

**CLOSE ENCOUNTERS: EVIDENCE OF THE POTENTIAL BENEFITS
OF PROXIMITY TO LOCAL INDUSTRIAL CLUSTERS**

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Abstract

Local clusters of high technology small businesses are of increasing interest to politician and academics. This papers draws on a study of 237 high tech small businesses located throughout the UK. Combining information on activity and location, firms were grouped according to their potential degree of embeddedness in local industrial clusters. Businesses with differing levels of cluster involvement were then examined in terms of market structure, supportiveness of local cluster and their performance. The findings lend support to the role of untraded rather than traded interdependencies in the dynamics of localised high tech clusters. Research indicating compensating behaviour by high tech businesses disadvantaged by location is also supported, emphasising the need to consider not only the location and activity but also entrepreneurial objectives.

JEL Codes: L23; L52; O18; R19

Keywords: high technology small firms, business clusters, rural locations, untraded interdependencies

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1. Introduction

Localised clusters of high technology small businesses are of increasing interest to politicians and academics. Underlying this interest has been the growing awareness of the economic role of high technology small firms. In the US and much of Europe, the last quarter of the 20th century saw the importance of small firms increase significantly, particularly in terms of employment (Acs and Audretsch, 1993). Further, activities experiencing rapid growth have tended to be those dominated by small enterprises (SBA 1999). This has been a particular feature of activities based on new technologies such as biotechnology, computer software, R&D services and telecommunications (SBA 1999).

The second factor prompting this development has been the resurrection of interest in localised industrial clusters (Porter 1990). The dense local networks of traded interdependencies (input –output relationships) based on high levels of specialisation which figure in descriptions of Italian industrial districts (see Pyke et. al, 1990) were noted characteristics of earlier localised concentrations of industry such as the hardware, gun and lock industries of Birmingham and the Black Country (Allen, 1929). More recent interest in industrial clusters has broadened to include untraded interdependencies (Storper, 1995) and, for high technology firms specifically, notions of innovative milieux. (see Lawson et. al. 1997).

The consensus picture of interest to policy makers is of a small high tech firm deeply embedded in a local high tech cluster highly innovative, experiencing rapid growth, serving essentially a niche market, globally oriented, collaborating with other local organisations in ways which enable it to benefit from technology or knowledge spillovers from the local research base and from localised specialist services (Goss and Vozikis, 1994; Jaffe, et. al. 1993; Keeble et. al 1997, 1998; SQW 2000). But how far does location matter to high tech small businesses? Are those embedded in high tech clusters more innovative? Are they more export oriented? Are the same characteristics likely to be found among small high tech firms

associated with more traditional manufacturing local industrial clusters? Against the consensus view are the findings that small firms in remoter or more peripheral locations may attempt to compensate for locational disadvantages by being more innovative and seeking larger international markets (Vaessen and Keeble 1995). What firms actually achieve is likely to be influenced not only by location but also by the nature of the activity undertaken and entrepreneurial objectives and ambitions and, more importantly, by some interaction of all of these.

Many studies addressing these issues have tended to focus on individual types of location such as Oxford or Cambridge (Lawson et. al 1997), West Midland (Freel, 2000), or specific industries such as opto-electronics (Hassink and Wood, 1998). This paper reports a more comparative approach. It draws upon a survey of high tech small businesses in the UK. By defining each participating business's local area, examining the prevalence of their activity in that area and assessing whether the local area was noted as an industrial cluster the participants were grouped according to potential involvement in a local industrial cluster. The outline of this paper is as follows: characteristics of the businesses studied are described in the next section. Methods used to classify the businesses according their potential involvement in local industrial clusters are outlined in the following section. Subsequent sections describe the results comparing businesses with differing levels of potential involvement in local industrial clusters in respect of indicators of niche markets, limitations encountered and collaboration and finally, performance, in terms of growth and innovation.

2. The Study

The survey reported forms part of an ongoing comparative investigation of small high tech firms in the UK and Japan, and followed a similar survey conducted in 1998 (Whittaker 1999). The criteria for inclusion were employment size (less than 250), independent status and high tech activity, (based on modifications to Butchart's (1987) definition of high tech activities (Hecker 1999).

The sample comprised suitable respondents to the 1998 survey, together with an equal number of additional businesses. The latter were selected from the Dun and Bradstreet database. A questionnaire was administered to 781 firms in December 2000. The overall response rate was 34.1%.

The questionnaire covered:

- Descriptive characteristics of businesses and CEO's: (activity, age, size, ownership structure, educational qualifications and prior employment in the research base¹).
- Markets, competition, and collaboration: (customer dependence, competitors, subcontracting, competitive advantages, limitations: collaboration and exporting).
- Performance: (employment and turnover growth, innovation, and R&D expenditure)
- Employment practices and policies: (qualifications of workforce, training and incentive schemes and levels of support for different HRM policies).
- Attitudinal variables: (CEO's personal objectives and approaches towards risk).

