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# Briefing Paper

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## THE ELECTRONICS INDUSTRY IN SCOTLAND

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### Electronics in Scotland: a brief history

The electronics industry in Scotland began in 1943 when Ferranti opened a gyro-gun sight factory in Edinburgh. The company, which ever since has been a seed-bed for electronics specialists, diversified into other areas of electronics after the war. In 1943 the Edinburgh factory employed only 100 people, by 1950 this figure had risen to 1,000. Ferranti's activities in Scotland have grown over the years and the company currently employs 7,700 spread across nine locations. The Scottish group manufactures navigational systems, lasers, radars, communication and central equipment, electronic components as well as computer aided engineering systems.

The only other pre-war electronics concern was Barr & Stroud. Now part of the Pilkington Group, it remains one of Scotland's most important electronics companies employing 2,000 people in the manufacture of electro-optical instruments, thermal imaging systems and, of course, defence systems. In fact, Barr & Stroud is one of the worlds leaders in military technology. This defence orientation remains at the heart of Scottish electronics currently accounting for 25% of employment in the industry.

The most rapid growth in the industry came with the advent of American multinational (MNC) investment in the post-war years. At the conclusion of the second world war North American manufacturers were anxious to expand into European and Empire (later Commonwealth) markets. However the dollar shortage meant that direct export was difficult. In an attempt to overcome this

hurdle, American companies began to establish manufacturing outlets abroad. The first "wave" of such investment in electronics in Scotland came in 1947 when National Cash Register (NCR) opened a plant in Dundee which employed 300 people. Honeywell came next, in 1948, Burroughs in 1949, and then Veeder-Root, followed by IBM in the early 1950's.

According to McDermott (1979) there were over 7,500 people employed in the Scottish electronics' industry at the end of the 1950's. The potential of the industry was recognised by the Scottish Council which instituted a programme to stimulate the use of electronic technology by Scottish engineering firms. Almost inevitably, this was done by using Ferranti as a conduit for contracts from the Ministry of Supply and the Scottish Office to firms in the electrical and engineering sectors. The hope was that such firms would thus be encouraged to apply their conventional expertise to the development of electronics technology. The experiment had only limited success, mainly because the management structure of the companies concerned was unsuited to the needs of a much more dynamic industry (McDermott, 1979).

The American companies established in Scotland in the 1950's and mid to late 1960's (which was the period of the second wave of investment) were involved in the manufacture of electro-mechanical business machines and, as the industry evolved, in full electronics production. The second wave included firms like Motorola, General Instruments, Hughes Micro-electronics, National Semiconductor and Hewlett-Packard. Such firms took their place alongside domestic companies working in defence electronics; Ferranti, Barr & Stroud and Marconi. It was at this time that Scotland's strength in semi-conductor manufacture was established.

The industry grew in Scotland for a number of rather obvious reasons. The financial inducements of post-war regional policy had a major part to play. By the time of the second wave of US investments in Scotland in the late 1960's, Development Area Grants were especially attractive. Other considerations included a labour force which was both large enough in number and qualified enough in skills to enhance financial inducements. The availability of sites and reasonable communications also had a role to play, as did the 'new towns' which brought all the foregoing attractions together in one location. Finally, Scotland had a justifiably good reputation as a centre of academic excellence, where universities were willing and able to undertake applied research and where graduates could be trained in the skill needs of the industry. All in all this was an attractive mix for the potential investor. By 1973 47% of total Scottish employment in electronics was in American-owned plants with only 9% in Scottish owned enterprises. In fact, the computer industry was almost entirely dominated by the Americans. The SDA (1979) estimate there were around 80 firms in the Scottish electronics industry in the mid-1970's, together employing around 37,000 people. Employment had been somewhat higher in the early part of that decade but fell in 1971 when the industry was hit by recession as capital goods industries throughout the world went into a downturn. The shortfall in demand was paralleled by a world overproduction of microcircuits. These factors served to highlight the absence of strong local markets and the industry's exposure to external conditions. Other weaknesses evident in the early 1970's stemmed from a scarcity of component suppliers, data processing experts and associated industrial consultants (problems which have still not been resolved). The 1970's witnessed a number of substantial setbacks for the Scottish industry. Such reverses pinpoint not only weaknesses within the industry in Scotland, but also demonstrate that the electronics industry is subject to rapid technological advance which, as in any other industry can leave particular firms uncompetitive, which in turn leads to redundancy.

