INNOVATION IN ESTABLISHED IRISH INDUSTRY

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Introduction

The study reported here is essentially an exploratory mapping exercise, carried out in the Summer of 1984.[1] A great deal needs to be done before we can offer a comprehensive view of innovation in Ireland, which might form the basis of a well-conceived set of policies to support industrial growth. Much has already been done in specific areas [Cogan, 1984; Murray, 1983], yet surprisingly little is known about the general innovative practices of the broad range of middle-sized, established, Irish companies – presumably the seed-bed from which the Telesis-recommended [NESC, 1982] "internationally competitive entities" are expected to grow.

Since the present study had its genesis in a piece of research carried out over 10 years ago by Professor Allen of the Massachusetts Institute of Technology [Allen, 1979] it might be appropriate to set it in context by recapitulating briefly some salient features of that earlier work.

A complete listing of all firms engaged in manufacture at that time (1971), listed by size group within 43 industry categories was used to develop a population for study. Seventeen unimportant industry groups were excluded from the intended coverage of the study. All firms with less than 50 or more than 500 employees were also excluded. Any firms newly established under IDA auspices were screened out. Thus, the initial target population consisted of all medium sized indigenous (or long-established subsidiary) companies in 26 important industrial sectors. In the event, time limitations forced a further concentration on the 12 most important of these sectors. (Importance was defined in terms of output, employment and exports.) From this population a sample of one firm in three was chosen at random from within each size and industry group, giving a total of 81 firms, 75 of which co-operated in the study (four had ceased to manufacture, two refused).

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The present study is based on the survivors from among these companies. We have given in detail the sampling plan of the original study, because it is important to understand the statistical basis of the current work. The firms we intended to study constitute a representative sample (one firm in three) of all surviving longer-established companies of medium size in the 12 most important industries in the country. Because of time constraints, we concentrated in this study on companies in the IDA East Region, which comprises counties Dublin, Kildare, Meath and Wicklow. Given the somewhat different industrial mix in this and other regions, our findings should not be generalised to the country as a whole. Since, however, the companies included represent such a substantial proportion of survivors, among leading industries, in what is arguably the most advanced industrial region of the country, the findings are unlikely to overstate the true situation with respect to industrial innovation.

While the surviving companies covered in this and the earlier study were identical, the contents of the studies differ. Allen's study focussed on each company's most recent significant innovation. He sought to establish the sources of initial ideas as well as the sources which companies used to "problem-solve" in order to translate the ideas into commercial reality. The present study covers these topics, but also extends to broader questions of innovation within the firm. Each firm was visited and the chief executive – as well as other relevant executives – interviewed about the following topics: (i) the firm's history of growth or contraction since the previous study; (ii) the nature of its strategic position, in terms of the growth or decline of its total market and market share; (iii) *all* attempted technical innovations of a product or process nature in the preceding five years, detailing their size, degree of novelty, success or failure, reasons for failure, etc.; (iv) the sources of ideas for each innovation, and the sources used to help solve any problem(s) encountered; and (v) the company's future intentions with respect to its competitive position and strategy, the intended place of product and process innovation in that strategy, and the firm's present technical capability for innovation.

The rationale for placing a study of each company's innovation history within the context of its strategic position, intentions and capabilities is simply practical. The reified entity called "Irish Industry" – and in particular the established segment which is the subject of this study – has been the whipping-boy of every industrial study of the last 20 years, for its failure to be or become something other than what it is. An enormous range of so-called helping agencies has been set in place to assist its transformation, largely in vain – for they are apparently little-used [Allen, 1979; NESC, 1982] and have certainly not brought about any transformation.

All policies require persistence if they are to succeed, but if, after over 20 years, a policy of criticising and 'helping' shows no sign of working, perhaps we should be humble enough to admit that our policies may be based upon faulty analysis. Since one of the authors was associated with earlier work in this mode [Tomlin, 1966], we thought it time that a study was carried out which made some attempt to understand the businessman's perspective. Any businessman who has succeeded in surviving the last fifteen years in Ireland is no fool. The country cannot afford to lose many more of its established businesses, for we cannot attract or generate replacements fast enough. Indeed we should look to these established companies for some of our needed growth for, whatever their faults and problems, they are at least there, with some market position, with some managerial resources, and with much hard-won experience of survival in a hostile environment. If we are to develop policies which will be effective in helping these sectors to survive and grow, these policies must be based on a proper and sympathetic understanding of the strategic and competitive situation as the businessman sees it, of the resources available to him, of his experience with attempts at adaptation, of his consequent intentions for the future, of his beliefs about the kinds of assistance he needs and the appropriate mechanisms for delivering it. It is in the hope of shedding some light on such questions, and of providing some useful input to policy formulation, that this study was carried out.

In order to give some pointers to the way in which average firms might develop, a number of newer companies, known to be successful innovators and strong financial performers, was selected for comparison, from the same industry and size groups. Their experience will be contrasted throughout the analysis with that of the established companies. The article has six sections. The first will deal with survival rates among companies, and will describe some features salient to innovation; the second will outline their strategic position; the third will describe their history of innovation; the fourth will compare their current sources of information with those uncovered in Allen's study; the fifth will examine their future innovative intentions, and current resources for carrying them out; the sixth and final section will consider some of the problems they will face, and ask what steps might be taken to help overcome them.