Table A1 (appendix) summarises the main characteristics of the businesses and their CEOs. The study focused on independent businesses²; 65% were completely new start ups. Almost 60% were manufacturing businesses. Service sector firms were further divided into two broad activity groups: computer services and telecommunications (CS&T): 19% of all firms, and research and development and technical services (RD&T), accounting for the remaining 23%. Two activities accounted for a quarter of the participants; 'instruments for measuring, checking and other purposes' (SIC 33.2) and 'software consultancy and supply' (SIC 72.2). A number of important high tech activities such as biotechnology, aerospace and the manufacture of computers, were weakly represented.

The median age of businesses was 16 years. There was a relatively even distribution of firms in terms of age, with almost as many businesses established before 1980 as since 1990. Responses were skewed towards smaller businesses; three quarters employed less than 50, and less than 20% had a turnover of £5 million and over. The majority of participants had founded their businesses and confirming the collaborative nature of high tech businesses (Whittaker 1999; Roberts 1991), had done so collaboratively. Businesses owned 100% by the participant together with those in which the only other minority shareholder was a spouse were classified as 'real and quasi sole proprietor', and accounted for 29% of all businesses³. The remaining collaboratively owned firms (71%) were roughly equally divided into those in which ownership was shared exclusively with other internal owners and those in which there was some external ownership. Significant⁴ sectoral differences were found in respect of both age and size and marked differences in the extent of external ownership: manufacturing businesses tended to be older and larger, CS&T businesses were notably newer and businesses engaged in RD&T were smaller and fewer had external owners.

The entrepreneurs were overwhelming male (92%) and 'middle-aged', with a median age of 51 and over 70% were over 45. The significant age differences found between businesses in different sectors were reflected in differences in the participants' ages. Those managing manufacturing businesses were notably older, while those in CS&T were younger. The high tech entrepreneurs were highly educated and well qualified. Almost two thirds had a degree, and half of these also held a post graduate degree. The importance of the research base in providing a source of high tech entrepreneurs was demonstrated by the finding that in one in four cases, a member of the original founding team had worked full time in higher education, or medical or research institution.

Hierarchical cluster analysis was used on the variables of sector, firm age, employment size, ownership and entrepreneur age to derive 5 robust groups or 'types' accounting for 95% of the businesses

considered.⁵ The characteristics of each type of business are summarised below.

Type 1 Small expert: (n=49)

Mostly RD&T businesses with some CS&T but no manufacturing firms. Predominantly small, employing less than 20, of varied age and CEOs mainly under 55. Virtually no external shared ownership.

Type 2 Externally supported: (n=26)

Mixed in terms of sector but with a relatively high proportion of CS&T firms. Predominantly new businesses (founded since 1990) with young CEOs, but large. No proprietorships: almost all having external ownership.

Type 3 New producers: (n=57)

Mostly manufacturers with a few CS&T but no RD&T firms, relatively new businesses, run by middle aged and younger entrepreneurs, employing less than 50, mostly with shared ownership.

Type 4 Old manufacturers:(n=61)

Overwhelmingly manufacturers, predominantly older businesses (founded before 1980) medium to large size, run by older CEOs, with varying ownership structures.

Type 5 Manager run:(n=19)

A small group in which the participants were generally young but had no ownership stake in the business, mostly older (though some younger) manufacturers.

3. Spatial and Industrial Cluster Analysis

The location of each business was examined and participants allocated to one of 5 categories given on table 1. Whether or not a business as regarded as 'adjacent' to a major population centre was based on a 10 mile radius but account was taken of accessibility by road but not of possible congestion⁶. The majority of businesses (88%) were located either in or adjacent to major urban centres.

To gain some idea of the local industrial cluster in which participant businesses could potentially be embedded, each individual business's 'local area' and the corresponding Local Authority Districts (LADs) covering that area were identified. Borrowing methodology used in the Sainsbury report (DTI, 2000) employment data (1998),⁷ at 3 digit SIC level, for the LADs in each business's 'local area' were used to determine

- a] the relative importance of the activity each business undertook in its own 'local area' (a cut off of 0.45% of total employment in the local area was used) and
- b] the extent to which that activity was over-represented in that 'local area' as compared to its national distribution (a location quotient of 1.25 cut off was used).

Information from the Sainsbury Report (DTI, 2000) on clusters was then used to classify the businesses in terms of the potential strength of their involvement in a local cluster on the basis given in table 2.

