There are however, some very encouraging signs of a resurgence of activity in this field, and the future holds some promise for further developments in this important area of industry.

**A Brief History of the Development of New Zealand Industry**

In the 19th Century (New Zealand's first century) the major activities within the country were farming, mining, and forest industries; and is not surprising that our first manufacturing industries were based on them. These early manufacturing industries supplied mainly food, clothing, building materials, and home furnishings; and they also supplied shipping with ropes and spars.

In the 1920's there was an expansion of the metal-working, furnishing, and clothing industries, and the beginnings of motor assembly.

During the Second World War the engineering industries made great progress as manufacturing industry was called on to meet the needs of war and to replace imports that could no longer be supplied from overseas. The radio and electronics industry played a very important part in the development. Military radios were produced that were equal to the best in the world. There is little doubt that we had some extremely good designers in this country at that time. New Zealand also played a significant part in the development and servicing of radar - an activity in which the Radio Development Laboratory of DSIR, and the N.Z. Post Office, played a leading part.

After the War we saw a further rapid development of New Zealand secondary industry as we embarked on a national policy of import replacement, and of the production of consumer durables. This was a period in which there was a high level of investment in industry, and many new enterprises were started.

In the 1960's - particularly in the late 1960's - there was a shift away from the policy of import replacement, and protection by import control and high tariffs, towards the development of industries orientated towards export.

Since 1969 the export of manufactured goods has been increasing at the rate of 27 % per annum (in money terms) and the export of forest products has been increasing at the rate of 14.6% per annum. In August 1974 export of manufactured goods (including Forest Products) reached 175 million dollars, and this year exports of manufactured goods will be in excess of 200 million dollars. The shift in emphasis towards export of manufactured products can be summarised in another way. In the decade from 1964 to 1974, the value of manufactured exports (including Forest Products) increased from 28 million to 260 million. The figure of 260 million for exports represents about $6^{0}10$ of the value of manufacture production. The view is now held in some quarters that about 20% of the output from manufacturing industry could be being exported by 1981/82; and if this happened the value of manufactured exports would be about equal in value to that of agriculture exports.

An increase in overseas earnings from manufactured exports is no longer desirable - it is **vital**.

The present situation with regard to the export of agricultural products persuades us that this is so. For example, in the meat industry we have in 1975 a situation where operations are no longer profitable for farmers and barely profitable for freezing companies. It would be difficult to exaggerate the importance of this industry to New Zealand. Of all New Zealand exports:

a) 40% of our export earnings come directly from the meat industry, and

b) with support to the dairy industry and wool industry the total directly, and indirectly, attributable to the meat industry accounts for almost three-quarters of our export earnings.

A brief look at the cost increases and returns on some of our meat products over the last six years (from the year 1969-70 to the year 1974-75) shows the following:

LAMB
Killing charges - up 225% in the six year period
Farmers' revenue - down 11%
EWE MUTTON
Killing charges - up 300%
Farmers' revenue - up 5%
BONER COW!
Killing charges - up 41%
Farmers' revenue down 54% (this latter figure applies only to the last 3 years of the 6 year period since there were changes in the grading system).
With the terms of trade so disastrously against us, we are presently having to borrow to sustain employment. It seems, therefore, that we must continue to broaden out export base. The establishment of manufacturing exports is therefore very important if we are to avoid wild fluctuations in terms of trade. If the electronics industry is to play its full share in our economic life it seems
(a) that, desirably, its Contribution should be export orientated
and/or
(b) at least some of our professional electronics effort should be aimed at improving the productivity of the primary products processing industries.

