SPIN-OFF COMPANIES IN THE IRISH ELECTRONICS INDUSTRY

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The Irish electronics industry has recently attracted considerable official comment, most of it complimentary and optimistic in tone. "Electronics will be the biggest single source of new jobs in industry in the coming years" according to the chairman of the Industrial Development Authority (IDA).[1] Employment in electronics is projected to increase from 10,000 in 1979 to 30,000 in 1985 and 40,000 in 1990. Emphasis has centred on Ireland's ability to induce dynamic foreign electronics companies to establish a manufacturing base in Ireland. There is no denying our success during the sixties and seventies in the pursuit of this objective.

The long-term goal for Ireland, however, is not an electronics industry dominated by "off-shore" manufacturing plants. It is hoped that the subsidiaries of these multinational corporations will generate a variety of indigenous spin-off opportunities. When technical people work in manufacturing organisations they acquire skills and competences which equip them to found new technology-based firms.[2] This process is regarded as one of the most effective mechanisms of technology diffusion and such technology-based companies have an impressive record for growth and innovativeness.[3]

It would be unrealistic to talk about or to expect an Irish "Silicon Valley" but at least some organic development of the indigenous electronics sector is timely. The objectives of this study are to identify spin-off companies in the Irish electronics industry and to analyse the characteristics of the incubator organisations and the circumstances under which the spin-offs took place.

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This study differs significantly from other spin-off and technical entrepreneurship studies: it is oriented towards the incubator firm whereas much of the literature concerns the psycho-demographic characteristics of the entrepreneur. Irish industrial policy has been primarily concerned with promoting Ireland as a base for foreign industry and in this context we must aim to identify and attract potential incubator firms. Before commenting on methodology some clarification of the term "spin-off" is called for. We follow Roberts and Wainer in defining it as any electronics manufacturing company which was founded by a previous employee or group of employees of other electronics manufacturing enterprises in Ireland.[4] The key words here are "electronics manufacturing". It is conceded that some important spin-off activities are excluded by limiting the definition to new manufacturing enterprises generated by existing electronics manufacturing companies. But the latter category of spin-off is undoubtedly the most important mechanism for spawning technology-based firms in developed industrial societies and is selected here for particular analysis.

METHODOLOGY

A list of electronic manufacturing companies in the industry was drawn up. The sources for this list included the IDA, NBST, SFADCO and a recent consultancy study.[5] These secondary sources were supplemented by telephone calls and personal visits to electronics companies. A total of 109 electronics firms were identified, 35 indigenous and 74 foreign. Companies were classified as Irish if their headquarters was located in Ireland. An investigation into the origins of the 35 Irish companies was next undertaken. This also involved telephone calls and personal visits supplemented by discussions with the IDA enterprise development and small business sections. The investigation paid particular attention to the organisations with which individuals had been associated before they established an electronics manufacturing firm.

Table 1: Sources of Irish Electronics Companies

Source	No. of Firms	Per cent of total
Electronics Manufacturing	6	17
Other Electronics Business	5	14
Educational Institutions	3	9
Non-Electronics Sector	11	31
Overseas Sources	5	14
Miscellaneous Sources	5	14
Total	35	99

Table 1 shows that six of the 35 Irish companies originated from existing electronics manufacturing industry. The six companies can be classified

as direct and indirect spin-offs. Direct spin-offs were formed by promoters immediately after leaving the incubator firm. Four companies fell into this category. Indirect spin-offs were companies whose promoters worked in other organisations subsequent to leaving the electronics incubator firm but before forming their own company. The remaining two companies fell into this category and in both cases, much of the technical experience necessary for the spin-off operation was acquired from the electronics incubator organisation.

Extended personal interviews were conducted with the principal promoters of each of the six spin-off companies. Two main sets of data were collected: the first related to the characteristics of the incubator company at the time the respondent was an employee; the second concerned the circumstances of the spin-off and some personal characteristics of the promoters. The interview questionnaire reflected factors which have been shown in the literature to affect spin-off potential. In the first category size of incubator company[6] and skills and experiences gained within the incubator organisation[7] have been highlighted; in the second category, items discussed in the literature include the availability of venture capital[8] and the environment of complementary technical services to support the embryonic manufacturer.[9] This study also examined a number of variables relating to the business functions carried out in the incubator organisation. The existence of R.&D. and marketing activity was investigated. R.&D. was differentiated by basic research and development (including product modification). Product type, manufacturing operations and scale of production were also examined. Finally, the degree of autonomy enjoyed by the local branch plant (in the case of foreign-owned companies) was investigated.