The participating businesses were almost evenly split into those with some clear potential involvement in a local industrial cluster and those without such potential involvement. Businesses in groups I and II were seen as potentially strongly embedded in a local industrial cluster⁸. Not only was there a significant concentration of activities broadly similar to their own within their local area but also those activities were strongly related to identified industrial clusters. By comparison those in groups III and IV were potentially less strongly embedded since in the activities they undertook were either less well represented or less concentrated in their local area (table 2). Businesses undertaking activities which appeared unrelated to any local industrial cluster were further differentiated on the basis on the information provided in table 1 between those located in major population centres, which may benefit from the effects of agglomeration, and those in more remote locations. The resulting classification is given on table 3.

Marked differences were found in the level of potential involvement in local clusters of businesses of different types (table 4). 'Small expert' businesses (type 1) comprising largely of those undertaking

RD&T and to a lesser extent CS&T conformed to expectations: outside of parts of the South East and Cambridge there are relatively few clusters based on scientific R&D alone, such activities and those of technical testing tend to be supporting activities. Interestingly almost a quarter of these were classified as relatively isolated⁹.

The small group of 'Externally supported' businesses (type 2) included those undertaking telecommunications, and software consultancy and were strongly related to local clusters and major urban centres. Types 3, 4 and 6 were dominated by manufacturing businesses, overall less involved in local clusters, but more likely to be related to major urban centres. This was particularly true for the 'old manufacturers' (type 4)

4. Niche markets and competitive advantage

CBR surveys have consistently suggested that SMEs operate in highly segmented and 'niche' markets (Kitson and Wilkinson 2000). The potential indicators of 'niche' markets studied include customer dependence, number and size of competitors and incidence and level of subcontracting relationships, together with perceptions of competitive advantage. Small high tech businesses differing in their involvement in local clusters are likely to vary in the degree and nature of the 'niche' markets they operate in.

Although SMEs are traditionally seen not to be involved in exporting (Storey, 1994), there is a relative lack of work (in the UK at least) on the spatial variations in small business export activity (Gorton, 1999). High tech SMEs are considered to be more export oriented, particularly those in localised high tech clusters. Apart from exports and subcontracting no information was collected on the spatial distribution of customers.

Overall the participants in the study appeared to operate in 'niche' markets (table A2 appendix). The majority displayed moderate levels of dependence on their principal customers. Although relatively few (11%) were dependent on a single large customer for more than 50%

of their turnover, just over a quarter were dependent on one customer for more than 25%, and only 10% obtained less than 10% of revenue from their top 3 customers. While few respondents (5%) reported no serious competitors, half reported less than 5, and almost three quarters reported less than 10. Participants were also asked how many of their serious competitors were located overseas. Some 36% reported no serious overseas competitors, but a similar number (35%) reported that the majority of their serious competitors were located overseas. Supporting the view of the greater export orientation of high tech SMEs almost two thirds of the businesses were engaged in exporting and for almost a quarter, exports accounted for over half of their turnover.

Fewer businesses strongly involved in local clusters had high level of dependence on a single customer (table 5). There were also marked differences in the number, size and location of competitors seen by businesses with differing levels of involvement in clusters. Reflecting remoter locations, isolated businesses saw significantly fewer serious competitors. There were also differences in the size of competitor seen, with entrepreneurs involved in local clusters regarding their businesses as confronted by proportionately more larger competitors. It has been argued that businesses in high tech clusters operate in global markets, although not quite statistically significant both businesses strongly involved local clusters and those isolated faced more overseas competitors. For the later this was reinforced by significantly higher export intensity (proportion of turnover exported). This finding confirms other work in the CBR suggests that businesses in remote locations may attempt to compensate for locational and restricted market disadvantages (Vaessen and Keeble 1995). There was little variation in the incidence of exporting between firms with different involvement in local clusters).

Turning to subcontracting, almost two thirds of all participating businesses undertook subcontracting work for others. For those doing so, there was a bi-modal distribution; for half it counted for less than 10% of turnover, but for a fifth, it accounted for 75% or more. (Further work not reported here suggests that high levels of

subcontracting may not be conducive to innovation.) Three quarters of the businesses put subcontracting work out to others, but for most, this counted for less than 25% of turnover. Participants were asked about the location of these links. As has been found in other studies (e.g. Whittaker 1997), there was a slight asymmetry: orders received were more geographically dispersed than orders placed.

Businesses weakly involved in local clusters were significantly less likely to be subcontractors and to do so less intensively (level of subcontracting). The bi-modal distribution for all participants was strongly evident among isolated businesses. There was some evidence of the importance of a local cluster in generating demand for subcontract work. Businesses strongly involved in clusters were distinctive in receiving significantly more orders for subcontract work from 'local' clients and together with businesses weakly involved tended to receive fewer orders from overseas, as compared to their counterparts with no involvement in clusters.