**Development of Electronics Internationally**
Before tackling the situation of the electronics industry in New Zealand, it might be useful to say something about the development of electronics internationally.
Perhaps the most notable thing about electronic advance in the last decade and a half, has been the very rapid rate of advance in this technology. The summary below will illustrate this:
1958/59
transistor began to displace vacuum tube
EARLY 1960's
Module block (transistors, resistors, and capacitors in a simple block designed for a specific function).
MID 1960'S
The development of electronic circuits on chips of silicon using alternating processes of masked etching and diffusion. The early integrated circuits were limited to a dozen leads or connections; but there has been rapid development since then.
TODAY (1975)
Chips can carry up to something like 20,000 components. There has been a steady increase in component density and a rapid advance in circuit organisation. For example, a recent micro processing, unit (0.21in x 0.217in) carries 5400 transistors.
To this audience one need not stress the rapidity of this advance. Electronics engineers will have had to cope with it in their professional lives.
From the point of view of this talk however, it highlights a serious problem from the point of view of the development of the electronics industry in New Zealand. The problem is this; "How can New Zealand research effort keep up with this tremendous rate of technological advance?". For myself, I think that in most areas of electronics components development, New Zealand cannot keep up because we do not have the manpower in research and development to match the rate of technological advance.

We can however, import electronic components and develop equipment for specialist applications; and in some areas, we can develop specialist construction skills - such as in the area of thick film micro-electronics technology.
Some suggestions for areas in which New Zealand might concentrate this development effort will be made at a later stage; but at this point I wish only to emphasise that the very rapid development of technology provides some serious problems for industry - not only technological problems, but financial problems as well.
Some of the consequences to a business enterprise which is in an area of rapidly developing technology are summarised below:

1.
In an area of rapid technology development, obsolescence of equipment proceeds at a much higher rate than in an area where technology is advancing slowly, and this increases the business risk due to rapid change in the market situation.

2.
To keep pace with a rapidly developing technology, new products must be through the development phase quickly in order to capture new markets before competing equipment erodes the market potential.

3.
A rapidly developing technology, new components, and new ways of doing things, mean that new possibilities present themselves at an amazing speed: Firms in this area must therefore have good access to the up-to-date situation and to the latest ideas and developments.

4.
In such a situation people with highly developed marketing skills are required to recognise, and to capitalize on, new marketing opportunities.

5.
In such a situation, companies require managers bold enough to seize new opportunities; and with extremely good judgement to select the right opportunities.

From the above listing, therefore, it will be readily appreciated that rapidly developing technology presents special problems for small companies - and all New Zealand companies are either small absolutely, or in the case of New Zealand subsidiaries of overseas companies, are only small local operations within big international companies.
The scale of research within New Zealand electronics industry is small absolutely, even though some companies plough back a considerable fraction of their sales income into research and development. For example, in one N.Z. electronics company development costs are about 12% of sales.
It seems to me, therefore, that if we are to succeed in this rapidly developing field, there has to be a close relationship between the R & D efforts of industry, government departments, and the universities. Our effort is too small to dissipate unproductivity.

**The "Supporting Services Infrastructure"**

Some of the disadvantages under which the electronics industry operates in New Zealand, have been given above. Manufacturing industry (of which electronics industry is part) does however, have the benefit of some valuable "support services" - services which are available to assist them produce better products, products which are produced more efficiently, and products which have been adequately tested. It is perhaps worth mentioning some of these briefly because they are there to assist the development of the electronics industry (as well as other sections), and in some instances the industry does not make as much use of them as it should.

Development Finance Corporation (DFC)
(Object: to provide finance for new industries and extension of existing ones)
- medium to long term loans
- reduced interest or interest-free suspensory loans for plant and machinery in export-orientated industries
- mortgages, bank overdraft and loan guarantees

Testing Laboratory Registration Council (TELARC)
(Object: to promote good measurement practices throughout the country)
- assessment and registration of laboratories
- directory of testing and calibration facilities
- assistance to achieve good laboratory practice and management

New Zealand Inventions Development Authority (IDA)
(Object: to promote the development of N.Z. inventions)
- advisory service on patenting
- technical and commercial assessments of patents - assistance with launching patented equipment
- financial assistant

Industrial Research & Development Grants Scheme (IRDGS)
(Object: to simulate research and development in New Zealand industry)
- cash grants based on salary, plant and miscellaneous research expenditure to firms undertaking eligible industrial research and development
- contract research let by firms to approved laboratories may also qualify for grants

N.Z. Industrial Design Council (NZIDC)
(Object: to promote good industrial design)
- information and advice on product and graphic design
- liaison between those who supply designer services and those who require them
- evaluation of products for the award of "Designmark" to well designed products