CHARACTERISTICS OF INCUBATOR ORGANISATIONS

The findings of the survey on the characteristics of the incubator organisations are as follows:

(i) *Nationality:* one of the six incubator companies was Irish and five were multinationals (MNCs), four American and one British.

Table 2: Spin-Off Rate by Nationality

Nationality	No. of Companies	No. of Spin-Offs	Spin-Off Ratio
MNC	74	5	1 : 15
Irish	35	1	1 : 35
Total	109	6	

The apparent bias towards spin-offs from MNCs (Table 2) is much less significant when the relative employment of the two categories is taken into account. MNCs employ more than 80 per cent of the industry workforce reflecting the much larger average size of non-Irish electronics firms.

(ii) *Size:* Table 3 gives the number of spin-offs by employment category. In the interview two further categories were included, i.e., 30 to 99 and 250 to 500 employees, but none of the six incubator organisations fell into either of these categories.

Table 3: Spin-Off Rate by Employment Category

Employment Category	No. of Companies	No. of Spin-Offs	Spin-Off Rate
10–29	30	1	1 : 30
100–249	16	1	1 : 16
Over 500	6	4	1 : 2
Total	52	6	

Among the large companies, approximately one in two had a spin-off. The fact that large companies had more spin-offs suggests that size may be related to incubator activity. This finding contradicts other studies which have shown that smaller companies (less than 500 employees) have more spin-offs than large ones.[10] A possible explanation for this disparity is that in Ireland spin-offs are presently occurring mainly from the "foundation" companies of the electronics industry, which tended to be large multinational companies.

(iii) *Product Category:* The firms in the industry may be categorised under five main product groups: components; computers and peripherals; consumer products; instruments and industrial controls; and telecommunications products. Table 4 classifies Irish electronics firms by product group and attempts to relate spin-off activity to this characteristic.

Table 4: Spin-off Rate by Product Category

Product Category	No. of Companies	No. of Spin-offs	Spin-off Rate
Components	29	1	1 : 29
Computers etc.	14	—	—
Consumer Products	21	2	1 : 11
Instruments etc.	26	2	1 : 13
Telecommunications	17	1	1 : 17
Total	107	6	

Although the number of spin-offs in each category is very small, the table shows that consumer products had the highest rate of spin-off. This was closely followed by instruments and industrial controls, with no spin-off from computers and peripherals.

(iv) *Research and Development:* the survey found that all incubator firms undertook some R.&D. and that in every case this R.&D. was developmental rather than basic. This result is very significant in so far as only 34 per cent of firms in the industry are known to engage in any form of R.&D. activity.

(v) *Stages of Production:* all incubator firms were involved in final assembly and product testing; there was no example of primary electronic fabrication. This finding merely reflects the current nature of manufacturing in the Irish electronics industry. (Only one company is engaged in high level fabrication).

(vi) *Scale of Production:* Table 5 contains an analysis of spin-off activity related to scale of production. The reason for a higher rate of spin-off from large volume producers is not obvious when viewed in isolation. It reconciles, however, with the earlier findings of relatively more spin-offs from large firms, particularly those producing consumer goods.

Table 5: Spin-off Rate by Scale of Production

Scale of Production	No. of Companies	No. of Spin-offs	Spin-off Rate
Single units/small batch	73	2	1 : 37
Large batch/mass production	36	4	1 : 9
Total	109	6	

(vii) *Marketing:* four of the incubator companies (including the Irish company) had an in-house marketing function. Marketing for two MNCs was handled by the parent company. The fact that three out of five MNCs in this survey carried out marketing in their Irish plant must be viewed in the context of another study which found that only 25 per cent of MNCs in the electronics industry have a marketing function based in Ireland.