Survival Rates and Company Characteristics

The rate of attrition among companies in the industrial sectors studied is shown in Table 1. About 60 per cent of companies have managed to survive the very testing decade since the first study. The attrition rate was heavier in the East Region than in the rest of the country, because of the better performance of the (largely co-operative) commodity food industry

Table 1: *Survival Rate by Industry and Region*

Industry	IDA East Region Original Sample	IDA East Region Survivors (a)	Rest of Country Original Sample	Rest of Country Survivors
Food				
Bacon	1	0	8	7
Other Meat	3	0	2	2
Milk Products	1	1 (1)	6	6
Choc. & Confect.	4	3 (1)	1	1
Canning	2	2 (0)	4	2
Clothing and Textiles				
Men's & Boy's	5	2 (2)	4	2
Cotton & Linen	1	0	3	1
Paper	7	5 (4)	—	—
Machinery				
Elec. & Electronic	6	2 (2)	2	2
Other	2	2 (2)	1	0
Chemicals & Pharm.	4	3 (2)	1	1
Building Materials	5	4 (4)	2	0
	41	24 (18)	34	24

(a) The numbers in brackets are those who participated in the follow-up study. None refused, but five could not be interviewed before closing date of the study, and one was about to cease manufacture.

in other regions. The price of survival, particularly in the bacon and meat areas of the food sector, has been a loss of independence as a result of absorption by larger groupings. To a lesser extent the same phenomenon is in evidence in areas of the building materials and paper sectors but overall is largely confined to areas outside of the East Region. It is obviously the more protected sectors which have survived reasonably well. Those exposed to competition without the benefit of EEC policy supports have been hit badly. The 'traditional' electrical machinery sector is a case in point. This sector was always weak. Most companies had been in existence as trading operations before the protectionist policies of the 1930s enticed them into a small manufacturing activity. These activities never flourished and, facing heavier competition brought about by EEC entry, most companies reverted to acting as agents for overseas suppliers. Even the survivors have not come through without loss. Only three out of 18 increased the numbers they employed, three remained stable, while twelve reduced their headcount by varying amounts.

It must be said that the industry sector composition of these survivors does not, prima facie, constitute a strong platform on which to build. We are weakly represented in growth industries, and have our only strength in the mature end of the fairly mature food industry. (Even this strength is measured in mere survival, which might have been questionable for many of these companies if EEC intervention policies had not existed.) One might ask to what extent the remaining companies have the freedom to embark on an expansionary policy, even if they had the will and the means to do so. A majority of the East Region firms surveyed are Irish-owned (12 out of 18), and 7 of the 12 are independent. There has been no tendency for these companies to pass into foreign ownership in the 10 years, or even into the ownership of other Irish companies: in fact, the only change was towards greater independence, as a result of a couple of management buy-outs. Although about two in three companies are subsidiaries of one sort or another, this does not mean that they are inhibited from pursuing innovatory strategies. Even in the case of foreign-owned subsidiaries – almost all of which have Irish management – many chief executives stated that they wished to make the Irish subsidiary essential to the parent, by moving from a position of manufacturing a wide range of goods purely for the Irish market, to manufacturing a narrower range for the company world-wide.

If the decade has been one largely of contraction and survival, it has also been one of some more positive change. No fewer than 67% of firms changed their chief executive officer, and 41% of all top management positions saw a change of incumbent. Having survived so far, these new executives may now wish to expand, and, as we shall see, they do.

Strategic Position of Established Firms

There has been no lack in Ireland of industrial analysis (going back to the CIO reports of the early 1960s) offering strategic advice which was largely ignored. Businessmen may have been right to ignore it, for it may have been wrong. If it was, we cannot be too hard on the advisors, because little research had then been done on corporate strategy, and little foundation existed – beyond rather vague and intuitive ideas – on which to base industrial policy.

The position has improved considerably over the last ten years. Largely as a result of the construction by the Strategic Planning Institute of a large data-base (the PIMS project) a great body of writing has emerged, based on reasonable evidence, about the strategic position of business units. While the data-base is of acceptable quality [Hambrick et al., 1982], many of the earlier writings based on it were not: simplistic analyses led to many absurd conclusions and recommendations [Anderson and Paine, 1978]. The position has now greatly improved, and with the more sophis-

ticated analyses of PIMS and other data now emerging, we are increasing greatly our ability to say something sensible about broad approaches to strategy.[2]

In general, all analysts suggest that holding a low or declining market share, especially of a static or declining market, is an unpleasant and unprofitable position to be in [Buzzell et al., 1975]. Even though there are ways to achieve acceptable return on investment in low-share situations – largely by concentrating on quality of product and service [Woo and Cooper, 1981] – these are not only less-preferred situations in themselves, but also constitute situations in which innovation strategies are difficult to follow, especially when based on internal development. Unfortunately, as Table 2 shows, most established companies in the East Region are in exactly such undesirable situations. A majority have either static or declining shares of static or declining markets.