Productivity Centre (PROD.C.)
(Object: to improve the productivity of N.Z. industry)
- promotion of improved productivity in manufacturing and servicing industry
- advice on productivity improvement
- interfirm comparisons
- productivity groups
- productivity improvement teams

Consumer Institute (CONS.INST.)
(Object: to protect the consumer and promote good products)
- testing and evaluation of consumer goods and publication of results
- evaluation of services to the consumer - submission on consumer legislation
- information service to consumers - consumer complaints service

In discussing infrastructure services to assist manufacturing, the work of two government departments should also be mentioned. They are:

Department of Trade & Industry
Information, advice and assistance to manufacturing and servicing industry is available from the department on:
- opportunities and requirements for industrial expansion or development
- availability and cost of industrial land, power, labour, transport and other services
- availability and sources of supply of raw materials, components and finished goods
- government and private services available for assistance to industry
- price stabilisation and control regulations
- regulations concerning trade practices, consumer protection, monopolies, mergers and takeovers
- import licensing
- industry protection - productivity
- exporting and export incentives
- resource conservation
- industrial research and development grants
- regional development and regional development incentives

Department of Scientific & Industrial Research
Broadly speaking, the DSIR objective is to initiate, plan, and implement research calculated to promote the national interest of New Zealand.
It is Government policy for DSIR to encourage industrial development through co-operation with industry in the development of New Zealand resources, and in the manufacture of new products, designed and/or developed in New Zealand, and which may have export potential for commercial applications.
More specifically, DSIR helps industry by the following:
- advice to Government on specific technological matters
- research on natural resources and on methods of exploiting these resources
- introduction of new methods and new technologies to the New Zealand scene
- provision of national testing, calibration and analytical facilities and services
- with the proviso that DSIR should not undertake work that could satisfactorily be done by available private organisations
- scientific and technical advice to such bodies as the Inventions Development Authority, Consumer Council,' Design Council, Industrial Research & Development Grants' Act Committee, Testing Laboratory Registration Council, etc.
- research and special development programmes aimed at building up a pool of skill and knowledge in techniques, processes, and methods, of importance to industry - with a view to making this knowledge available through advisory services
- provision of special facilities, such as pilot plant facilities, testing facilities, etc.
- making grants, and letting contracts, to universities and technical institutes for research and development projects which are important from an industrial point of view
- funding research associations

DSIR support to the electronics industry takes a number of forms. It covers such things as facilities for making a very wide range of precision electrical measurements; the dissemination of a standard frequency throughout New Zealand by making use of the T.V. "colour burst signal" to an accuracy of about 1 part in 10"; the availability of acoustics measuring facilities; the availability of a temperature controlled room in which equipment can be checked from -5°C to50°C, and of humidity and temperature controlled

cabinets for checking over a very wide range of climatic conditions; equipment for vibration tests on equipment over a wide range of frequencies and "g's"; introduction of new technology such as thick film hybrid microelectronics, coupled with lectures and seminars to a wide cross-section of the NZ electronics industry; development programmes to improve the efficiency of technology of other industries which may sometimes have spin-off for the electronics industry (such as computer control of the spray drying of milk powder for the Dairy industry and the automatic weighing, grading, and marshalling of carcasses in the freezing industry); etc.

**The Role of Universities**

Universities obviously have a key role to play in the development of the electronics industry. It is from the Schools of Engineering and of Physics that future professional electrical engineers will come. Contribution of the university it not, however, limited to the supply of graduates. From university research programmes come opportunities for new products and new devices. The blind aid spectacles developed by Professor Kay and his students are being manufactured in New Zealand, and it would probably be true to say, that it is one of the most sophisticated electronic products to be manufactured in this country.

What is perhaps more important than the development of any particular product however, is the fact that students in universities are now receiving "training for innovation". I can remember the time when practically every student of mechanical engineering had, at some stage, to design a crane hook! I have no doubt that as a design study it was a worthy topic, but it is one which would be unlikely to challenge the imagination of the student, or lead him to think in terms of new and imaginative concepts. I believe that in the universities today, students are being challenged to exercise their imagination and think in much bolder and innovative terms. Graduates with this outlook must surely have a beneficial effect on the development of our electronics industry in the future. One should note in passing that the total number of engineering graduates in 1974 was 410, of which about 100 were graduates in electrical engineering.