In respect of putting out work to subcontractors, again businesses only weakly involved in clusters tended to do so less, and less intensively. Isolated businesses were more likely to use subcontractors but urban related businesses used subcontractors more intensively. Although this latter group made slightly more use of overseas subcontractors it was interesting that there were no marked differences between firms with different levels of involvement in clusters in the relative importance of local subcontractors. There was no clear evidence that clusters constituted a better source of such subcontract supply links.

The competitive advantages seen by entrepreneurs may also indicate the nature of the markets they operate in. Accordingly participants were asked to indicate the importance of 11 possible competitive advantages on a five point Likert scale (table A3). Advantages indicative of niche orientations, such as 'Personal attention/responsiveness to client needs', 'Quality of product/service' and 'Established reputation' were the most highly rated. By contrast advantages associated with atomistic competition such as 'Marketing and promotion', and 'Price/cost advantages' tended to be eschewed.

Three groups of advantages were created from factor analysis, which focused a) on the product/service itself ('product/service'), b) on aspects of producing or delivering that product/service ('delivery'), and c) marketing of the product/service ('marketing'). 'Product/service' advantages received the highest level of support overall whereas 'Marketing' advantages received the least.

There were no pronounced differences between businesses with differing levels of involvement in clusters in respect of the major groups of competitive advantages. There were some differences in respect of individual advantages. Entrepreneurs in isolated businesses tended to give greater levels of support to 'technical expertise' and 'personal attention to the client/customer', and lower levels of support for advantages more related to atomistic competition¹⁰. This lack of clear differences in the competitive advantages seen by firms differentially involved in clusters was not unexpected given the nature of the sample firms the majority of which were likely to operate in some form of niche market. What might be of greater interest is identifying differences in these niche markets. A clear distinction emerged between competitive strengths in technical expertise, reputation and quality on the one hand, and design, novelty and specialised nature on the other. It is argued elsewhere, (Quince and Whittaker, 2002) that the former may reflect niche markets where the technology is embodied in the person whereas the latter may reflect niche markets where the technology is embodied product or service. Businesses involved in clusters gave significantly less support to advantages reflecting niche markets in which the technology was embodied in the product or service (mean score of 3.39 compared to 3.61), which suggests that the primary benefits of proximity may be in respect of tacit knowledge.

5. Supportiveness

The extent to which a local industrial cluster is supportive may be indicated indirectly by the constraints or limitations experienced by businesses. Participants evaluated the importance of 11 limitations on a 5 point Likert scale. Overall the response to these questions was

muted: few were seen as 'significant' or 'crucial'. 'Increased competition', 'Overall growth of demand', 'Lack of marketing/sales skills' and 'Access to new markets' were the most important limitations. At the other extreme, protection and acquisition of intellectual property rights, and the 'Availability of manual/clerical skills' were the least important. Factor analysis produced three groups of limitations, in order of decreasing importance: demand, supply and technological.

There were large differences in the evaluation of limitations by businesses with differing levels of cluster involvement. The most pronounced differences were found in respect of demand limitations, both as a group and among individual limitations. 'Increased competition' was a significantly less important limitation for isolated businesses and those strongly involved in a local cluster. Similarly the latter saw 'Access to new markets' as less important, especially when compared to urban related businesses. Overall there were fewer pronounced differences in respect of supply limitations. 'Lack of technical expertise' was a more important constraint for businesses involved in clusters, particularly those weakly involved. However, interestingly, 'Cost and availability of finance' was regarded as more important by those strongly involved in clusters. Differences were also found in respect of technological limitations, here the most pronounced was found in for 'Acquisition of IPR' which was seen as a significantly more important constraint by businesses strongly involved in clusters.

Isolated businesses together with those strongly involved in clusters appeared to confront fewer demand constraints. For the former this may be a reflection of their greater involvement in export markets. For the latter this does not imply that the cluster alone represented demand rather some aspects of it may have given greater access to new markets. However the high tech businesses strongly involved in clusters considered lack of technical expertise, the acquisition of IPR and the cost and availability of finance to have been more significant limitations on their actions than other businesses. How far did these evaluations reflect differing local environments as opposed to

differences in firm behaviour and entrepreneurial ambitions? Pursuit of growth may increase awareness of constraints. Performance achieved and growth sought are discussed later.

Opportunities for collaboration also indicate the supportiveness of a local industrial cluster. Research has pointed to the role collaborative arrangements play in the development of high technology SMEs, particularly in respect of innovation and foreign competition (Keeble et. al.1998; Oliver and Blakeborough 1998; Klien Woolthius 2000). Just as founding tends to be a collaborative affair, so does developing a business.