Table 2: *Market Position of Established Companies*

	Overall Market Status		
Market Share	Growing	Static	Declining
Growing	2	1	1
Static	4	1	4
Declining	—	3	2

Strangely enough, the degree of competition experienced from imports is neither especially severe nor growing as Table 3 shows. It may be that some sectors are sufficiently naturally protected – or so unattractive – that foreign competition is not particularly threatening. (That is not to say of course that competition among home-based suppliers is not severe.) It is also significant that exporting companies experience more severe and growing competition from imports than domestic companies. This lends

Table 3: *Import Competition Experienced by Established Companies*

	Type of Company	
	Exporters	Non-Exporters
Intensity of Competition		
Severe	1	1
Moderate	5	1
Low/None	4	3
Change in Intensity		
Growing	3	0
Stable	7	5
No Change	0	3

force to the argument that firms in 'non-traded' industries are relatively secure; firms in other sectors may be forced to export as they experience greater competition on the home market from foreign suppliers.

If the intensity of foreign competition experienced is unexpectedly low, the basis of competition is strategically unpromising. When asked what was the principal basis of competition in their served markets, 75% of companies named price, 17% named quality and 8% named service. This strongly suggests that these companies are selling undifferentiated commodity products, which is certainly no prescription for success in low-share, declining markets. The problem of innovation is something that these firms are going to have to address more directly and with greater urgency than heretofore, according to their stated intentions (see Table 11). It will be difficult for many, in the circumstances in which they find themselves at present, to make the necessary adjustment.

Before considering the recent history of attempted innovation in established companies, we should contrast their strategic position with that of the comparison-group of successful newer companies mentioned above. A total of eight newer companies was chosen, one in food, one in building materials, two in paper and four in machinery manufacture (three electrical or electronic). As well as being in more promising industry sectors, these companies were somewhat larger and somewhat more likely to be foreign-owned than those in the established group. The market position of these new firms is very much stronger than most of the established group. Half of them have a growing share of a growing market, the remainder have a static or growing share of growing or static markets. Virtually all experience low-to-moderate foreign competition, which is not increasing in severity. Furthermore the principal form of competition in the served market is quality (75%) rather than price (25%). Thus, we see that the more successful newer companies have positioned themselves strongly in growing markets where, by offering differentiated products to well-chosen segments, they are avoiding significant price competition. This strategy may not be open to all companies, but the fact that it is being followed successfully, by companies chosen for their innovative reputation, shows that it can be accomplished by firms not very different from those in the longer-established groups.

History of Innovation

Our concern in this section is to establish the amount and nature of innovation among established companies, and to contrast this with the experience of innovative firms here. We shall refer also to international evidence, to see how far the history of attempts here matches experience elsewhere. How much innovation is going on? The 18 established and 8 new firms were asked to report on all product and process innovations

attempted over the previous five years. These innovations were characterised as major or minor by the respondents, on the basis of their importance to the company in terms of their impact on sales, profits, costs or investment required. Thus the terms as used here ae relative – it is impossible at this stage of our knowledge to categorise an innovation as 'objectively' major or minor. The following are some examples of major innovation attempts which will serve to illustrate fairly typical scenarios among established companies:

(i) *Spun-Pipe Manufacture:* While on a visit to similar firms and equipment suppliers in Germany, the production manager of a concrete products manufacturing company saw large diameter reinforced concrete pipes being spun in a form of centrifuge. The equipment was expensive but the incentive of accessing a new high value added market with such products was compelling. The manager was a graduate mechanical engineer with many years of experience in the industry and had been given freedom by his chief executive in the area of process and product development. The German user company was cooperative in allowing him to investigate the design and operation of the system. After 6 months development work a simple machine was constructed for one-tenth of the cost of the one seen in Germany. It was capable of producing up to 90" diameter pipes of very high quality. Prior to this the company was only capable of producing up to 60" pipes of much lower quality. The product was new to the market in Ireland but, because of the high quality, had distinct export possibilities – something unusual in a normally untraded industry sector. Undercapitalisation unfortunately resulted in the joint product and process development not reaping its potential rewards. The idea was subsequently tried by larger domestic competitors but, apparently with less expert knowledge available to them, they were unable to match the process performance of the originators.

(ii) *Process Modernisation:* A food company subsidiary operated a 'wet-process' jelly manufacturing system for many years and it had become uneconomic, largely as a result of labour intensity. The firm's foreign parent decided to concentrate all of its jelly manufacturing in its Irish plant. The product was mature and price sensitive but had a reputation for quality which gave it market leader status. It was important that the production process be made more efficient under these circumstances but there was no standard equipment available with which to modernise the production facility. The parent company had little expertise outside the Irish subsidiary on how to deal with a product of this type and so it was left in the hands of the 'industry-wise' Irish production staff to devise a solution. The production manager, while not professionally qualified as an engineer, had enough practical experience to assess problems and possible solutions and go outside to subcontractors when required.