**Technical Institutes**

One of the significant developments in engineering training in recent years has been the development of New Zealand Certificate courses at Technical Institutes. In DSIR we have been extremely pleased with the people who have graduated from these courses, and I know from the fact that these are, widely sought after by industry that they are also proving themselves in the industrial world. There were 878 certificates gained in 1974 in engineering and science. Of these N.Z. Certificates of Engineering numbered 536 (68 electrical and 51 in telecommunications). To date 3,174 certificates have been awarded. I am aware that there is a problem for the electronics industry; namely, that NZCE graduates cannot at present be registered with the Electricians Registration Board unless an apprenticeship has been served. This is a difficulty which will need to be resolved if the industry is to fully utilize the excellent source of trained people.

**The Electronics Industry**

Having considered, briefly, the rate of change of technology internationally, the consequences for New Zealand industry which flow from this rate of growth, and the type of infra-structure available to support the electronics industry, one comes now to consider industry itself.

The main thrust of the industry, at present, is in "consumer" electronics (radio, T.V., record players). Production is presently estimated to be about $70 million, of which only

about 10% is in the professional electronics field. About $80^0$10 of the $7 million of professional electronics production, comes from four of the 60 odd firms in this field. There is, therefore, a large number of firms with a very small level of production, and four firms with a combined production of about $5.5 million.
New Zealand electronics production per head of population lags well behind that of most developed countries, and there seems, therefore, to be considerable scope for a much higher production - if only on the grounds of "if others can do it, why can't we?". Population size does not seem to be a serious (imitation since countries like Norway, Sweden, Denmark, and Australia, seem to be doing much better than we are. Remoteness from world markets (for exports) is a marketing disadvantage; but freight costs should not be a serious disadvantage for high-added-value low-bulk items.
There is probably not one single problem to be overcome, but rather a series of things we could do, each of which would add a little to our overall strength - and, hopefully, lead in time to a much stronger professional electronics industry. My personal views are set out below.

**Government Purchasing**
In many overseas countries, Government purchasing is used as a tool for industrial development. Defence purchasing by the United States Government has undoubtedly contributed significantly to the electronics within the USA. Other examples could be given.
In New Zealand the Post Office, Ministry of Electricity, Ministry of Defence, Hospital Boards, etc., make large "public sector" purchases, and there seems to be no reason why some of this equipment should not be developed and made in New Zealand. For example, N.Z. Post Office spends about $32 million per annum on equipment. About $5 million's worth of this is electronic in the "true" sense. Of the $32 million spent annually, about $12 million's worth is assembled or manufactured in this country - principally PABX assembly, cable manufacture, and manufacture of telephone instruments.
This expenditure, plus other purchases by the "big spenders" listed above, could be used to stimulate further development and production in this country. Obviously however, this sort of thing does not just "happen". It seems to require the following:
[a]
a policy decision by government that purchasing will be used as a development tool;
[b]
industry to keep appropriate government departments fully informed on the development capabilities of the industry;
[c]
some consistency of government policy if development effort is not to be wasted (for example, the decision to relax the requirement for SSB radios for certain types of vessels has, to some extent, dissipated the market after a lot of effort had gone into this development);
[d]
administrative tools such as effective "development contracts" and/or "preproduction order schemes";
[e]
action by government departments to make industry aware of their future needs well ahead of actual requirement, so that development and `type' testing can be completed in good time for subsequent production and delivery target dates to be met. Equipment specifications obviously need to be carefully drawn up in the first instance.

[f]
when very large contracts are being let to overseas suppliers, it should be a condition that the successful tenderer must have some of the work done in this country, and there must be a "new technology" content in such local production. "Offset" agreements are another way of ensuring similar results.

