

Looking outward to innovate

5 Looking Outward to Innovate

Innovation requires resources, and Chapter 4 discussed the most important resource of all for small firms: its people. All other resources have to come from outside, from the firm's business environment. The most important parts of that environment are probably customers, suppliers, other contacts who provide information or ideas, and sources of finance. The idea of this chapter is that the way firms develop their relations with the outside world can make a difference to their success in product innovation. How big a difference, is what we will seek to find out.

The idea that the outside world is important for innovation runs counter to some stereotypes, especially the stereotype of the inventor-entrepreneur. Innovation, as we have already pointed out, is not the same as invention. It may of course come about entirely as a result of creative work inside the firm, but that is not necessarily so. Equally, it may involve finding ideas from outside, and harnessing those skillfully to the firm's market. We already showed, in Chapter 4, that the firms using microelectronics components (which many would regard as the vanguard of innovation) were those *least* likely to rely upon their own ideas.

How the firm builds relationships with outside organizations is, presumably, largely a reflection of the capabilities, outlook and choices of its management. But it may also depend on the outside world which it has to deal with. That world could vary from one region to another: for example, because of differences in the regional supplier and customer industries. In this chapter we look at external relations from

the viewpoint of the small firm, but in Chapter 6, we will provide a separate assessment of regional differences.

Financing innovation

Small firms in Britain, as we showed earlier, rarely feel that product innovation is prevented by lack of finance. On the other hand, this is a common complaint in the case of process innovation, involving as it often does the purchase of costly machines.

Since the chief aim of the research was to clarify product innovation, we asked the British firms whether the main sources of finance for product development were internal or external. The answer to this question explained, to a large degree, why financing was not perceived as an obstacle to product innovation, since nearly eight in 10 of innovators were using internal rather than external finance (Table 5.1).

Table 5.1 Sources of finance for product innovation

column percentages

	East Midlands	North-East
Internal finance only	44	47
External finance only	5	2
Both internal and external	9	2
Not known	2	2
Not applicable (no innovation)	40	47
<i>Base for percentages</i>	55	43

Although we asked for further details of external finance (from banks, government, and so on) so few firms in the sample were using these sources to support product innovation that a breakdown would be pointless. So far as internal financing is concerned, the main form this takes is retained profits. Hence the profitability of small firms appears to be vital to their capacity to innovate. This ties back to a finding which we reported earlier (see Table 2.4): whereas 57 per cent of innovating firms reported being on a rising profit trend, this applied to only 43 per cent of non-innovators.

What we cannot say, on this basis, is whether small firms have simply adjusted their ambitions to the financing actually available. In other words, financing may not arise as a constraint, because the firms have ceased to pursue the kind of targets which would necessitate external loans or grants. Difficulties with banks had left several of the entrepreneurs in our case-study firms with a deep resolve never to become dependent upon finance from that source. Financial services more sympathetic to small business could lead to a greater demand for external finance. Paradoxically, this would probably be reflected in a greater feeling of financial constraint, since more firms would be looking outward and more would be disappointed.

Although the numbers are too small to permit any firm conclusion, there is some suggestion in Table 5.1 that the firms in the North were even less inclined than those in the East Midlands to use external finance (the respective proportions doing so were four and 14 per cent). In Chapter 6 we will examine some general differences in regional financing. The overall conclusion, however, is that external relations with sources of finance were not an important influence on product innovation in this sample.

Information, ideas, and R&D partners

Product innovation is virtually impossible unless the innovator is exposed to information which suggests ideas and possibilities. The nearest our survey came to such a broad view of information was when it asked, 'Do you get any technical information from people that you keep in touch with outside your company?' As Table 5.2 shows, most firms (89 per cent) got technical information through personal contacts.

Table 5.2 Technical information through personal contacts

	<i>Row percentages</i>	<i>Base</i>
East Midlands	93	55
North	84	43

Innovators with microelectronics	95	22
Other innovators	91	34
Non-innovators	83	42

The costs of product or process development

Precision Ring Makers (PRM) was the largest company within the British study, and although it had developed new products, its main R & D effort was directed towards process improvement. The annual cost of this effort was estimated at £40,000.