For the study as a whole almost 60% of the businesses had entered into at least one such arrangement in the previous two years, and 60% of these had more than one agreement. Most commonly, collaboration was with suppliers closely followed by customers and other firms in the same line of business. By and large, these were with organisations elsewhere in the UK, although (reflecting the subcontracting pattern mentioned above), local collaborations, tended to be with suppliers, while collaborations with overseas customers were more common than those with local customers. Collaboration with distributors also tended to be international. Just over one in five of the participants had collaborated with an organisation in the research base.

The reasons given for collaboration were multiple, the most common were related to expansion: to 'expand range of products/services' (75%), 'provide access to new markets' (56%) and 'develop services/products for current customers'. 'Sharing research and development activity' was mentioned by just under 40%.

Slightly more isolated businesses and those with strong cluster involvement had entered into collaboration. However isolated businesses were more likely to collaborate with only one type of organisation compared to other businesses. This is reflected in fewer isolated businesses collaborating with each of the different types of

organisations identified on table 7 with the exception of research base organisations. Isolated businesses were significantly less likely to have collaborated with suppliers and to a lesser extent with customers. Interestingly businesses located in major urban centres were the most likely to have collaborated with the research base, whereas those involved in clusters were slightly more likely to collaborate with firms in the same line of business.

The nature of the questions used and the small numbers involved prevent any detailed analysis of the spatial orientation of these collaborative links, however some general comments can be made. Among isolated businesses collaboration with firms in the same line of business tended to be local, whereas those with customers included overseas links. For businesses located in or near major urban centres collaboration with suppliers tended to local and these businesses were also distinctive in having more collaboration with their local research base. Businesses weakly involved in clusters tended to collaborate with organisations located 'elsewhere in the UK' rather than local ones. The distinctive feature of the spatial orientation of the collaborative links of businesses strongly involved in clusters was the extent of links with overseas organisations. This was found for all types of organisation with the exception of those in the research base and was particularly strong for suppliers and distributors.

There was little difference in the number of purposes for collaboration cited by businesses with differing levels of involvement in clusters, but there were differences in the relative importance of these purposes. The most notable differences were found in respect of isolated businesses which were significantly less likely to have undertaken collaboration to meet current customer needs or for the purpose of improving market or financial credibility. Sharing R&D was a more important reason for collaboration for these businesses than for others.

For the study as a whole collaboration was associated with both recent and long term growth and innovation. As mentioned earlier differences in awareness of limitations may reflect differences in

objectives and strategies towards growth as much as real environmental constraints. It is to the issue of performance that this paper now turns.

6. Performance and Objectives

Participants were asked about performance – growth of employee numbers and turnover in the past two years – and innovation and associated aspects such as R&D and applications for intellectual property rights. The overall results are presented in table A2 (appendix). Almost two thirds (62%) experienced some increase in turnover in the two years prior to the survey, but there was somewhat less growth in terms of employment, with half increasing full time employee numbers. Large increases in both employment and turnover were reported by a small number (19) of businesses.

Assessing growth in small businesses is problematic: relatively small changes appear large in percentage terms because of small initial numbers. Growth in turnover and employment was assessed in relation to size to produce four categories: no growth or contraction, and low growth, average growth and high growth for size. Employment and turnover growth were combined to produce a composite measure of recent growth. Businesses can pursue different growth strategies, such as expansion of turnover but stable employment, particularly over a period of time as short as 2 years.¹¹ Almost 30% of the businesses had experienced no growth in either turnover or employment in the two years prior to the study whereas 22% recorded high balanced growth. As a measure of *long-term* employment growth, size in relation to age was used, in those businesses in which the participant had a founding role.¹² Just over a quarter, (27%), were considered to have achieved high growth for their age.

Innovative activity was high. Participants were asked if their business had in the past two years undertaken innovation 'new to their firm but not to their industry', (non novel) or 'new to both their firm and their industry' (novel), in terms of product, process or logistics. Almost

four in five had undertaken some innovation in the preceding 2 years. Two thirds of the innovators (56% of all businesses) reported introducing a 'novel' innovation. The majority of businesses (61%) undertook R&D, however just under 20% devoted more than 10% of their turnover to it. As other CBR studies (Wood 1997) have found, the level of spending on R&D was strongly related to both whether a firm undertook innovation or not, and the level of innovation undertaken. Almost two thirds of the non innovators recorded no spending on R&D.

Much of the interest in high tech clusters arises from the assumed positive impact on performance of involvement in such clusters. As can be seen from table 8 being part of cluster was associated with better growth overtime particularly compared to isolated businesses. Although there was no relationship between cluster involvement and overall recent growth (composite growth) apart from fewer firms with involvement in clusters recording no growth, there were differences in respect of recent turnover growth. Businesses associated with clusters were more likely to have achieved high turnover growth, for their size, compared to those without such involvement.