Knowing through industry sources the type of modern equipment others had installed, management decided to copy and modify the concepts encountered. The development team, centered around the production manager and the quality control manager (who was technically qualified) developed a close working relationship with a firm of machinery manufacturers and suppliers in the U.K. and within one year developed a very successful new process, gained valuable design experience and enhanced the reputation of the Irish operation in the eyes of the parent, which entrusted them with pilot process development of other products.

(iii) *New Product Development:* An electrical company won an order for the supply of radio equipment. Part of the order required the provision of 'duplexors' which enable aerial systems to be flexibly used to transmit and receive. Although the company had extensive experience in the design and construction of aerials, it had no experience of duplexor design and consequently had to go to a firm in the U.S., which specialised in their design and manufacture, to supply that part of the contract. The cost of the units was high. An investigation by the company's professionally qualified chief engineer and design team was started, with a view to establishing whether or not it would be possible to design and manufacture such units within the existing resource-base of the company. As a result it was decided to branch out into the area with some simple units. All of the design and manufacture could be carried out in-house with the exception of internal surface finishing which it was decided to contract-out. On receipt of an order which included duplexors, the company produced its first commercial batch. Gradually the professional staff extended their design expertise and the range of products in the area rapidly expanded, currently representing a major source of export earnings for the company in directly related markets to their main-stream activity.

Minor innovations, such as the introduction of slimline milks by one milk products company and similar product-line extensions, product improvements and process improvements, of course abound. In general, however, these innovations are 'minor' because they involved comparatively little adaptation or novelty and had relatively little impact on performance. In all, 47 major and 85 minor attempted innovations were mentioned by established firms, and 53 major innovations by new firms. This represents an annual rate of 0.52 'major' innovation attempts and 1.33 'major' innovation attempts by old and new firms respectively. Since the success rate of old firms was 68% and that of new firms was 98%, the annual rate of successful innovation was 0.36 and 1.30 respectively. That is to say, established companies make a successful major innovation roughly once every three years, while newer companies do so roughly every nine months.

Table 4: *Sectoral Performance Measures on a Company Basis*

Sector	Annual Rate of Total Innov.	Success Rate	Annual Rate of Successful Innov.
Food	0.90	78%	0.70
Building Materials	0.60	92%	0.55
Machinery Manufacturers	0.30	33%	0.10
Electrical & Electronic	0.50	20%	0.10
Paper	0.60	67%	0.40
Chemical & Pharmaceuticals	—	—	—
Men's & Boy's Clothing	0.60	67%	0.40
Average	0.52	68%	0.36
New Company Average	1.33	98%	1.30

There is considerable variation from sector to sector among the survivors, both in the rate at which they attempt innovation and in the degree of success which they achieve.

The very low rate of attempts, and the even lower rate of success, in the machinery and electrical sectors is disappointing. The fact that there are so few survivors in these crucial sectors, and that the survivors perform so poorly, is a measure of the task facing us in developing an indigenous industry with a decent technical base.

How does the rate of innovation here compare with other countries? The best-known, broad-ranging studies of product innovation performance are those carried out by the consulting firm of Booz-Allen and Hamilton. The most recent such study [Booz-Allen 1982] shows that "from 1976 to 1981 . . . the median number of new products introduced (by U.S. companies) was 5. Over the next five years that number is expected to double". Elsewhere it is stated that there were "13,000 new product introductions between 1976 and 1981 in the 700 companies (we) surveyed" and "a 65-percent rate of success was achieved". Their reported findings are somewhat ambiguous but, taken at face value, it appears that the median annual product innovation rate per firm in U.S. manufacturing industry is 1, yielding one successful product launch every 18 months. Extrapolating their figures would seem to indicate a current successful innovation rate of approximately one per annum. It should be remembered that the recorded innovation experience of Irish companies in our study includes *both* product and process changes. If only successful *product* innovations are counted, we find an annual rate of 0.3 for older companies and 1.2 for newer companies. Clearly, the better firms are performing at, or somewhat above, the current median American value. Equally clearly the older firms are, in general, significantly less innovative than their U.S. counterparts. We must, however, remember (although Booz-Allen give

no information on company size) that the U.S. companies in their study are likely to include some of the largest and most advanced corporations in the world. It would be absurd to expect such small companies as we studied to match their rate of product innovation. The three to four-fold difference in successful innovation rates is, however, an indication of the significant challenge facing the older companies if they wish to play in the bigger international league. The results achieved by the new companies show that an acceptable level of performance by international standards can be attained by indigenous Irish companies.

While something can be learned by comparing overall innovation rates, more may be gained by studying rates of success and failure. Virtually all minor innovations, whether in older or newer companies, were successful. We shall therefore confine our analysis to major innovation performance. It is well-known from international studies that process innovations are more likely to succeed than product innovations; that incremental innovations are more likely to succeed than radical ones [Cooper, 1980]; and that innovation attempts are more likely to fail for commercial than for technical reasons, especially when they involve entry to radically new markets [Cooper, 1975]. As we shall see, Irish and international experience match very closely in all respects.