Fabrication and Assembly Company (FAC) did not assess the total cost of development work as it was difficult to separate from other activities. However, a rough estimate of the cost of developing the prototype de-slagging machine was £10,000. This was financed through retained profit.

Farm Machinery Manufacturer (FMM) was able to cost its R & D effort accurately, as this work was established as a separate section. The department had been much larger before market setbacks forced a contraction of the business. The current annual cost was £58,000, which represented about 20 per cent of total costs. As an example of project costs, about £35,000 had been spent on development of a specialized feeding system, for use by pig breeders, to measure the amount of feed consumed by each pig. A grant under the Business Improvement Services scheme had covered 70 per cent of this development cost.

Specialized Knitting Machines (SKM) were developing a fully computerized scarf knitting machine. Although not yet complete, the development cost for this machine was estimated at £100,000. A grant of £25,000 had been obtained from the Department of Trade and Industry under its Support for Innovation scheme. The remaining funding came from retained profits.

Incinerator Company (IC) had no overall costing for its development of the new advanced incinerator. The cost of one important stage, the building of a prototype, was estimated at £40,000. An Innovation Grant of £17,000 towards development had been obtained from the Department of Trade and Industry.

Small Firms' Innovation

There are some small differences suggesting that innovators have more external contacts for technical information than do non-innovators, and the East Midlands similarly more than the North. But at this very general level, the main and obvious point is that few firms are cut off from outside information.

We also asked firms to tell us what their sources of technical information were. For the great majority, as would be expected, the sources were industrial: customers, suppliers, or other firms working in the same industry. Almost nine in 10 of the firms with external technical contacts referred to at least one of these, usually more than one. The category mentioned most often, perhaps surprisingly, was not customers (48 per cent) but suppliers (68 per cent). In addition, about one-third got information from a variety of other sources beyond their immediate industry contacts. These included research or professional institutes (such as the Welding Institute or Production Engineering Research Association), mentioned by 14 per cent; trade associations (six per cent); universities or colleges (seven per cent); technical or professional journals (six per cent); and consultants (five per cent). So these small firms were far from being shut off from sources of specialist information.

The next step is to assess the value of this external technical information to the small firms. Table 5.2 has already suggested some statistical link with product innovation, but we also asked the firms directly what importance they attached to the external information, first for their product innovation, then for their process innovation. The majority of firms found it important, especially for product innovation. Two thirds of the whole sample (75 per cent of those with external technical information) said that the information was either 'important' or 'very important' for product innovation. The corresponding proportion for process innovation was 38 per cent overall, or 43 per cent of those getting external information.

Where firms said that external information was *very important* for product innovation, this proved to be connected to a high degree with actual product innovation and with having staff engaged in R & D activities. In other words, external information mattered most to those who were committed to innovation and who were succeeding.

Table 5.3 'Very Important' information, R & D, and innovation

	<i>percentages regarding information as 'very important'</i>	
		<i>Base</i>
Innovating with microelectronics	77	22
Other innovation	62	34
No innovation	38	42
<hr/>		
Having R & D activity	74	46
No R & D activity	38	52

It might have been expected that the North-East, with its lower degree of innovation than the East Midlands, would have attached a lower importance to external technical information. Remarkably, the opposite was the case. No less than 65 per cent of Northern firms thought external information was very important, compared to 47 per cent in the case of the East Midlands. The difference held good whether firms with or without R & D activities were considered. We will come back to this surprise finding shortly.

The most direct evidence of outsiders helping with product innovation is when a firm acknowledges this as the source of the product idea in question. In fact, one in three of all the small firms in the British sample (more than one half of those with product innovations) acknowledged the part played by external ideas, often side-by-side with the firm's own ideas, in bringing about recent product developments. In nine per cent of small firms, the external ideas were contributed in a formal collaboration. But by far the largest group of external ideas came from customers, acknowledged in 23 per cent of the whole sample (41 per cent of innovators).