Figures for employment in electronics are, until very recently, at best estimates.

**EMPLOYMENT IN THE SCOTTISH ELECTRONICS INDUSTRY**

Year	Employment
1949	1,500
1959	7,500
1970	49,000
1974	37,000
1978	30,900
1982	38,500
1984	42,000

The remarkable expansion in electronics employment of the 1960's is explained by the fact that the following companies began operations during that decade; GEC, Philips, Pye, Marconi, Gentech, Hughes, Hewlett-Packard, Motorola, National Semi, General Instruments, Fabri-Tek, Exacta, Highland and Jones Scott. Early on in the 1970's things started to go wrong. Between 1974 and 1978 employment in non-Scottish owned plants fell from 37,000 to 30,900. This fall-off was particularly marked in US and European companies. Between 1974 and 1976, employment provided by English companies fell from 15,000 to 13,800, thereafter recovering slightly to 14,600. Companies which left included Plessey, IIT and Dasa. Other companies which either closed or had substantial redundancy programmes included Pye, MFE Corporation, Honeywell, Burroughs, and NCR. In the case of Plessey, IIT and Dasa the ostensible cause of their closures was significant cutbacks in purchases by the then Post Office. The other companies fell victim to organisational and/or technological change. The latter embraced the changeover from electro-mechanical to wholly electronics technology. This shift particularly hurt Burroughs and NCR, but other companies, for example Honeywell, also felt the chill winds of change. NCR once had eight factories in Scotland, now it has one. Burroughs' plant at Cumbernauld once employed 3,000 people, now under 1,000 people work there, while a further 400 people work at its Livingston facility.

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### **The Present**

The 42,000 people currently working in the Scottish electronics industry are spread across the following sectors: Industrial, Commercial and Telecommunications accounts for 25% of employment as does defence electronics; information systems has a 22.5% share. Semi-conductors and components, a sector with a very high employment potential, currently employs 17.5% of the electronics' workforce. Sub-contracting has 7.5%; finally, the consumer sector employs the remaining 2.5%.

As described above the 1960s was a decade of rapid growth for the industry. Indeed, the end-decade figure greatly surpassed estimates of likely employment levels made by the Scottish Council at the beginning of the 1960's. At that time the Council believed that by 1970 the industry would employ 20,000 people. Despite the setbacks of the 1970's, growth in the industry has resumed. Output has doubled since 1975 and, in fact, rose by almost two-fifths between 1979 and 1982. Employment however, really only began to recover in 1982 though investment had of course been continuing in expectation of post-recession demand.

1984 has already proved a notable year for the industry. Investments from National Semiconductors, Shin-Etsu, Hewlett-Packard, ACT, Berkeley Glass Lab, SCI Systems, have all greatly boosted either actual or potential employment. Most recently the investment by Integrated Power Semiconductors at Livingston will increase that town's complement of electronics firms to 41. Despite its deserved reputation for excellence amongst companies already operating in Scotland, there still exists a credibility barrier for those outwith the country. Evidence of this emerged recently in a survey undertaken by The Electronics Location File. The survey covered 315 British based companies from all sectors of the industry and from all areas of Britain. No distinction was made between British or foreign-owned companies. The findings which are most pertinent to Scotland are as follows: 78% of the companies expected conditions to improve for the industry as a whole in 1984, 90% expected an improvement for their own company. A further 58% expected their companies to set up new manufacturing or commercial facilities within the UK sometime in the next three years. However, half of all new investments will be in southern England. Scotland comes seventh out of twelve in a regional locational preference table.

