THE IRISH ELECTRONICS SECTOR: TECHNICAL MANPOWER AS AN INDICATOR OF STRUCTURE AND SOPHISTICATION

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The present divergence of views on both the nature and the potential of the Irish electronics sector has created confusion and uncertainty at a time when confident and agreed policies are needed to meet new challenges. The efforts of the Industrial Development Authority (IDA) to promote Ireland as "The Silicon Valley of Europe" have been castigated in a review of Irish Industrial Policy by the Telesis Consultancy Group [NESC (64), 1982]. Telesis depicted the industry in Ireland as one of "low cost assembly operations" with a threat hanging over its long-term future. The term "Singapore of Europe" has been coined to convey the image of Ireland as an off-shore low cost manufacturing location supplying the European market. The IDA strongly rejects this assessment and points to the names of world leaders in the electronics industry who operate in Ireland and who have "graduate participation of between 25% and 30%" [White, 1982].

The question must be asked if the data available permit such widely different interpretations. One explanation is that distortion has arisen from selective use of industry data by the protagonists in the debate [Ruane, 1982]. It has also been suggested that "while the electronics industry has a high technology image, most of the jobs in it, worldwide and not just in Ireland, are assembly-type jobs" [ibid]. During 1981 the Science Policy Research Centre (SPRC) at University College, Dublin carried out an extensive study of the Irish electronics sector.[1] This paper draws on the findings of that study to provide some new insights into the Irish electronics sector. It introduces empirical data on technical manpower so as to allow comparisons with the electronics sector in other countries.

Conventional Performance Indicators

The data collected and published for electronics, as for all other industry sectors, relate mainly to employment, output and exports. The most recent Census of Industrial Production is for 1978 which is quite unsatisfactory for a sector which is growing as rapidly as electronics. The problem is

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compounded by the fact that electronics was not identified as a separate industrial sector until 1973. There is also confusion caused by the tendency to inflate the electronics sector by including electrical engineering firms and sub-suppliers making non-electronic components such as metal cabinetry, pressings and injection mouldings. On the other hand, international trade statistics for electronics are both comprehensive and up to date. This is of particular value in the case of electronics: estimates derived from the SPRC study indicate that ninety-five per cent of gross output is currently exported.

(a) *Employment*

Table 1 shows that employment in electronics doubled between 1973 and 1981.

Table 1: *Employment in Electronics 1973 to 1981*

	No. Employed	Increase (per cent p.a.)
1973	7,757	—
1974	7,598	−2.0
1975	6,405	−15.7
1976	6,919	−8.0
1977[a]	7,706	11.4
1978[a]	8,384	8.8
1979[a]	9,184	9.5
1980[a]	11,326	23.3
1981[b]	13,393	18.2

Source: CSO, IDA (a) SPRC Survey (b).
Note: Electronics is defined as NACE categories 330,344 and 345 in the European System of Integrated Economic Accounts (ESA).

The lusty growth of electronics employment throughout the current recession (averaging 20 per cent per annum) is particularly noteworthy. This appears to vindicate the IDA claim that Ireland has come through "in an outstanding manner" at a time when "the electronics industry worldwide is being hammered" [White, op. cit.]. It comes as no surprise, however, to discover that this vigorous growth is attributable to new start-ups. Data were obtained for twenty firms which comprised the bulk of the industry in 1973: the aggregate employment of these firms was 5,974 in 1973 and 5,985 in 1981. A further six firms which existed in 1973 had ceased to operate by 1981.

The rapid flow of new entrants into the Irish electronics sector came both from multinational corporations (MNCs) and indigenous firms. Fifty-

nine of the seventy-four MNCs and twenty-seven of the thirty-five indigenous firms which were operating in 1981 started up after the beginning of 1973. Most of the employment growth, however, came from the new MNCs because indigenous start-ups since 1973 were responsible for only about five hundred sustained jobs.