The small firms in the North-East were not even half as likely as those in the East Midlands to benefit from customer ideas in product development. They were also less likely to get ideas from collaborative development work. Hence, as we have already pointed out in Chapter 4, there was a completely different balance between the two regions in their ways of getting ideas. The East Midlands were developing new products on the basis of a 50-50 balance between internal and external

External links in product and process development

Precision Ring Manufacturer (PRM) had carried out several joint research projects with the Production Engineering Research Association (PERA). The joint projects were concerned with process improvements, examination of material handling processes, and material development and testing. The technical information centre of PERA was also used to ascertain metallurgical data.

Fabrication and Assembly Company (FAC) had developed links with an American company, which had proved helpful in its development. The link had arisen because another British company, which was held a licence from the American firm, had sub-contracted its manufacture to FAC. The American company shared technical information with it, and provided the idea for the de-slagging machine which was FAC's most recent new product. However, the design for the European market, developed by FAC, was substantially different from the design for the US market (which was more highly automated). In 1986 the American company purchased a minority shareholding in FAC.

Specialized Knitting Machines (SKM) had engaged in joint development work with a scientific research institute. This institute had developed computer hardware and software for a computer controlled knitting machine designed by SKM. SKM had not directly paid for the development work carried out by the research institute, but had agreed to purchase the controller units from the institute.

ideas, whereas in the North-East, the balance was close to 75-25. As we know, the 50-50 balance seemed to be producing the higher level of innovation.

How can these findings be reconciled with the higher level of importance attached by Northern firms to external technical information, which we referred to earlier in this section? Can it make sense for firms to claim that external information is very important, and yet, in practice, rely mainly on their own ideas? A possible explanation is to suppose that the Northern firms *seek external ideas for product innovation but cannot get satisfactory access to them*. In particular, there could be an unsatisfied need in the Northern region for ideas from customers to flow to the small firms.

Another indication of the openness of small firms to external influence is if they collaborate in development work with other firms. In all, just over one third (36 per cent) of firms in the British sample had had such a collaborative relationship, either for product or process development. These firms were particularly likely to be product innovators, and particularly innovators with microelectronics. No less than 59 per cent of the firms using microelectronics components had been involved in collaborative efforts, compared with only 21 per cent in the case of non-innovators. Moreover, these relationships had generally proved to be effective. In more than four of five cases of collaboration, the firms stated that the joint development work had been successful.

Taken as a whole, the results of the British survey provide very strong evidence of the practical importance of external contacts which bring in technical information or ideas, and lead to cooperation.

The location of suppliers

Suppliers seem likely, from the results already presented as well as from common sense, to be particularly important as external sources of ideas and information. Indeed, trading linkages between firms are widely believed to be of great importance for the dissemination of new technology generally. This leads to the notion that some regions could be particularly favoured through having a high concentration of supplier firms with complementary knowledge, while others could similarly be at a disadvantage through a lack of such natural linkages.

Customers and product innovation

Fabrication and Assembly Company (FAC) had taken its prototype de-slagging machine to an international trade fair. There it was purchased by a company, which agreed to carry out a field trial on behalf of FAC. The company regarded this agreement as greatly assisting the development.

Farm Machinery Manufacturer (FMM) had suffered a major setback, partly because it had failed to assess customer demand. After the success of its earlier cattle feeding control systems, it was intent on remaining in the technical forefront of the market. This led it to develop a fully automatic integrated milk recording and cow feeding system. However, market demand for such a sophisticated and costly system was not sufficient to justify this development, and substantial financial losses resulted.

Specialized Knitting Machines (SKM) had managed the transition from sub-contractor to developer of innovative knitting machines largely because of an unexpected order from an Italian company for a machine to knit ties. The basic ideas for subsequent new products were in the main generated by actual or potential customers. Orders for customized knitting machines helped the company to offset its substantial development costs, and were vital in the company's efforts to enter new areas.