(viii) *Degree of Autonomy:* the respondents were asked to identify where decision-making authority resided for the following corporate decisions: selection of products to manufacture, product adaptation, product pricing, market selection and product promotion. The Irish company and one of the MNCs made all the decisions locally. The four remaining MNCs had all these decisions made in the parent company (two cases), in the European regional office (one case), and jointly with the parent company (one case).

(ix) *Summary:* Table 6 contains a summary of the characteristics of incubator organisations. Serial numbers are used to represent the companies in order to preserve confidentiality.

Table 6: Characteristics of Incubator Organisations

Characteristic / Serial Number	Type of Organisation	Size	Product Group	R.&D. Performing?	Stages of Production	Scale of Production	Marketing Function	Location of Selected Strategic Decisions (a)
1.	MNC	Large	Components	Yes	Component assembly & Test	Mass production	No	Parent
2.	MNC	Medium	Instruments & Industrial Controls	Yes	Final assembly & Test	Small batch	Yes	Local Region Parent
3.	"Irish"	Large	Telecom-munications	Yes	Component assembly & Test Sub-assembly & Test Final assembly & Test	Large batch	Yes	Local
4.	MNC	Large	Consumer	Yes	Component assembly & Test Sub-assembly & Test Final assembly & Test	Mass	No	Parent
5.	MNC	Large	Consumer	Yes	Final assembly & Test	Mass production	Yes	Local
6.	MNC	Small	Instruments & Industrial Controls	Yes	Component assembly & Test Final assembly & Test	Small batch	Yes	Region

(a) Selected strategic decisions are (i) choice of products (ii) adaptation of products (iii) price of products (iv) market selection (v) product promotion.

CIRCUMSTANCES OF SPIN-OFF

In this section we give the survey findings on the circumstances under which spin-offs occurred and on the personal background of the promoters.

(i) *Age of Spin-Off Companies:* three of the spin-off companies were set up in 1979, one in 1978, one in 1974 and one in 1971. The recent origin of most of the companies is both surprising and disappointing. It raises a question about the average life-expectancy of Irish spin-off firms.

(ii) *Experience of Promoters:* Table 7 contains a summary of the business functions performed by principal promoters in their incubator organisations. The importance of R.&D. is particularly noteworthy. These findings reconcile with Roberts and Wainer's study of firms spun-off from MIT Laboratories where it was found that promoters tended to have worked in developmental research during their period of employment.[11]

Table 7: Functions Performed by Principal Promoters in their Incubator Organisations

Serial Number	R.&D.-Related Functions	Other Functions
1.	Process Development Process Adaptation	Nil
2.	Product Development Product Adaptation	Marketing Purchasing
3.	Product Development Product Adaptation	Nil
4.	Product Development Product Adaptation Process Development Process Adaptation	Manufacturing and production trouble-shooting Equipment maintenance Quality Control Purchasing
5.	Product Development Product Adaptation	Manufacturing Quality Control Marketing Purchasing
6.	Product Development Product Adaptation	Purchasing

(iii) *Products of Spin-Off Companies:* all but one of the spin-off companies manufactured products which were in the same product group as the incubator firm. This agrees with Cooper's finding that 85 per cent of his sample exploited the same general technology as the incubator firm.[12] Even when the Irish spin-off company changed and extended its product range, it remained within the same product group as the incubator company.

(iv) *Initial Markets:* none of the spin-off companies commenced manufacture with the security of a definite order for its products and none was engaged in subcontract work for its incubator company. Spin-off companies, however, have not developed significant export markets (except for some sales to the United Kingdom).

(v) *Role of Innovation:* only one of the six spin-off companies was founded on the basis of an innovative idea which the promoter wished to commercialise. Furthermore, the single innovating company subsequently had to abandon its plan (to make telephone memory diallers) in the face of foreign competition.

(vi) *Use of Technical Services:* the respondents were asked if they purchased external technical services such as machining, plating, data processing etc. at the time of start-up. Only two of the companies purchased external services: one bought technical and accounting services, and the other purchased a technical service. These findings indicate that the availability of complementary technical services did not play a major role in the formation of the spin-off companies.

(vii) *Start-up Capital:* the median capital required to found the six companies was £19,500. This included initial working capital and product and process development costs. In most cases, the latter costs were over two-thirds of capital requirements. The respondents were requested to rank-order the sources of their initial capital on a scale of 1 to 7. In five of the six cases personal assets (savings, sale of property etc.) was ranked as the primary source. The detailed rankings are given in Table 8.