Product Versus Process Innovation

It was not always possible to divide innovations neatly into these two distinct classes – in many instances the novelty of product and process were inextricably bound together. True to expectations, established companies achieved a higher rate of success with innovations involving process changes than with changes which were purely product-oriented. Newer companies on the other hand were successful with all their attempts at purely product-based innovation, as Table 5 shows. These success rates are phenomenally high, for every kind of innovation and for

Table 5: *Major Innovation Successes and Failures Over the Last Five Years, by Type of Innovation and Company*

	Established Companies			New Companies		
Outcome	Product	Process	Both	Product	Process	Both
	%	%	%	%	%	%
Failed in Development	16	0	0	0	0	0
Failed in Commercialisation	21	0	24	0	0	0
Success Unclear	5	29	0	0	0	25
Successful	58	71	76	100	100	75
	100	100	100	100	100	100
Number of Innovations	19	7	21	45	4	4

every kind of firm. The latest Booz-Allen survey shows that, among the U.S. firms they studied, only one product in five put into development succeeds commercially: about 67% fail in development or testing (usually because of negative commercial feedback), while about 33% of the survivors fail after being commercialised. It would appear that Irish companies follow a more conservative policy than larger U.S. corporations, introducing fewer and 'safer' products. Such failures as there are take place at the commercialisation phase rather than in development – bearing out the general experience that products are more likely to fail for commercial rather than technical reasons.

Radical Versus Incremental Product Innovation

The word 'radical' in this context does not mean the sort of innovation which transforms or creates an industry, such as the advent of the transistor. It refers merely to the degree of novelty of the innovation and associated activity relative to the company itself. As we indicated above, general experience is that the probability of a particular innovation being successful becomes lower the less familiar the areas of involvement are to the company concerned.[3] The tables which follow show that this also holds true in an Irish context. The degree of novelty involved in a product innovation can be characterised in a number of ways. One of the most satisfactory is that of Heaney (1983), which is used in Table 6.

Table 6: *Major Product Innovations by Original Company Group, by Novelty and Success (N = 40)*

Outcome of Attempt	Novelty of Innovation			
	Product Improvement	Line Extension	New Product for Established Market	New to World
Failed in Development	—	6.7%	6.7%	14.3%
Failed in Commercialisation	—	6.7%	20.0%	71.4%
Outcome Uncertain	—	6.7%	—	—
Successful	100%	80.0%	73.3%	14.3%

The greater the degree of novelty in the innovation, the less likely it is to be successful; and the more novel it is, the more likely it is to fail in commercialisation. Further light can be cast on this phenomenon by using a classification developed by Berry and Roberts (1983), which characterises innovations by their joint technical and market novelty.

FAMILIARITY MATRIX

Market Factors	S	T	S	T	S	T[a]
New Unfamiliar	—	—	0.0	7.5	0.0	2.5
New Familiar	100.0	5.0	73.0	27.5	66.7	7.5
Base	100.0	5.0	75.0	40.0	50.0	5.0
	Base		New Familiar		New Unfamiliar	

Technology Factors

(a) The above analysis is based on 40 major product-linked innovation attempts in the established group of companies.
S — Denotes the percentage success achieved within the category.
T — Denotes the percentage of the total number of innovation attempts falling within the category.

Three things can be seen on inspecting this diagram. First, established Irish companies stick, for the most part, to familiar markets and/or technologies when they engage in innovation. Second, they are relatively successful when they do so, and quite unsuccessful when they do not. Third, they have more success with unfamiliar technologies (provided the market is familiar) than they have in unfamiliar markets. The fact that Irish experience matches that of foreign firms so closely is not of merely academic interest. As we shall see, many established firms wish to break out of their currently undesirable strategic positions by entering new markets based on new products. This will involve them, not merely in more innovations, but in more high-risk innovation.[4] The strategic implications of these facts are obviously of great significance to the companies concerned.

Sources of Ideas and Problem Solution

One of the aims of this study was to follow up, ten years later, Allen's study which focussed on the sources of ideas for Irish innovations, and on the sources the innovators turned to for help in solving problems encountered in bringing their ideas to fruition. Allen discovered that it was three years on average since the firms' last significant innovation. He also discovered a preponderance of process (68%) over product innovation (32%), though he indicated that these categories were often difficult to discriminate in particular instances. Since the surviving companies visited in the present study produced a major innovation on average every three years (which would suggest a mean interval of 18 months since their last major innovation) it looks as if their rate of innovation – while still low – has doubled in the last ten years. Furthermore, since product or combined innovations now account for 80% of all major innovations, it looks also as if there has been a substantial shift in the relative balance towards new product development. This shift in direction has been particularly marked among Irish-owned firms. These are hopeful signs. Too much should not be read into them, however, for there are certain difficulties in

comparing the results of Allen's study with the present one. This study is based on the survivors from Allen's, who may always have been more innovative than those who failed, thus increasing the apparent rate of innovation. Furthermore, it concentrates on the East Region, excluding thereby a large number of food processing companies. These may reasonably be considered more likely to engage in process rather than product innovation and, purely on a cost basis, to adjudge process changes to be more significant than new products.