The authors of the survey remark: "the figures for Scotland are disappointing: all the more so because the country already exhibits a very healthy technological base". This may, in fact, be an overstatement, leaving aside survey methodology, no information is presented

on the number of forecast nor the total amount of the likely investments. However, the survey is salutary in that it is yet another reminder of the need to contain euphoria.

**REGIONS LISTED IN ORDER OF LOCATIONAL PREFERENCE VOTE (20)**

Regional Preference	No	Percentage
1 South East	54	29.7
2 South West	27	14.8
3 London	25	13.7
4 Wales	20	11.0
5 North West	17	9.3
6 West Midlands	15	8.2
7 Scotland	13	7.1
8 East Anglia	12	6.6
9 East Midlands	10	6.6
10 North East	8	4.4
11 Yorks & Humberside	7	3.8
12 Northern Ireland	4	2.2

Source: Electronics Location File

Scottish based ownership in the electronics is still remarkably small and the SDA would very much like to see it expanded - a desire more easily expressed than achieved.

**THE SCOTTISH ELECTRONICS INDUSTRY - EMPLOYMENT BY COMPANY OWNERSHIP (%)**

Location of Ownership	% Share
Japan	1
European	5
Scottish	10
USA	40
English	44

Source: Locate in Scotland

However, McNicoll and Swales (1982) suggest that there is no compelling evidence that, individual examples notwithstanding, non-British MNC's are more likely to lay off workers than their British equivalents. According to Massey (1972) the vulnerability of branch plants seems to be connected to their relation-

ship with other parts of the parent, that is, whether or not they are engaged in a self-contained activity or involved in some kind of wider production system. Branch plants have had a bad press because they are associated with routine, low-skilled production and usually do not have research and development facilities. This absence of R & D is oft times cited as one of the major weaknesses of Scottish electronics industry development. However, this view has recently been challenged by Morgan and Sayer (1983) who argue that branch plants in the electronics industry are typically engaged in production which cannot easily be removed (due to specificity of product) or at least not without significant impact on production. Moreover, although the local multiplier effects of branch plants is small in 'peripheral regions', indigenous plants appear to be little better integrated into local economies. However, this situation need not be permanent. The authors point to central Scotland as an area now approaching 'critical mass' beyond which local sourcing can be expected to increase.

Since the term 'critical mass' is currently being widely used it is perhaps appropriate to give it some definition and clarification. The best example of this phenomenon is in the semi-conductor sector which through its production of integrated circuits lies at the heart of the industry. Currently there are over 3000 people employed in the sector, and by 1986 it is expected that employment will have grown to 7,500. The sector's evolutionary cycle takes the following form. The first stage entails warehousing and marketing functions for the European market. The next step is an assembly plant for the same market. Low-volume wafer fabrication is next in line, then comes high-volume wafer fabrication which greatly increases local autonomy). The next stage embraces silicon foundry work and design capability and finally, world product responsibility.

The Scottish integrated circuit industry is made up of the following companies: Motorola, National Semi-conductor, General Instruments, Hughes, Burr-Brown and NEC (the latter is Japanese, the others are American). National Semi now has capacity for all of the above functions, although assembly is limited. Likewise Motorola, but in its case warehousing is limited.

The Scottish sector accounts for 80% of UK integrated circuit output and 21% of European output. At present, the sector manufactures for both high and low volume users, for example, General Instruments concentrates on customised circuits rather than volume memory devices. This means that Scotland can produce a diverse product range for a variety of end user markets.

The semi-conductor sector is of strategic importance as the industry as a whole is dependent both upon the quantity and the quality of product available to it from this sector. If anything seriously goes wrong in semi-conductors then the remainder of the industry suffers. For example, at the moment there is a world shortage of 'chips' and this is causing disruption to production further down the line. "So semi-conductors is now accorded a strategic role for national economies similar to that of steel fifty years ago." (Morgan and Sayer; 1983)

The £30 million investment by Shin-Etsu Handotai in silicon production will further strengthen Scotland's position in semi-conductors. Currently, the industry has to go abroad for supplies of silicon. The presence of a 'raw material' supplier makes the task of finding semiconductor investment that much easier. The plant itself, which will be at Livingston, should employ about 600 people by the beginning of the 1990's.