(b) *Output*

Table 2 shows a remarkable expansion in the gross output of the Irish electronics sector between 1973 and 1981. The choice of the price index of exports to deflate electronic gross output may be questioned but the main point here is that constant money output has grown at least three or four times over a period of eight years. Taken in conjunction with the doubling of employment (Table 1), this reflects a significant increase in labour productivity in electronics over the period. The extraordinary export performance of the electronics sector (95 per cent of gross output) is attributable to the MNCs who export nearly 100 per cent of their production. The SPRC survey found that the export performance of the indigenous firms was much more modest and was directed mainly to the U.K. market. Total electronic exports, however, were less concentrated in the U.K. market than manufactures generally: the U.K. 28 per cent, W. Germany 24 per cent, France 9 per cent and the U.S.A. 6 per cent.

Table 2: *Gross Output and Exports in Electronics: 1973 and 1981 Compared*

	Gross Output		Exports	
	Current Value	Constant Value	Current Value	Constant Value
1973	£52.5 m	£52.5 m	£28.0 m	£28.0 m
1981	£730.0 m	£239.0 m	£697.0 m	£228.0 m

Source: Export data from "Trade Statistics of Ireland"; Gross Output for 1981 was obtained by grossing up exports using ratios based on information from SPRC Survey.

Note: The price index of exports was used to deflate the 1981 money values of output and exports.

Proponents of the view that Ireland does not possess an electronics industry of any significance are not impressed by output or even export figures. They claim that Ireland is only carrying out partial steps in the manufacturing process, such relatively low-skill activities as "assembly, test, packaging and simple machining or coating functions" [NESC. op. cit.]. This proposition can be tested by analysing the professional, technical and skill levels in the Irish electronics sector and making international comparisons. The next section attempts to carry out this analysis.

Technical Manpower

The proportion of technical manpower is not a *direct* measure of the competitive strength or technological sophistication of an industry but it is a more reliable and revealing indicator of these characteristics than measures already discussed. There are many reasons why it merits more attention than it has received up to now:

(i) *Prima facie* an industry sector with a relatively high proportion of professional and technically-trained workers is competing on the basis of knowledge-intensity/technical skills and is not vulnerable to low-wage competition

(ii) Wealth creation, in the sense of greater value-added per work-hour leading to higher incomes per capita, should be the major goal of industrial policy[2]. If industry can be re-structured, over a period, towards more professional, technical and skilled jobs, this is a more effective way of improving value-added than relying on productivity increases which arise from making existing activities more capital-intensive.

(iii) Ireland has a young well-educated population and spends a very high proportion of its national income on education. If this resource is to be utilised, all industry sectors must move towards greater workforce participation by professional and technically-trained people.

(iv) Statistics on skill distribution are easy to collect and are an effective way of monitoring progress and of making international comparisons on industry structure and technology.

Skill distribution of the industrial workforce has not appeared in any of the government statistics but there is evidence that those bodies concerned with planning and implementing industrial policy in Ireland are aware of its importance. Implicit targets for engineer and technician density ratios of eight and ten per cent respectively, for the electronics sector in the mid-eighties, are contained in a speech by the managing director of the IDA given in December 1979 [Killeen, 1979]. There has not been any subsequent reference to these targets, perhaps because they proved too ambitious. Similar targets, however, were used by the Manpower Consultative Committee in 1980 to arrive at the expected demand for graduate engineers over the period 1980-1990 [Proceedings, 1981]. But the most encouraging and concrete development has been the recent recommendation by the National Economic and Social Council that steps should be taken to collect data on skill structure and income levels by industry sector [NESC (66), 1982].

(a) *Technical Manpower in the Irish Electronics Sector*

The survey sample interviewed by the SPRC consisted of thirty-seven electronics firms, stratified by five product groups and by MNC/indigenous. The sampled firms represented sixty per cent of employment for MNCs

and seventy-nine per cent of employment for Irish firms. Table 3 gives the density of engineers and technicians by product group and the average for the total sector.