The relative lack of clear differences in innovative activity between businesses with differing potential levels of involvement in clusters may appear to fly in the face of evidence suggesting that that cluster based firms are more innovative (table 8). However innovative activity and novel innovation in particular was strongly related to activity: manufacturing businesses were significantly more likely than those undertaking RD&T to have introduced a novel innovation. The latter group included businesses undertaking contract R&D this perhaps raises questions as to the appropriateness of the innovation measures used. Such businesses may well play a vital role in facilitating the innovative activity of others. Finally the sample specifically included very new businesses founded since 1998. Although there was relatively little difference in the incidence of R&D undertaken by businesses differing potential cluster involvement there were differences in the level of spending. As found

in respect of exporting there was some evidence of businesses potentially disadvantaged by location attempting to compensate for that disadvantage. Isolated businesses together with those strongly involved in clusters tended to undertake R&D more intensively.

Many studies of have suggested that SME's are not growth oriented (ACOST, 1990) however CBR surveys have consistently shown a majority aiming for at least 'moderate' growth. In this study of high tech small businesses the overwhelming majority (90%) sought growth with just marginally more seeking 'moderate' rather than 'substantial' growth (48% compared to 42%). Participants were also asked to describe their approach to risk. Two broad categories of approach were identified: a 'closed' approach characterised by risk avoidance or aversion, and an 'open' approach characterised by willingness or calculated willingness to assume risk. Slightly more entrepreneurs displayed an open approach (54% compared to 46%).

Strong associations were found between performance, both over time and in the recent past on the one hand, and future growth objectives, and, to a lesser extent, attitudes towards risk. (There could be various interpretations of this.) In over two thirds of businesses recording high balanced growth in the preceding two years entrepreneurs sought 'substantial growth', compared to just under a quarter in businesses stagnating or contracting. Similarly entrepreneurs in over half (56%) of the businesses performing well over time were aiming for 'substantial' growth, compared to just over a quarter of those in firms which had performed less well over time. Recent, and to a lesser extent long term, performance were positively associated with a more open approach towards risk: 72% of recent high growers displayed such an approach compared to 47% of non-growers. Seeking venture capital can also be seen to reflect a positive orientation towards growth. Only 39 participants had sought venture capital and those doing so were significantly more likely to aim for 'substantial' growth and to have an open approach towards risk.

Businesses strongly involved in clusters were more likely to seek 'substantial' growth, particularly when compared to businesses located in major urban centres. By contrast isolated businesses were less likely to adopt an open approach towards risk, while those strongly involved in local clusters were more likely to do so. These differences were not quite statistically significant. There was however a pronounced and significant tendency for more businesses strongly involved in clusters to have sought venture capital.

7. Conclusions

The comparison of small high technology firm with differing levels of potential involvement in local industrial clusters illustrated differences in respect of the structure of their markets, innovative activity, growth and global orientation. Few differences were found to indicate that businesses strongly involved in local clusters tended to operate in niche or highly segmented markets to a greater extent than businesses in other locations. But the former were more aware of facing more larger and more overseas competitors. Similarly no difference was found between firms in different locations in respect of the incidence of either innovation or exporting although those strongly involved in local clusters spent high proportions on R&D and exported more. These businesses were also more likely to have collaborated with overseas organisations.

The study provided some evidence that local industrial clusters were more supportive. Again it was not that businesses more involved in local clusters were more likely to act as subcontractors but that those doing so were more likely to be serving local clients. Further businesses located in industrial clusters saw fewer demand limitations, were more likely to have experienced high levels of employment growth overtime and of turnover in the two years prior to the study. Their entrepreneurs were more strongly growth oriented and open to risk and more likely to have sought venture capital. These findings suggest that rather than traded interdependencies the most potent forces in local industrial clusters may be indirect influences

raising aspirations, lessening perception of risk together with potentially greater access to venture capital. There is also some suggestion that businesses differing in their potential involvement in local clusters also faced different types of niche markets. The results point to need to look more closely at exact nature of interorganisational linkages within clusters and more importantly to mediating or facilitating linkages.

The findings also support the view that what may be more important in understanding the dynamics of small high technology firms is not just the potential benefits to be derived from particular locations but also the interaction between location, activity and entrepreneurial ability, objectives and ambitions. The isolated high tech small firms in this study appeared to attempt to compensate for locational disadvantages through exports and R&D activity (Vaessen and Keeble 1995) but unlike their counterparts supported by local industrial clusters their performance had been weaker. This may reflect the lessening dynamism of rural locations noted in other CBR studies (Keeble 2000). Perhaps a salient reminder to politicians that the economic expectations placed on small high tech firms also extend to those in more disadvantaged locations.