Scotland then would seem to be in a highly fortunate position given the existing state of the indigenous semi-conductor subsector. But how does this relate to 'critical mass'? The hope is that around the semiconductor plants there will emerge indigenous companies ranging in scope from repair and maintenance firms to computer manufacturers. These in turn will attract highly skilled electronics personnel. Yet more companies will be attracted by the presence of highly skilled, yet scarce, personnel and associated employees. A virtuous circle is created. From this growing group will emerge innovators and entrepreneurs who will spawn 'venture capital' specialists.

The next two years will be critical for

the Scottish industry and for the transition of the notion of 'critical mass' from hypothesis to reality. At present Scotland is not developing sufficient numbers of innovators/entrepreneurs and it seems unlikely that, at least in the short to medium term that much employment growth will be generated by indigenous companies. That there is room for such companies cannot be in doubt: in 1980 only 30% of the Scottish electronics industry's sub-contract demand was sourced within Scotland. So that whilst 60% of the industry's machining and turned parts demand was met by Scottish firms, only 9% of its plastics requirement came from Scottish companies. In relative terms Scottish companies have not responded to downstream demand from the electronics sector. This is not to suggest that there have been few Scottish based start-ups or expansion, only that the overall number has been much less than one would have liked. Since 1978 the following companies have all either begun operations or expanded existing facilities: Clyde Valley Control, Future Technology Systems, GL Electronics, Graphic Life Systems, Goldcrest Electronics, Micropack, Northern Circuits, Rodime, SEEL, Speyside Electronics, Strathclyde Circuits, Fortramic, Osprey, Prestwick Circuits and, most recently, Kineticon.

### The Future

Future developments within the industry can be grouped under the following critical headings; semi-conductors, very large scale integrated circuits (VLSI), artificial intelligence (AI), and optoelectronics. The semi-conductor sector has already been discussed, but a brief note on the other headings is in order.

VLSI technology enables extremely complex systems of 100,000 semi-conductors and upwards to be fabricated on a single chip. Currently such technology is being deployed in 32 bit general purpose ultra-performance processors. Its potential is much greater in special purpose micro-processors which will be capable of speech recognition and synthesis. VLSI is amongst the most spectacular of the new technologies since it is at the heart of the fifth generation computers currently being developed in Japan and which

represent a quantum leap into associative and informational behaviour by computers.

Such characteristics linked to a computer become known as Artificial Intelligence and has considerable applications in robotics and other industrial, medical and educational fields.

Finally, opto-electronics represents another growth node. This technology is concerned with the development of integrated opto-electronic devices which have major potential in image processing applications such as brain and body scanners and military systems. But it is with fibre-optics which the technology has its most immediate economic potential. For example, in the medium to long-term fibre-optics will replace co-axial technology for cable television and interactive service purposes. Scotland has a company base in opto-electronics with Barr and Stroud and Ferranti field leaders, and a small Edinburgh company, Edinburgh Instruments, designing and manufacturing lasers. However, given the strength of the Scottish defence sector, with Ferranti, Marconi, RACAL, MESL and Barr and Stroud, more indigenous spin-offs would have been expected than thus far achieved.

Similarly 'software' development in Scotland has not been particularly encouraging. 'Software' is the means by which general purpose micro, mini and mainframe computers are programmed for user specific requirements. Software development is critical for the information industry and as such is also a pivotal sector in the post-industrial economy. However, developments in software capability and production techniques have not matched the rapid increases in potential capability of low cost hardware. What is more, software is an increasingly dominant cost element. Added to these problems is the fact that the software product/service industry in Scotland is very small-scale. Only 25 out of the 1000 UK listed companies are in Scotland (they employ 400 full-time software experts), and only about half of the Scottish based companies are Scottish owned. It is hard to see this particular sector developing very much in Scotland

given the limitations of the market and the overwhelming dominance of southern England. It would seem that Scotland will have to look to other sectors for growth. This despite the fact that there are probably pools of untapped human resources within Scottish universities.