Sources of Ideas for Innovation

The limitations mentioned above should be borne in mind when considering changes in the sources of ideas between the two studies.[5] As Table 7 shows, there has been a slight shift among survivors towards internal idea generation. New companies are even more apt to generate ideas themselves.

A tendency to self-reliance could be interpreted as an index of technical sophistication. This interpretation is supported by the data in Table 8, which show the higher technology industries as much more self-reliant than the others. Thus the slight move in this direction suggests a positive development in innovative potential. Table 9 shows the percentage of idea-generating messages received from each external source. (The average number of external idea-generating messages per innovation was about two). The table is complex, yet it demonstrates interesting stabilities, differences and changes.

Table 7: *Source of Idea Generating Message*

		Present Study	
	Allen's Study	Survivors	New Firms
Internal	21.3	25.0	43.0
External	78.7	75.0	57.0

Table 8: *Location of Technology Sources used in Hi-Tech Industries*

Sector	Source					
	Within Firm			Outside Firm		
	"A"	"S"	"N"	"A"	"S"	"N"
Hi-Technology (Electrical & Electronic, Chemicals & Pharmaceuticals)						
Other	19.4%	25.0%	33.3%	80.6%	75.0%	66.7%

Note: These figures are exclusive of documentary sources.

"A" = Allen's Studies
"S" = Survivors
"N' = New Firms.

Table 9: *Percentage of Total Externally Generated Ideas by Source and Type of Firm*

Source of Messages	Irish Companies			Foreign Companies		
	Allen's Study	Present Survivors	Study New	Allen's Study	Present Survivors	Study New
Commercial Sources						
Irish Companies						
Parent Co.	1.8	—	—	n.a.	n.a.	n.a.
Customers	0.9	23.8	—	—	16.7	20.0
Consultants	—	—	—	—	—	—
Suppliers	2.7	—	—	6.9	—	—
Same Industry	5.4	—	—	6.9	—	—
Different Industry	—	—	—	10.3	—	—
Total	10.8	23.8	0	24.1	16.7	20.0
Foreign Companies						
Parent Co.	n.a.	n.a.	n.a.	34.5	33.3	40.0
Customers	5.4	—	33.3	—	—	20.0
Consulants	3.6	—	—	3.4	—	—
Suppliers	27.9	9.5	—	20.7	16.7	—
Same Industry	24.3	28.6	66.7	10.3	—	20.0
Different Industry	—	4.8	—	—	16.7	—
Total	61.2	42.8	100.0	68.9	66.7	80.0
Trade Fairs						
Irish	2.7	—	—	—	—	—
Foreign	5.4	9.5	—	—	—	—
Total	8.1	9.5	0	0	0	0
Other Sources						
Support Agencies						
Government Department	3.6	—	—	3.4	16.7	—
Industry Association	3.6	9.5	—	—	—	—
University/Research Institute	1.8	—	—	—	—	—
Total	9.0	9.5	0	3.4	16.7	0
Publications						
Trade Journal	8.1	14.3	—	—	—	—
Other	2.7	—	—	3.4	0	0
Total	10.8	14.3	0	3.4	0	0

The most obvious finding is that direct personal contact with commercial firms remains overwhelmingly the most important source of ideas for all companies. Publications contribute only a small percentage of ideas (and only to established Irish companies). Support agencies of one sort or another continue to be ignored; the earlier evidence of the contribution of

universities and state-funded research agencies has vanished. This is not surprising at the idea-generating stage. Most of these companies are clearly commercially rather than technically driven, and the important message for them is one which indicates that an idea has commercial possibilities – often on the basis that it is already being commercialised elsewhere. Such market-led ideas are unlikely to transfer from universities to an established company, and we should therefore not expect a significant traffic in original ideas until companies add a technological drive to their current commercial drive. Foreign trade fairs remain a small but useful source of ideas for native companies. However, since the vast bulk of ideas come from direct contact with companies, we shall confine the rest of this discussion to examining patterns in their use. Foreign sources remain much more important than domestic sources, for all firms. Indeed, except in the case of established Irish firms at present, they contributed, and continue to contribute, a majority of all external ideas.

One interesting change in the use of domestic sources is that established native companies appear much more likely now that in the past to use domestic customers as idea sources (0.9% to 23.8%) and much less likely to use foreign suppliers or vendors (27.9% to 9.5%). This undoubtedly reflects the apparent shift from process innovation (in which equipment supplies from abroad are likely to be important) to product innovation (in which customer tastes are more likely to be dominant). It is a little disappointing that established native firms do not make more use of foreign customers as idea sources, something they will clearly have to do if they wish to enter export markets with new products. In this respect it is gratifying to see how many ideas newer Irish firms derive from foreign customers (33%).