Table 3: *Density of Technologists in Irish Electronics Sector by Product Group (1981)*

Product Group	Engineers (per cent)	Technicians (per cent)
Components	4.4	4.4
Computers	3.8	12.6
Consumer	2.2	5.3
Instruments and Industrial Control	11.6	13.3
Telecommunications	5.8	9.7
Total Electronics	5.1	9.0

Source: SPRC Survey.[3]

The internal differences between the product groups are significant. The more complex electronic products such as instruments, industrial control and telecommunications products require more technical manpower than standard consumer products and components.

Table 4 compares the technical manpower of MNCs with indigenous firms, differentiated by the same five product groups as in Table 3. This table shows that overall technical manpower density in the indigenous firms is similar to that in the MNCs. It also confirms the relatively high technical manpower levels in telecommunications and industrial control for both sub-sectors. Since there was only one indigenous firm in computer manufacturing this entry has been omitted.

Table 4: *Density of Technologists by Product Group: MNC's and Indigenous Firms Compared (1981)*

Product Group	MNC's		Irish	
	Engineers (per cent)	Technicians (per cent)	Engineers (per cent)	Technicians (per cent)
Components	4.3	4.5	6.6	3.3
Computers	3.7	12.8	—	—
Consumer	2.8	4.0	1.2	7.7
Instruments and Industrial Control	10.5	12.6	33.0	25.0
Telecommunications	5.0	12.8	6.2	8.4
Total	4.9	9.2	6.0	8.2

Source: SPRC Survey.

(b) *International Comparisons*

International data on skill levels are shown in Table 5. The data are from

different sources but the categories are reasonably comparable in all cases.

Table 5: *Technical Manpower in Electronics: Comparative Data on Selected Countries (per cent of workforce)*

	Singapore	Ireland	Scotland	U.S.A.
Engineers		5	9	17
Technicians	<6	9	13	11
Craftsmen		3	8	10
Non-Craft Production	>90	60[a]	n.a.	38

Source: Irish data on engineers and technicians from SPRC Survey and other categories from Murray & Wickham; Scottish data from Booz Allen and Hamilton; U.S.A. data from Pacific Studies Centre; Singapore data from L. Lim Ph.D. dissertation (See references).

(c) *Analysis*

Table 5 shows a clear hierarchy of manpower sophistication among the four selected countries. The pre-eminence of the U.S.A. which is the acknowledged world leader in electronics is not surprising. The other three countries, however, share the common characteristic that their electronic sector is a creation of the MNCs: 90 per cent of employment for Scotland, 87 per cent for Ireland and 84 per cent for Singapore. The implication from the table is that the MNCs have different operating policies for different locations. It is proposed to try and explore these differences and to interpret them.

Part of the explanation is that the production activities of the MNCs in their overseas locations show variations both in product range and in stages of production carried out. The most basic off shore electronics production plants are engaged in low skill assembly of semi-conductor components, consumer products and computer sub-assemblies, which, apart from some consumer products, are then exported to the parent company for testing and final assembly. Singapore is a good example of this type of production operation, but recently, some higher skill activities such as testing have been added.

The manufacturing activities of the MNCs in Ireland include a proportion of the lower grade production activities mentioned above but Table 6 shows that telecommunications, instruments and industrial control equipment are also well represented. Production stages in Ireland are not limited to low-skill semi-conductor assembly and printed circuit-board sub-assembly: they also include higher-skill testing and final assembly. Ireland exports finished products and some components to the European market and not sub-assemblies to the U.S. parent.

Table 6: *MNC Employment Proportions by Five Product Groups: Ireland 1981*

Components	25%
Computers/Office Equipment	33%
Consumer Products	15%
Instruments and Industrial Control	13%
Telecommunications	13%

Source: SPRC Survey.

The stages of production and the products manufactured are quite similar for Scotland and Ireland. Scotland, however, has four large U.S. mainframe computer manufacturers who employ a high number of engineers in production, testing and product adaptation. The military electronics sub-sector also contributes to the higher technology profile of Scottish electronics.