The main source of future investment and jobs will understandably be American multi-nationals, particularly in semiconductor manufacture where Scotland already has an exceedingly strong base. Of the 'critical' technologies it seems most likely that most of future US investment will be in semiconductor technology. However, given the continuous process of quality improvement allied to inexorable advances in automation, greatly increased output (and quality) is likely to be allied to more limited employment potential. Even so, the figure of 7,500 semiconductor jobs by 1986 does seem achievable.

Investment from Europe and Japan is unlikely to be all that great, although NEC may expand their Livingston plant to become their production centre for all integrated circuits for the European market. As such it would be the first fully integrated, Japanese owned, facility in Europe. There are also rumours that NEC is actively considering a European centre for manufacturing telecommunications equipment and electronic telephone exchanges. Clearly, Scotland is in a strong position if such investment does go ahead.

On a less positive note, the prospect of Japanese investment for TV manufacture and electronic components does not seem great. Likewise it would be over-optimistic to expect much new UK and European investment, although manufacturers might wish to build upon existing investments. This said, Scotland does have a strong base in 'information systems', for example, IBM, Digital and Honeywell etc. The attractions of an increasingly strong semiconductor sector might well lead to further investment. However, a serious shortage of properly trained personnel, particularly in electronics engineering is already hindering expansion.

## CONCLUSION

Electronics will remain amongst the fastest growing industries worldwide. Although investment from abroad is both welcome and necessary, the international and regional competition for such investment is becoming much fiercer. This means that it is vital to sell existing strengths, particularly in semi-conductors and systems. However, as California has demonstrated it is via the link between innovations/entrepreneurs and venture capital that most growth comes.

The SDA has performed well, but the problem remains one of stimulating entrepreneurs in a climate which does not seem to propagate such a group. There is great potential within the Scottish industry for sub-contract work and for software development etc. yet the emergence of a thriving indigenous sector has been lamentably slow. Venture capital is available but there is inadequate knowledge as to how best to exploit it. Another weakness lies in inadequate marketing expertise and/or knowledge of potential customer needs, but in the final analysis, Scotland's recent history of a deficiency of entrepreneurial skills seems to be the major flaw.

Perhaps what is required is a national examination of prevailing attitudes to self-employment. A programme linking the universities, the media and existing employers might be required. Questions such as the relationship between initiative and taxation, educational background and orientation to self-employment, minimum skills for such a task, the role of venture capital, etc. must be looked at closely if Scottish based electronics companies are to flourish.

Although external investment is welcome and 'branch plants' are not necessarily more vulnerable than locally owned enterprises, nevertheless Scotland's dependence on such investment is far too great, the more so given prospective technological change even in the short interval to the early 1990s. Scotland must develop both domestic electronic firms and an indigenous capacity for

research and development work (the proportion of technical personnel in research and development and product design has been static over the last five years).

Finally, if Scotland has between 55,000 to 60,000 employed in electronics by the end of the decade it will have done well. But electronics alone cannot solve the Scottish unemployment problem. Over the last ten years the country has lost 200,000 jobs.

## REFERENCES

- (1) P McDermott, 1979 'Multinational Firms and Regional Development', **Scottish Journal of Political Economy**, Vol 26, No 3, pp287-306
- (2) **SDA/B002-Allen**, 1979 "The Electronics Industry in Scotland: A Proposed Strategy, Glasgow, p44.
- (3) Electronics Location, File, 1984 84/1.
- (4) **Locate in Scotland**, SDA, 1982, 'Electronics in Scotland: Industry Profile, Glasgow.
- (5) I McNicoll and J K Swales, 1982, Public Expenditure on Industry in Scotland, in **Government Spending in Scotland**, Paul Harris, Edinburgh pp85-106
- (6) D Massey, 1972, 'What Sense on Regional Problem: **Regional Studies B**, No 2, pp233-243.
- (7) K Morgan and A Sayer, 1983 The International Electronics Industry and Regional Development, **Urban and Regional Studies**, University of Sussex.