One obvious advantage for the East Midlands firms is that they are situated in an area which contains many of the leading machine builders. Hence it seems more likely that they would be able to keep up to date with advances in process technology through local machine suppliers. As was shown in Chapter 3, a much higher proportion of the East Midlands firms in the sample had invested in CNC machines, than was the case in the North-East. It transpired that just over half of these firms had obtained CNC equipment locally or from within the region. Of the five Northern firms in the sample with CNC machine tools, only one had obtained theirs from a supplier within the region. In most cases, software for CNC operations was also provided by the machine supplier, and this probably further enhanced the advantage of having a local source of supply. On the other hand, it should also be noted that some East Midlands firms were getting CNC equipment supplied from abroad.

The regional contrast was much slighter in the case of traditional (non-CNC, non-microelectronic) production equipment. Not only did similar proportions of the East Midlands and Northern samples invest in such machines, but also the East Midlands firms were only slightly more likely to get these traditional machines from local sources. The overall picture for equipment supply is shown in the table below.

Table 5.4 Location of production equipment suppliers

column percentages

	East Midlands		North-East	
	CNC	Non-CNC	CNC	Non-CNC
Within 30 miles of firm	13	20	0	14
Within the region	11	4	2	2
Elsewhere in the UK	13	15	12	16
Outside the UK	16	11	2	9
<i>Base for percentages</i>	55		43	

Note: There can be more than one location of supply per firm.

The origin of microelectronic components or sub-systems being used in the new products of these small firms is obviously of particular interest. The first distinction to be drawn is between components or systems made in-house, and those bought-in from outside. Nearly all

the users of microelectronics components, we found, got supplies from outside, although one in three were designing and making at least some of their own requirements. The components or systems supplied from outside were equally divided between standard catalogue items and those made to special designs.

Microelectronic components or systems for incorporation in products, unlike CNC machine tools, were in nearly all cases supplied from *outside the region*. The main locations of microelectronics suppliers were the UK (beyond the region) with 50 per cent, and elsewhere in Europe (41 per cent). So the much higher tendency to use microelectronics which existed in the East Midlands was *not* attributable to local sources of supply. The firms had to find suppliers of this technology outside their immediate area.

It is, of course, possible that the East Midlands would have been getting still further ahead of the North-East if it had possessed a strong local microelectronics components industry. On the other hand, having to look far afield for supplies could bring a firm into contact with a wide range of new ideas, and could serve as an advantage in the long run. We asked all the firms in the British sample what proportion of their materials supplies (of all kinds) came from within a distance of 30 miles. Considering the median of the responses, we found substantial differences between the East Midlands and the North-East, and between the firms using microelectronics (most of which were in the East Midlands) and the remainder. The results are summarized in Table 5.5.

Table 5.5 Dependence upon local supply

	<i>Median percentage obtained locally</i>	<i>Number for median</i>
East Midlands	30	53
North-East	50	39
Innovating with microelectronics	20	21
Innovating without microelectronics	40	31
Not innovating	37	40

Note: six firms were unable to estimate this figure.

It is apparent that, when the location of supply was considered as a whole, local linkages were *not* favouring innovation. On the contrary, those with the highest tendency to innovate were getting larger proportions of their supplies outside the locality of their firm.

The location of customers

We have already seen that customers are one of the main sources of ideas for new products for small firms, and that they were far more important in practice for the small firms in the East Midlands than for those in the North-East. The next point to consider is whether the location of customers had anything to do with their value as sources of innovation.

There are plausible reasons to suppose that local customers would be an advantage, but equally plausible reasons for supposing the opposite. A strong local market would, presumably, make it easier for the small firm to develop close links with its major customers and so become more likely to get valuable information and ideas from them. But dependence on the local market could also make small firms parochial, and deprive them of contacts from further afield which might be fresher or more novel than what local industry could generate.

Three measures of the location or dispersion of customers are: the percentage of sales within a 30-mile radius ('local sales'), the percentage of sales outside the region, and the percentage of sales going to exports. Whereas the median of local sales was 10 per cent for the East Midlands sample, it was 25 per cent for the Northern sample. Innovative firms, especially those innovating with microelectronics, also sold relatively smaller proportions of their output locally than did non-innovators. Similarly, firms in the East Midlands, and those which had new products with microelectronics, sold 65 per cent of output outside the region, whereas the median for the remaining firms was about 50 per cent. When it came to export sales, the levels were low for most firms *except* those with new products incorporating microelectronics. The median sales for the latter group were 25 per cent, whereas for the remainder they were only two per cent.