Research and development (R & D) is a strategically important function for the electronics industry world-wide. This is evident from the high levels of expenditure and high concentrations of engineers and technicians in the R & D function. The levels of technical manpower shown in Table 5 are linked in an important way to the amount of R & D carried out in each of the four selected countries. In the U.S.A. seven per cent of sales revenue goes into R & D, but only three per cent in Scotland and just less than one per cent in Ireland.[4] There is virtually no electronics R & D carried out in Singapore. The figure for Scotland is distorted by the inclusion of military electronics firms who are highly research-oriented. The R & D performance of the MNCs in Scotland is not significantly different from that in Ireland: responsibility for strategic R & D is retained by the parent. Some product development is carried out locally, particularly in product groups like instruments, industrial control equipment and telecommunications.

Policy Implications

1. Ireland has chosen the MNC route in developing her electronics sector. This has brought considerable success within a decade in terms of employment growth and improved balance of payments. Wealth creation, however, as reflected in proportion of professional and technical personnel, has been more modest.

2. Ireland is not an off shore manufacturing location in the same sense as Singapore or Puerto Rico: it is characterised by more complex products and higher-skill production operations. The products of the Irish electronics sector are marketed in Europe and not sent back to the parent company for further processing. The similarities with Scotland are much

closer than those with Singapore. However, a study of the Scottish electronics sector in 1979 found that after nearly three decades "the majority of non-Scottish operations were established as manufacturing satellites and few have progressed significantly beyond this role" [Booz, Allen and Hamilton, 1979].

3. The very low R & D activity of the MNCs in Ireland is now widely recognised. It would be a misreading of the economics and the history of MNC operations internationally, however, to expect this situation to change radically. MNCs tend to locate their R & D at home for very good economic reasons such as proximity to key customers and early adopters of new products, availability of specialist research personnel and infrastructural facilities. In 1977 U.S.A.-based MNCs spent only seven per cent of their total R & D expenditure outside the U.S.A.

4. The evidence is very strong that MNC-dominated electronic sectors in overseas locations display few of the dynamic symptoms of the Silicon Valley model. They certainly do not have a propensity to spin-off large numbers of high-growth innovative firms. The SPRC study found that four indigenous firms, with a total employment of 41 had spun off, and that none of these was truly innovative [Cogan and Onyenadum, 1981]. A Scottish study found only one spin-off after two decades of MNC involvement in Scotland [McDermott, 1979]. This is not surprising in the light of the MNC strategy referred to earlier: by not setting-up abroad integrated businesses with product development and marketing functions they effectively preserve technological monopoly.

5. An alternative, but longer-term, strategy open to a late developing country such as Ireland is to place more reliance on nurturing a high quality *indigenous* electronics sector while continuing with the employment-creating policy of attracting MNCs. This strategy requires more selective and more interventionist policies based on a thorough knowledge of the technology and the competitive economics of different segments of the electronics industry and a capacity to identify specific barriers to entry [O'Brien, 1982]. There is much to be learnt from the experiences of other small countries such as Denmark and South Korea who have built up strong indigenous electronic industries. Ireland should now look more closely at this alternative.

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NOTES

1. The study was directed by R. O'Brien. A stratified sample which represented seventy-nine per cent of employment for Irish firms and sixty per cent for MNCs was covered by personal interview.

2. The objective of wealth creation has been neglected in Irish industrial policy but the Managing Director of the IDA in a recent paper to the Statistical and Social Inquiry Society of Ireland (Dec. 1982) stated: "The IDA is therefore looking at a concept of industrial development which focusses on the output or income generating capacity of industry", p. 12.

3. A survey of eighty per cent of the Irish electronics industry by Murray & Wickam, in 1981, found 5.3 per cent professionals (nearly all engineers) and 7.8 per cent technicians.

4. Expenditure on R & D was obtained from following sources: U.S. data from *Business Week*, July 5, 1982; Scottish data from Booz, Allen & Hamilton; and Irish data *R & D Survey, 1979*, National Board for Science and Technology.