The surprising fact to emerge from the table is the continuing reliance by native companies on foreign firms in the same industry. What is even more surprising is the extraordinary importance of this source for new companies – all of which tend to be in export markets and in areas of higher technology than established firms. Generally, however, firms making use of this source of ideas either operate in lightly traded, process dominant, industrial sectors or were able to observe the operations of foreign firms in the course of travel. Allen had expressed legitimate fears that this source of ideas would dry up on entry to the E.E.C., with foreign firms now seeing us as competitors, and consequently being less willing to share ideas with us. Indeed his original analysis showed that there was substance to this fear. The threat appears, however, not to have emerged with any force.

It is interesting in this context that foreign-owned companies hardly use this source at all. Not surprisingly, they make heavy use of the resources

Table 10: *Percentage of Problem-Solving Messages by Information Source and Company*

Source of Message	Allen's Study	Present Study	
		Survivors	New Firms
Internal	38.6	37.1	29.2
External			
Commercial			
Domestic	20.9	8.6	12.6
Foreign	36.0	40.0	54.2
Other			
Domestic	2.7	8.6	4.2
Foreign	—	—	—
Documentary	1.8	5.8	—
	100.0	100.0	100.0

of their parent companies. Clearly, Irish firms, lacking a parent in the same industry abroad, are forced to access non-parents. Their continued ability to do so is vital to their innovative success. Allen's fears may yet be justified, as firms seek more determinedly to enter foreign markets. In this event, they will have to work harder to tap their external sources, and also increase their capability to generate technology in-house, as those in higher technology industries have already had to do (Tables 7, 8 above).

Sources of Problem Solution

Companies were significantly more self-reliant in solving problems than in generating ideas. Nonetheless, a majority of their problem-solving messages came from outside. (The average number of problem-solving messages per innovation was about 2.5). Furthermore, foreign sources have become more important for established companies, and are exceptionally important for new ones.

Problem-solving messages tend to come from a more even spread of commercial sources than is the case with idea-generating messages, but foreign commercial sources remain by far the most important external source of reference. Publications are used hardly at all, universities never. There has been an increase in the use by established firms of government sponsored support services, such as IIRS, AFT etc.: these now constitute about 12.5% of all external messages as against 3.3% ten years ago. It must nonetheless be considered disappointing that their contribution is so meagre, especially at the problem-solving stage, where they might reasonably be expected to be more prominent than in idea generation. It is particularly disappointing that the new, higher-technology companies make hardly any use of them. Allen's strictures on some support agencies, based on his previous study, aroused considerable controversy. It is clear from the present study that they were well-founded, and surprising that

they have not led to a more positive response. It will be argued that these agencies contribute much in other ways. No doubt this is true. Yet the fact that they continue to have so small an impact on the innovative practices of such a substantial segment of Irish industry suggests strongly that, just as businessmen must significantly alter their strategic thinking, so must our policy makers fundamentally re-think our whole approach to the support of industrial innovation.

Strategic Intentions and Resources

There is no point in expecting innovative behaviour unless executives intend to innovate, nor is there any point in devising support mechanisms until we know what resources companies have for putting their intentions into practice.

We saw in the last section that there are already signs of movement among surviving companies toward a somewhat more innovative stance. Table 11 shows that almost all executives interviewed in established companies stated that new product development would be a significant element in their future competitive strategy – which usually aimed at sales growth, often in export as well as domestic markets.

Table 11: *Future Market Development Intentions of Established Companies*

	Target Market		
Strategic Objective	Domestic Only	Domestic and Export	Total (a)
Growth via NPD (b)	22%	39%	61%
Maintain via NPD	17%	6%	23%
Growth No NPD	—	—	—
Maintain No NPD	17%	—	17%
	56%	45%	100%

(a) Percentages do not add to 100% because of rounding.
(b) NPD = New Product Development.

Interestingly, these intentions are not confined only to Irish-owned companies. As we mentioned above, executives of foreign subsidiaries often stated their intention to become indispensable to their parent by becoming a world supplier of specific products, rather than remain vulnerable to closure in attempting to manufacture a wide range of products for a small geographic area. This strategy may not be easy to execute, and may carry its own dangers but, given the difficulty of gaining access to foreign markets, it seems promising enough to warrant whatever support can be given. As indicated already, growth via new product development, especially in export markets, will call for substantially more and riskier innovation attempts than companies have been used to making in the past. What kind of human resources do established

Table 12: *Average Number of Qualified[a] Staff Employed by Established and New Firms*

Ownership of Company	Established Firms		New Firms	
	Technical Staff	Marketing Staff	Technical Staff	Marketing Staff
Irish Independent	2.1	0.2	12.5	6.0
Irish Subsidiary	0.8	—	20.0	5.0
Foreign Subsidiary	3.8	0.5	77.5 (b)	1.3 (b)

(a) Formal qualifications at third level.
(b) These figures are distorted by the inclusion of one large company at an early stage of development, which is not yet marketing but which is embarked on a significant R&D programme.

companies have for such innovation? Only one had anything corresponding to an R. & D. facility. The remainder relied for innovation on ad-hoc project teams put together under the guidance of a senior (technical) manager. These teams were seldom dedicated to the project: some or all members usually had to carry out their normal technical and managerial duties simultaneously. In a majority of cases (60%) these teams had come together often enough and successfully enough to constitute a viable development group, if the company decided to dedicate them to innovation.