Notes

- ¹ HEIs, research institutes and hospitals.
- ² Single person businesses were not included.
- ³ The legal requirements of incorporation frequently result in a spouse being designated as a director but having no real involvement in running the businesses.
- ⁴ Unless stated otherwise tests of statistical significance used were non parametric tests: Mann Whitney for two group comparisons or Krushal Wallis for multigroup comparisons and 'significant' was at the 5% or better.
- ⁵ Firms with no full-time employees were excluded.
- ⁶ With the exception of Greater London.
- ⁷ Excluding public sector employment, for Great Britain only, and for the year of the original study.
- ⁸ It was not possible because of the relatively small numbers involved to further differentiate between high tech and non high tech industrial clusters.
- ⁹ Other analyses, not reported here, suggest that this type of businesses contained the highest proportion of potential 'life-style' entrepreneurs.
- ¹⁰ Combined mean for technical/scientific expertise and personal attention for isolated 4.2 compared to 4.02 for all other businesses. Combined mean for marketing and promotion and price/cost advantages for isolated 2.75 compared to 3.10 for all other businesses.

¹¹ Very few firms expanded employment while contracting turnover.

¹²	Employment Size Groups (number of employees)		
	Smaller (<20)	Medium (>=20<50)	Larger (>=50)
Age Groups			
Newer (since 1990)	2	3	3
Established (1980-1989)	1	2	3
Older (before 1980)	1	1	2

Scores 1= Low growth for age 2 = Growth in line with age 3 = Good growth for age. Only firms in which the participant had been involved in a founding role were included. Acquisitions and MBO/MBIs were excluded.

TABLES AND FIGURES

TABLE 1: LOCATIONAL DISTRIBUTION OF BUSINESSES

Locational category	Percentage (n=221)
In or adjacent to conurbation	38
In or adjacent to major town (pop $\geq 100,000$)	44
In or adjacent to moderate town (pop $\geq 50,000 < 100,000$)	6
In or adjacent 'market town' (pop $\geq 10,000 < 50,000$)	7
Rural (pop $< 10,000$)	5

TABLE 2: STRENGTH OF INVOLVEMENT IN LOCAL INDUSTRIAL CLUSTERS

Criteria	Group	Strength of involvement in local cluster	Percentage (n=215)
(a) $> 0.45\%$	[I]	Local high tech cluster activity	14
(b) $LQ > 1.25$	[II]	Activity noted as associated with or supporting a local cluster	11
(a) $< 0.45\%$	[III]	A locally over-represented activity associated with local cluster	10
(b) $LQ > 1.25$			
(a) $> 0.45\%$	[IV]	Local concentration of an activity associated with local cluster	14
(b) $LQ < 1.25$			
(a) $< 0.45\%$	[V]	Activity not clearly associated with local cluster	52

TABLE 3: CLUSTER INVOLVEMENT CATEGORIES

Cluster involvement	Percentage (n=215)
Remote/isolated ¹³	16
Urban related	35
Weak involvement	24
Strong involvement	24

TABLE 4: CLUSTER INVOLVEMENT OF BUSINESS TYPES

Cluster involvement	Business Types				
	Small expert (n=48)	Externally supported (n=26)	New producers (n=56)	Old manuf' trs (n=59)	Manager run (n=17)
	%	%	%	%	%
Remote/ isolated	23	15	11	19	12
Urban related	15	31	41	49	47
Weak involvement	48	15	21	15	0
Strong involvement	15	39	27	17	41

TABLE 5: NICHE MARKET INDICATORS

	Involvement in cluster category			
	Remote/ isolated	Urban related	Weak involvement	Strong involvement
Dependence on 1 customer (n=207) (% of turnover)*				
<25%	72	71	67	84
>=25%	28	29	33	16
Competitors (n=207) (number of serious competitors) *				
< 5	61	39	58	40
>=5<10	21	33	14	27
>=10	18	28	28	33
Larger competitors (n=191) (% of all competitors)				
<50%	21	25	23	15
>=50%<100%	36	26	19	25
100%	43	49	57	60
Overseas competitors (n=186) (% of all competitors)				
None	41	34	48	30
1-<75%	15	40	21	30
>=75%	44	26	32	40
Exports (incidence) (n=184)				
Exporters	66	71	60	62
Exports (level) (n=120 exporters only) (% of turnover)*				
<25%	26	48	61	41
>=25%<50%	21	15	14	26
>=50%	53	37	25	33
Subcontracting for (incidence) (n=215)*				
Subcontractor	43	36	17	46
Subcontracting for (level) (n=140 subcontractors only) (% of turnover)				
<25%	40	37	61	54
>=25%<50%	10	22	12	14
>=50%	50	41	28	32
Origin of subcontract orders (n=137 subcontractors only)*				
Only local	10	15	19	32
Local and elsewhere UK	55	50	63	54
Some overseas	35	35	19	14
Subcontracting to (incidence) (n=215)				
Client	37	29	17	25
Subcontracting to (level) (n=158 clients only) (% of turnover)*				
<25%	54	40	65	59
>=25%<50%	32	31	26	31
>=50%	14	28	9	10
Location of subcontract order placed (n= 144 clients only)				
Only local	30	33	24	29
Local & elsewhere UK	60	47	62	55
Some overseas	10	20	14	16