Table 8: Rank Order of Sources of Funds (a)

	Sources						
Serial Number	Personal sources	Bank	Other lending agency	IDA grant	Other grant	Sale of shares	Other sources
1	3	—	2	1	—	—	—
2	1	2	4	3	—	—	—
3	1	3	—	—	2	—	—
4	1	—	—	2	—	—	—
5	1	6	—	7	—	—	—
6	1	—	—	2	—	—	—

(a) The respondents were asked to give a score of 1 to the most important source of start-up capital i.e. the source contributing 50% or more of capital, a score of 2 to the next most important source, etc.

The respondents were also asked if they encountered difficulties in obtaining money from lending agencies. Three out of the six answered in the affirmative, two had no difficulty, and one did not seek agency funds. In the cases where difficulty was experienced, the banks were mentioned

as the most reluctant source of money because they inherently distrusted technical companies. In view of the fact that most of the spin-off companies were financed primarily from personal funds and that funds from non-personal sources were difficult to obtain, it may be inferred that venture capital was not available in the environment.

(viii) *Employment:* in three cases the promoters of the company were the sole employees at the time of start-up. In the remaining cases, employment at start-up included the promoters and a maximum of three other employees. In mid-1981 average employment for the six companies was 24.

(ix) *Number of Promoters:* three of the companies had a single promoter and the other three each had two promoters. This finding is borne out by studies of entrepreneurship elsewhere. In the U.S. Sausbauer[13], Cooper[14] and Shapero[15] variously showed that the proportions of new technical firms started by groups of two or more entrepreneurs were 48% (Austin), 61% (Palo Alto) and 59% (a study of 955 geographically diversified firms).

(x) *Personal Data:* all nine entrepreneurs involved in forming the six spin-off companies were male. Apart from one co-promoter who had formal training in banking and commerce, all the rest were qualified engineers. All nine had received third level education and four had obtained master's degrees. This finding agrees with other research results on technical entrepreneurship. Roberts[16] and Sausbauer[17] found that the median educational level of entrepreneurs was a master's degree. These findings about the educational level of technical entrepreneurs conflict with earlier studies of non-technical entrepreneurs which showed that entrepreneurs tended to have moderate educational qualifications and, in some cases, actually dropped out of high school. It is not surprising, however, that technical entrepreneurs are found to have a master's degree because it appears that the competitive advantage of new technology-based firms may be closely related to the technological knowledge of their promoters.

(xi) *Motivation:* in order to ascertain why the respondents behaved entrepreneurally, they were asked what prompted them to form their own company. Their responses are tabulated in Table 9.

Table 9: Reasons for Forming Own Company (a)

Reason	Number of Respondents
Uncertain career prospects in incubator organisation	2
Always wanted to start own company	2
To control my own destiny	1
Challenge of going it alone	1
Total	6

(a) The statements tabulated in Table 9 are the answers given by the respondents. The last three are not mutually exclusive.

Two out of the six respondents were prompted to start their own companies by bleak career prospects. Shortly after these two respondents left their incubator organisations, the latter went into liquidation. This type of negative trigger is what Draheim refers to as a "push"[18]. In other words, the individuals were forced into entrepreneurship by factors beyond their control. The other four respondents gave a variety of answers which may be summarised as a desire "to go it alone" which in Draheim's terminology is regarded as a "pull".

(xii) *Summary:* Table 10 contains a summary of the circumstances of spin-off and personal data on promoters for the six companies surveyed. Companies are again represented by serial numbers to maintain confidentiality.