In short, then, the East Midlands firms were less dependent on local sales, and correspondingly had sales more widely spread through the UK, than did the Northern firms. Firms making new products with

Markets for Innovative Small Firms: Examples

Fabrication and Assembly Company (FAC) had begun by supplying a specialized product to a single industry (civil engineering), but had found this was not a sufficient basis for a business. It now had a highly diversified customer base. It sold to heavy and light engineering establishments, the steel industry, glass industry, power generation industry, and civil engineering. There were no dominant customers.

It was located in the East Midlands region. Customers within the region accounted for about 15 per cent of sales turnover; customers within the UK beyond the region accounted for 70 per cent; and export customers, 15 per cent. Only 10 per cent of its own material and component supplies came from within the region.

Farm Machinery Manufacturer (FMM) had been supplying the dairy farming industry for more than 10 years when the imposition of milk production quotas by the European Commission led to a severe contraction of its market. It had subsequently attempted to broaden its markets, first by entering other parts of agriculture, and then by moving into electronic systems outside agriculture.

Located in the Northern region, FMM sold mainly outside the region, with 70 per cent in the UK and 30 per cent overseas.

Specialized Knitting Machines (SKM) sold chiefly to the textile and knitting industry, but with its new meat fibre knitting machine, had also obtained entry to the food processing market.

Located in the East Midlands, an area known for its strong textiles and clothing industry, SKM might have been expected to have strong local linkages. In fact, regional demand for its specialized products was negligible. More than one half of SKM's products were sold overseas, especially in the USA, while the rest were sold in the UK. It also had no direct UK competitors: its main competitors were located in Italy, the Federal German Republic, and Taiwan. International sales were seen as an important means of balancing the company's dependence on a specialized product.

Although not linked locally on the demand side, SKM had strong regional links on the supply side, getting more than one half of its materials and semi-finished products from local firms.

Incinerator Company (IC) sold chiefly to hospitals in the UK, and to military establishments overseas. The UK accounted for 40 per cent of sales, and export markets for 60 per cent. Although IC was quite narrowly based, its sister company (from which it had grown) had a quite different, and complementary, market pattern. This sister company built customized machinery, and fabricated and machined components to order, for a wide range of industries.

Located in the North, IC was almost entirely independent of the regional economy. Its sister company, however, sold about 90 per cent of its output within the region, but because of its wide spread of customer industries, was not dependent upon any major customers.

microelectronics (most of which were in the East Midlands) were the least dependent on local sales, and had a particularly high level of export sales. Indeed, without microelectronics, these small firms seemed to have little chance of penetrating export markets.

A small firm is likely to be more dependent than a large firm on its larger customers, and so we thought it important to find out the location of major customers, and the share of sales which they accounted for. In the survey as a whole, four in five of firms had one or more customers taking at least 10 per cent of sales. The median share of sales taken by these was 25 per cent. There was no difference between the East Midlands and North-East samples in their degree of dependence on these larger customers. However, the location of the larger customers differed considerably for the firms in the two regions,

Table 5.6 Location of major customers, by region

column percentages

	East Midlands	North-East
No major customers	9	12
Local or within region	31	49
UK, outside region	45	33
Overseas	15	7
<i>Base for percentages</i>	55	43

as is shown by Table 5.6.

The Northern firms were more dependent upon large customers *in their own region*, whereas the East Midlands firms were more likely to have large customers *outside the region or overseas*.

The location of major customers was also very different indeed between innovating and non-innovating firms. Of those innovating with microelectronics, four in five had large customers outside the region, and one in three had large overseas customers. For those innovating without microelectronics, nearly one half had major customers outside the region, but most of these were in the UK. Only

Table 5.7 Location of major customers, by innovation level
column percentages

	Innovating with microelectronics	Innovating without	Not innovating
No major customers	9	6	14
Local or regional	9	44	50
UK, outside region	50	41	33
Overseas	32	9	2
<i>Base for percentages</i>	22	34	42

36 per cent of the non-innovators had major customers outside the region (Table 5.7).