It is instructive to compare the numbers of staff with third-level qualifications in established companies and in newer firms in the same industries (which, as we have seen, are much more innovative).

It is obvious that the established companies are very much weaker in terms both of technical and of marketing staff than the newer companies in their industry. The absolute level of highly-qualified marketing staff is indicative of the problems they will face, given their intention to enter new markets, and given that it is marketing flaws that kill most innovation. We do not wish to suggest that formal qualifications are a passport to success – a deep understanding of the new markets to be addressed is even more important. The figures do indicate, however, the relatively weak resource base from which established companies start. Berry and Roberts (1983) suggest that entering unfamiliar markets or unfamiliar technologies may best be done in a learning mode, first acquiring knowledge, rather than by

Table 13: *Average Total Number of Externally-Oriented Innovation Attempts Per Firm (1979-1984), by Type of Company*

Type of Innovation Behaviour	Established Firms			New Firms		
	Irish Independent	Irish Subsidiary	Foreign Owned	Irish Independent	Irish Subsidiary	Foreign Owned
Licensing	0.14	0.4	—	1.0	2.0	0.4
Joint Venture	1.14	0.6	0.67	2.0	—	0.2
Acquisition	—	—	—	2.0	—	—
Other	—	—	—	2.5	—	0.8

a direct assault based on internal development. They suggest various combinations of licensing, acquisition, joint venturing, and venture capital investments, as attractive opening gambits.

Table 13 shows that established companies have made little use of such approaches in the last five years, whereas new companies – especially those which are Irish-owned – have quite a lot more experience with them.

Policy Implications

Established Irish companies face a formidable task. They are weakly placed strategically, they wish to embark on a process of repositioning which is inherently risky, and they are doing so from a rather weak resource base. (The fact that we have virtually no long-established machinery industry left is a fact which does pose a significant problem for industrial development.) Conventional wisdom and some analyses suggest that this line of approach is difficult and likely in many instances to be unsuccessful, even among business units attached to large companies.[6] [Hambrick and Schechter, 1983]. If the task facing the companies is substantial there are, however, grounds for optimism. These companies have survived in difficult circumstances, and they do wish seriously to change. They have a history of some success in innovation: by comparison with ten years ago they have increased their rate of innovation, shifted it more towards product innovation, and enjoyed very high success rates with their attempts – especially the more conservative ones. Furthermore, even if they are short of qualified staff, they have in many instances the nucleus of a development team with a history of successful projects. Most significant of all, however, they have the example of firms newly established in their own industrial sectors. These newer companies achieve a consistently high rate of successful product and process innovation, often directed at export markets. They are strongly placed strategically, have significant human resources, and a wider experience of externally-oriented forms of innovation.

It is not our intention to offer prescriptions for industry policy aimed at regenerating the established sector, although it is clear from the lack of impact by support agencies that new approaches are needed. It is far too early to specify what these approaches might be. But it is not too early to start the dialogue, and to start building the networks, on which any policy of development will depend for its success. We know from experience in the Boston area [Bullock, 1983], and from Swedish and other European experience [Utterback, 1983], that the building of networks among businessmen and the support services they draw on is one of the simplest and most effective ways to help them develop. The stimulus administered by seeing the success of their peers; the increased confidence in their own abilities; the mutual support in the face of uncertainty; the exchange of

information, of business opportunities and of services: all are essential supports to businessmen attempting the risky process of bringing new products to uncertain markets – even though they pass unnoticed in conventional analysis.

The participants in the study were most anxious to hear its results. One feedback seminar has already been held and another will follow. Knowing how successful the MIT Forum is in helping high-technology entrepreneurs integrate themselves into the now highly-developed Boston area network, we in U.C.D. would like to use these seminars as the first step in building an Irish network of businessmen and support agencies (including the Universities and Colleges) which, by meeting and maintaining a continuing informal dialogue, can evolve a set of priorities and policies, grounded in real experience, which will help us preserve and regenerate our vital established industrial base.

NOTES

1. Because of its exploratory nature, it has not seemed appropriate to burden the analysis with the usual apparatus of statistical significance tests and confidence limits. The findings of the study are indicative, not conclusive.
2. Charles Carroll of IMI will shortly publish a volume, based on PIMS analyses, of strategic considerations particularly relevant to Ireland.
3. The payoff of successful innovations is, however, higher the more 'daring' they are. Thus the expected financial value of more radical innovation is in all probability higher than that of more incremental approaches. Executives' risk-aversion means that their subjective expected utility is lower, hence the preference for portfolio approaches, which spread the risk by trying innovations of different types.
4. Berry and Roberts suggest ways to reduce these risks – see Section 5 below – but they remain considerable.
5. To maintain as much comparability as possible with Allen's study, data were analysed only for the most recent significant successful innovation (which was what he had asked about) rather than for all major innovations.
6. Much of this analysis is unsatisfactory, because it is based on too short a time-span of experience. One of the authors is engaged on a study of the PIMS data-base to investigate the success over time of re-positioning strategies based on product and process development.

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