SUMMARY AND CONCLUSIONS

This study attempted to look in depth at spin-off activity in the manufacturing sector of the Irish electronics industry. Only six of the one hundred and nine firms in the industry can be classified as spin-off companies (under the definition adopted here). As a result, the sample is too small to enable us to pronounce authoritively on the profile of spin-off companies or on the characteristics of incubator organisations. Some general observations, however, are offered. The incubator companies tended to be large (over 500 employees) U.S. multinationals, manufacturing consumer products or instruments. They produced standard products in large volume, but engaged in some product development/adaptation to meet the specific needs of the European market. Three of the companies had a marketing presence in Ireland. The spin-off companies were mainly of recent origin employing, on average, twenty-four people. They manufactured products in the same product group as their incubator firm and showed little evidence of significant innovation in their initial products or processes. The main promoters had obtained varied but broad experience in the incubator organisations. However, they all shared one important technical experience: exposure to the product/process development function during their period of employment. All the nine promoters involved in setting up the six spin-off companies had received third-level education and four of them had a master's degree. All the main promoters, and all but one of the co-promoters, were qualified engineers.

One conclusion to be drawn from the study is that the level of spin-off activity in the Irish electronics industry has been very low. The six spin-off companies constitute five per cent of the firms, but only one per cent of the industry employment. Another conclusion must be that the technological calibre of the spin-offs is uncertain. They were founded on a doubtful technological base: they did not embody any product or process

Table 10: Circumstances of Spin-Off and Personal Data on Promoters

Serial Number / Attribute	Year Established	Products at Start	Product similarity with Incubator Organisation. Actual/Group (a)	Products Now	Definite order for Products Prior to Start up?	New Company based on Innovative Idea?	Start-up Capital	Primary Source of Capital	Employment at Start	Employment Now	No. of Promoters	Educational Background of Promoters	Formal Qualification of Promoters
1.	1979	Printed circuit boards	No/Yes	Printed circuit boards	No	No	£100,250	IDA Grant	2	14	1	Mechanical and Industrial Engineering	B.E. and MIE
2.	1974	(i) Process timers (ii) Beer's law converters	No/Yes	Various equipment for haematology	No	No	£ 30,000	Personal	3	15	1	Electrical engineering and Accountancy	B.E. and M.Sc.
3.	1978	Relay sets in power units	No/Yes	(i) Trunk dialling unit (ii) Meter recording systems etc.	No	No	£ 14,000	Personal	1	42	1	Electrical Engineering	B.E. and M.Sc.
4.	1979	(i) Memory dialler (ii) Process control equipment	No/No	(i) Broadcast equipment (ii) Process control equipment etc.	No	Yes (Memory dialler)	£ 14,000	Personal	2	8	2	(i) Elec. Eng. and Acctcy. (b) (ii) Elec. Eng.	(i) Dip. (b) (ii) Dip.
5.	1971	Pocket transistor radios	No/Yes	Transistor radios Record players TV sets 'Phone answering equipment.	No	No	£ 14,000	Personal	5	64	2	(i) Elec. Eng. (ii) Banking/	(i) B.E. & M.Sc. (ii) B.A.
6.	1979	Process control equipment	Yes/Yes	Process control equipment	No	No	£ 25,000	Personal	2	6	2	(i) Elec. Eng. (ii) Mech. Eng.	(i) Dip. (ii) Dip.

(a) "Actual" refers to the products of the spin-off company, "Group" refers to the grouping of the products as explained above. Thus, No/Yes means that the products of the spin-off company are dissimilar to those of the incubator organisation but the product groups are similar.
(b) The first case (i) refers to the principal promoter and the second case (ii) refers to the partner (second promoter).

innovation or look to the local environment for technical support services. They were spun-off by large mass-production organisations producing mature products. A high level of technological sophistication is more likely with products made in small quantities or to individual customer specification. A further conclusion is that the life-expectancy of Irish spin-off companies is relatively short. Most of the companies now in existence were founded within the last three years. It could of course be argued that serious spin-off activity did not develop in Ireland until the late seventies but this proposition appears difficult to defend. It is possible to make some general recommendations. First, when promoting Ireland as a manufacturing base for foreign companies it is desirable to attract companies which are potential incubator organisations, viz, companies with a full range of corporate functions who, as a minimum, engage in product development/adoptation in their Irish plant. Secondly, it is necessary to identify and foster potential technical entrepreneurs viz. well educated technologists who have wide experience in industry particularly in the research and development function. Perhaps the single greatest deficiency at the moment is adequate venture capital for such individuals.

Finally, it is recommended that the progress of the six spin-off companies be monitored over the next few years. The factors which may cause new technology-based spin-off companies to fail are just as important to study and to understand as those which make them succeed.

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