What we have considered for major customers, we can also look at for *major customer industries*. In this case, we focused upon industries taking 25 per cent or more of the sales of a firm, and asked where such industries were located. Four in five of small firms in the British sample had customer industries of this importance. The key customer industries for East Midlands firms were more often located

Table 5.8 Location of major customer industries, and region
column percentages

	East Midlands	North- East
No major customers	18	19
Local or regional	36	49
UK, outside region	36	33
Overseas	9	0
<i>Base for percentages</i>	55	43

outside the region, including overseas, than they were for the Northern firms (Table 5.8), although the difference was not a large one.

Firms with new products, especially those using microelectronics,

Table 5.9 Location of major customer industries, by level of innovation

column percentages

	Innovating		Not innovating
	with microelectronics	without	
No major customers industry	27	15	17
Local or regional	18	41	55
UK, outside region	45	35	29
Overseas	9	9	0
<i>Base for percentages</i>	22	34	42

were *much* less likely to depend upon local or regional industries, as Table 5.9 shows. The firms using microelectronics were also less likely to have *any* industry taking as much as 25 per cent of its sales; their markets were widely spread.

The question posed at the start of this section - Was it local or dispersed customers which were more favourable to innovation? - has been rather firmly answered. Firms with more customers outside the region, with their largest customers outside the region, and with their major customer industry outside the region (or no dependence on any one industry) were all much more likely to have new products, especially those with microelectronics.

Care must be taken with the interpretation of these findings. Innovation may be helped by having markets beyond the locality or region, but new products may equally help firms to develop such markets and to escape dependence on local industries. Our evidence does not indicate which direction of influence is more important; it seems plausible that each influence helps the other.

Moreover, while the East Midlands firms are both more innovative and less dependent on local customers and industries than those from the North-East, it does not follow that innovation will be linked to dispersed markets in all regions. It is possible to envisage major

technologically advanced industries developing in certain areas and being supported by small supplier firms which themselves are highly innovative. It is where the dominant customers or industries are *not* technologically dynamic that one would expect their local suppliers to be at a disadvantage from the point of view of product innovation.

Main customer industries

This leads us to consider which industries were named by the small firms in the British study as their major markets, and in particular to ask whether these industries were different between the two regions. By major, we mean as before those industries taking 25 per cent or more of a firm's sales.

A firm could name more than one such industry, and the average number named was 1.8 in the East Midlands sample and 1.5 in the Northern sample: another indication of the wider distribution of markets for the East Midlands small firms. The size of the survey limited us to analyzing the industries in terms of the 10 broad groups which are the highest level of the OPCS industrial classification.

Not surprisingly, the most prominent industry group for both regions was engineering and metal manufacture (which also includes vehicles). This group accounted for 44 per cent of the major customer industries mentioned by the East Midlands firms, and for 38 per cent in the case of the North-East. Another predictable similarity between the regions was that only a small proportion of their major markets were in the service sector. Beyond that, however, there were some possibly

Table 5.10 Major customer industries, by region

column percentages

	East Midlands	North-East
Primary and Extractive	16	32
Chemical and related	9	19
Engineering etc.	44	38
Other manufacturing	20	2
Construction and services	11	10
<i>Base: all industries mentioned</i>	<i>81</i>	<i>53</i>

important differences in the composition of major markets between the regions (Table 5.10).

The Northern firms were much more dependent upon the extractive and process industries, which accounted for one half of their major markets, but only for one quarter of the major markets of the East Midlands firms. Moreover, 'other manufacturing' industries were important in the East Midlands, accounting for one in five of major markets, but not in the North-East. This group of industries includes food and drink processing, textiles, clothing and footwear, paper and printing, and furniture making. The overall picture, then, is of the small firms in the North-East being particularly dominated by the heavy extractive and process industries, while the East Midlands firms have major markets widely distributed across the whole of manufacturing.