**Industry R & D**

Eric Pernase, Managing Director of AWA, commented recently in a paper to an Industrial Design Seminar, that there was a very significant difference in the research budgets of most developed countries and that of New Zealand. This can, perhaps, be highlighted by contrasting the research budgets of New Zealand and Sweden for 1969. The research budgets were distributed as follows:

| | |
|---|---|
| New Zealand | 70% Government; 10% industry; 8% university |
| Sweden | 4% Government; 70% industry; 8% university |

On the basis of these figures, New Zealand certainly appears to be "the odd man out". By contrast with Sweden, the Government research budget - as a proportion of the total - seems to be enormous. One should remember, however, that the N.Z. Government Research effort is divided up as follows

| | |
|---|---|
| Agriculture and Forestry | 56% |
| Manufacturing | 6 ¼% |
| Environment | 25% |

New Zealand Government research in the manufacturing field is only 4 ¼% of the **total** research effort. I believe, therefore, that it is not that government research to aid manufacturing should be cut down, but that industry research and development should be increased. A good deal has been done in the past to encourage research in industry. The industrial research and developments grant scheme, referred to earlier, was introduced specifically to increase industrial R & D and the number of professionally qualified people in New Zealand industry (according to the 1972/3 report of the I. R. & D. Grants Committee, grant recipients in that year employed 426 professionally qualified people). Tax rebates for research, grants from the Inventions Development Authority, financial assistance from the Development Finance Corporation, direct grants from Government to Research Associations, etc. are other methods which have been used to lift the level of research and development for New Zealand industry.

Government purchasing, referred to in the previous section, is another effective way of stimulating industrial R & D. Firms which are successfully able to manufacture for `big spending' Government departments, and can supply equipment which is competitive in price, quality, and performance, have the benefit of "bread and butter" lines which can spread the cost of expensive R & D teams.

**Concentrating on `Strengths' and National Need**

It seems sensible to capitalize on present "strengths" and national needs. N.Z. has had long experience and considerable success developing `communications' equipment. Building on the skill and experience of the industry is an obvious way to go.

Our biggest industry is agricultural production and processing. It is my personal view that there are considerable opportunities for development of electronic measuring and control equipment to improve the quality of our processed food, and to improve the productivity of these industries (for example, 60°?(’. of the costs in the freezing industry are labour costs - while it will always be a labour intensive industry, there is scope for automation of many processes).

Affluent countries seem to devote more and more money to the business of `staying alive and well'. Medical electronics, based on active medical research, seems to be a worthwhile avenue of development.
One has only to read the `power planning report' to note the large investment in new power station scheduled to take place over the next decade or two. The trend here is toward increased automatic control, data logging, and data processing. 1 would have thought that there were significant opportunities in this area.
Manufacturing industry is 'coming of age' and success in the export field will need products which compete in quality, and price, with the overseas product. Surely there must be increased opportunity for small-scale automation, process control, instrumentation, and test equipment.
I could go on at length. Your list would probably be a little different from mine; but surely we could all agree that there are opportunities here for future development in electronics based on present industries and on the things we do well.

**Technology Transfer**

In this rapidly developing technology, efficient technology transfer is desirable. We must have transfer from the "world body of knowledge" to N.Z. engineers and scientists, and from Government and university research workers to N.Z. industry. There are minor problems such as the fact that it takes too long for journals to get here - say a six month delay. We could improve circulation of journals in Government departments and universities, to industry. We could have more seminars and summer schools.
But the best way of transferring technology is to transfer people. When professionals from high technology organisation are actually transferred to a so-called user organisation, they bring with them an awareness of the technology available; and after they are familiar with the needs of the new organisation, they are able to see how these could be benefited by the new techniques. Technical reports, symposia, and other avenues for exchanging information may be useful, but their impact is small compared to the transfer of personnel.
I have no magic formula; but I believe we should work at transferring people within Government laboratories, universities, and industry. 1 also believe that extended visits of overseas experts of the type that Professor M.S.P. Lucas made to PEL to introduce thick film microelectronic techniques, must be much more widely used in the future. Contracts by industry, and government departments, to universities for research on industrial problems, should be much more widely used in the future.

**Conclusion**

In my view the development of a strong professional electronics industry is a very important element in our industrial development plan. Failure to develop strength in this area will inhibit growth in other areas of industry.
I have sought to outline some of the problems as I see them; to describe some of the infrastructure which we have to assist the electronics industry; and to suggest some of the steps we could take to stimulate development in this area. I hope that the Slade Lecturer ten years from now can look back with pride at the achievements of the industry between then and now - achievements in which I hope we will all have played a part.