It was also of interest to see which industries were named by firms using microelectronics for new products. These were, of course, mainly East Midlands firms, and as with the whole East Midlands sample, their major customer industries proved to be widely distributed across industry groups. They were strongly represented among firms which had markets in 'other manufacturing', so one reason why the East Midlands firms were so much more likely to be involved in microelectronics may have been that they were serving these industries. On the other hand, two-thirds of the industries mentioned by product innovators using microelectronics were those in which the Northern firms also had a strong presence, namely, the extractive, process, and engineering industries. These innovators were indeed serving all the main industry groups, even services.

Accordingly, customer industries are *not* an explanation for levels of product innovation in the British sample, at least not in the sense that one customer industry favours innovation while another does not. Rather, it seems that the innovative firms are more capable of reaching all kinds of industries, just as they are more capable of reaching widely dispersed geographical markets.

Comparisons with the German firms

The evidence from the British survey seems to point to some of the strongest conclusions of the study, so it is of particular interest to see whether the parallel German study points in similar directions.

In drawing the comparisons with the FGR, it must be recalled (see Chapters 1 and 2) that the sample there covered firms of a larger average size and with a generally higher level of product innovation than in the British sample. It was to be expected, therefore, that the German firms would also be making use of external contacts and information sources to a high degree. Indeed, the majority of German firms turned out to have cooperative links with their customers, and also with universities, research institutions, and other external organizations. The general impression is that they were well supplied with external information, and regional differences did not enter into this.

Although the questions about suppliers were expressed somewhat differently in the German part of the study, the indications were that the German firms were more dependent upon local suppliers than the British firms. Nearly four in five, in both German regions, stated that their most important suppliers were local (within 50 kilometres).

Differences in regional linkages emerged as of great importance, however, when the patterns of customer industries were examined. The Nordrhein-Westfalia region (NRW) differs from the Baden-Wurtemberg (BW) region in its traditional dependence upon coal, iron and steel, regarded as a single group in the FGR under the title 'Montan industry'. This group accounted for 23 per cent of manufacturing output by value in the NRW region in 1983, while it accounted for less than one per cent in the BW region. Conversely, machine building and vehicles accounted for more than one half of manufacturing output in the BW region, but only one quarter of the output in the NRW region. It seemed plausible that these structural differences of the regions should be connected to the markets of small firms, and that this in turn would influence their product innovation.

There was, as expected, a great difference between the major customer industries of the firms surveyed in the NRW and BW regions. NRW firms named the coal, iron and steel sector as major customers in 37 per cent of cases, whereas this group accounted for only three per cent of customer industries named by the BW firms. Conversely, 60 per cent of the major industries mentioned by the BW firms were in the capital goods group (roughly equivalent to the engineering group in the UK), while only 34 per cent of the customer industries named by NRW

firms fell into this category. Evidently, the different structures of the two regions had a marked impact on the markets of the small firms.

So far as dependence upon local or regional markets was concerned, it also turned out that firms serving the 'Montan' industry were different from the remainder. This group of firms stated in 60 per cent of cases that the majority of their sales went to local or regional markets, while 13 per cent had their main markets elsewhere in the FGR and 27 per cent overseas. Firms serving the capital goods sector had the locality or region as their main market in only 31 per cent of cases, the FGR beyond their own region in 35 per cent of cases, and overseas in 34 per cent of cases. A similar geographical distribution was reported by firms mainly serving 'other' industries. It is worth noting, in passing, that the German sample as a whole had much greater involvement in export markets than did the British sample; and in this respect there were relatively small differences between the German firms serving different groups of industries.

The differences in industry linkages were clearly much sharper in the German survey than in the British. It was also much clearer that the influence ran from industrial structure to the shape of small firms' markets, rather than the reverse. As has already been shown, sales to the 'Montan' industries were virtually confined to the NRW firms. A separate analysis for firms supplying the capital goods sector as their major market, showed that NRW firms in this group were actually *less likely* to be dependent upon local customers than those in the BW region. Evidently, it was only inasmuch as they were tied to a traditional local industry that the NRW firms adopted a local marketing outlook.

The crucial question, for the purposes of this study, is whether industrial and geographical market linkages are related to product innovation. In the British survey, we showed that the chief relation was geographical: innovators were more likely to be marketing their products outside the region. In the German survey, industrial linkages were the basis of differences in geographical markets, so it is in the industrial differences that we must seek an influence upon product innovation.

In a number of respects, however, it was found that the firms serving the coal, iron and steel industries were just as committed to product innovation as were those serving the capital goods sector or

Small Firms' Innovation

'other' manufacturing industries. For example, four in five of the firms with coal, iron and steel as their major market had introduced a new product in the past two years, and the same proportion had begun to develop further products in that same period. These are high proportions, and about the same as the result for the whole German sample. Similar conclusions applied when the focus was upon *completely new* products. No less than 55 per cent of the firms supplying the coal, iron and steel industries reported that they had recently innovated to that extent.

It was only when attention was directed upon innovation *with microelectronic components* that the disadvantage of the firms supplying the traditional 'Montan' sector became apparent. They were, in fact, only half as likely to be using microelectronics as was the remainder of the sample. And, as all the suppliers to this sector were in the NRW region, naturally the level of microelectronic innovation in that region was depressed through this industrial dependence.

Linkages between small firms and their customer industries therefore provide a rather deep insight into the regional differences in the German part of the study. In particular, the analysis reinforces the point that it is not enough simply to classify small firms as innovators and non-innovators, since innovation can not only be of different types but also can play quite different roles depending upon the circumstances.

For small firms in the NRW region serving the declining coal, iron and steel industries, product innovation was limited in its possibilities, by being largely cut off from the new developments in microelectronics. Product innovation under those circumstances could only mean continued dependence upon an industry with limited economic prospects. It was not surprising to find that whereas 84 per cent of small firms serving the capital goods sector saw the future market potential as positive, this was true of only 36 per cent of those supplying the 'Montan' industries.

Conclusions

Product innovation within small firms depends to a large extent upon external relations. Information and ideas flow into the firm through its network of contacts, especially with suppliers and customers, and the

firms most ready to acknowledge the importance of this flow are those which have recently developed new products. But the influence of market relationships often goes beyond information and ideas. Many of the small firms develop collaborative relations and joint projects, with high levels of success. The ability to develop new products also depends upon funding from retained profits, so customers are the main direct source of finance.

Since customer and supplier networks are so critical for innovation, it is important to know the most effective forms for these networks. We particularly considered what was the relative effect of having local or geographically dispersed markets, of serving one main industry or a range of industries, and of having a few major customers or a spread of smaller customers. The advantage generally seemed to be with those firms whose networks were spread wide rather than narrowly concentrated. Innovative firms seem to be attracted towards diversified markets, partly because innovation helps them to enter new markets, but also because wider market relations help to stimulate ideas and to find openings for new products.

The shape of market networks seemed closely linked to regional differences in innovation. This was true, although in different ways, in both the German and British samples. In Nordrhein-Westfalia, small firms serving the traditional local heavy industries of coal, iron and steel were less able to operate in national markets, to diversify, and to make use of microelectronics in their new products. They continued to innovate, but it was an innovation which locked them in to their existing narrow markets rather than giving them entry to new opportunities. In the North-East of Britain, there was a general tendency to be linked both to local sources of supply and to local customers. Although most of the firms in this part of the sample believed that external technical information was important, narrow markets meant that they were less able to acquire it and incorporate it in their development work. Their failure to incorporate the new microelectronics technology into their products would in turn continue to confine them to narrow markets.

The findings of this study suggest that an ideal type of innovative small firm would devote effort to developing business contacts and links outside its own area, would actively exploit its network to get new product ideas and technical information, would avoid being dominated

Small Firms' Innovation

by local customers or industries, and would use its new product capability to diversify and export. We would not want to claim that this is the only way in which product innovation can be fostered, but the evidence which we have presented is strong enough to indicate that such a pattern of market relations will be important in a wide range of circumstances.