* Statistically significant

TABLE 6: IMPORTANCE OF LIMITATIONS

	Involvement in cluster category			
	Remote/ isolated	Urban related	Weak involvement	Strong involvement
Limitation	Mean Score	Mean Score	Mean Score	Mean Score
Demand*	2.31	2.79	2.63	2.42
Increased competition*	2.31	2.96	2.88	2.80
Overall growth of demand in main product markets	2.29	2.59	2.61	2.42
Access to new markets*	2.14	2.61	2.39	1.90
Supply	2.13	2.20	2.30	2.25
Marketing/sales skills	2.11	2.51	2.53	2.56
Management skills	2.34	2.17	2.47	2.30
Availability and/or cost of finance	1.97	2.28	2.00	2.40
Lack of technological/scientific* expertise	1.89	1.84	2.49	2.06
Availability of manual/clerical skills	1.71	1.83	2.02	1.72
Technological*	1.56	1.78	1.49	1.82
Difficulties implementing new technology	2.06	2.11	1.78	2.08
Acquisition of IPR*	1.20	1.45	1.39	1.64
Protection of IPR	1.29	1.51	1.31	1.52

* Differences between all or some groups statistically significant at 5% level

TABLE 7: COLLABORATION WITH OTHER ORGANISATIONS

Type of organisation	Remote/ isolated	Urban related	Weak involvement	Strong involvement
	%	%	%	%
All collaboration	69	56	53	64
More than one organisation	13	35	22	30
Suppliers	21**	65	52	55
Customers	38	50	56	55
Distributors	17	35	22	39
Firms in the same line	38	43	52	58
Research base	25	40	26	24
Number of purposes				
More than one	71	78	70	76
Share R&D	58	38	26	36
Expand range of products/services	67	80	78	73
Improve market/ financial credibility	12	25	30	24
Meet current customer needs	25*	53	67	52
Spread costs	21	12	11	9
Provide access to new markets	54	58	52	55

**Significant at 1% level or better

* Significant at 5% level or better

TABLE 8: PERFORMANCE

	Cluster involvement category			
	Remote/ isolated	Urban related	Weak involvement	Strong involvement
	%	%	%	%
Long term growth (n=147)*				
Low growth	48	29	22	18
Average growth	31	48	51	39
High growth	21	23	27	42
Recent growth (Composite growth) (n=213)				
No growth	34	35	19	26
Low	14	24	27	22
Moderate/uneven	31	20	31	27
High balance	20	21	23	26
Employment growth (relative for size) (n=199)				
No growth	50	53	43	48
Low	19	11	16	17
Average	22	24	20	10
High	9	11	20	25
Turnover growth (relative for size) (n=202) *				
No growth	42	40	35	31
Low	10	26	18	17
Average	45	19	20	21
High	3	14	27	31
Innovation (incidence)(n=212)				
Innovator	83	83	83	76
Innovation (level)(n=172 innovators only)				
Non-novel	31	27	35	37
Novel	69	73	65	63
R&D (n=215) (Spending as a percentage of turnover)				
None undertaken	40	34	40	40
<10%	34	49	54	31
>=10%	26	17	6	29

* Significant at 5% level or better

TABLE 9: GROWTH OBJECTIVES AND APPROACH TOWARDS RISK

	Cluster involvement category			
	Remote/ isolated	Urban related	Weak involvement	Strong involvement
	%	%	%	%
Growth objective				
No growth	17	7	15	6
Moderate growth	40	61	40	43
Substantial growth	43	33	44	51
Approach toward risk				
Closed	58	46	42	39
Open	42	54	58	61
Venture Capital*				
Sought	20	14	14	33

*Significant at 1% level or better

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Appendix

Table A1 Characteristics of the businesses and of the participants

Type of business (n=235)	%	Sectors (n=236)	%
Completely new start	65	Manufacturing	58
Spin out/off	16	Services	42
MBO/MBI/acquisition	15	<i>Computer activities and telecommunications</i>	<i>19</i>
Other	4	<i>R&D and technical services</i>	<i>23</i>
<hr/>			
Size Employment (n=232)		Size Turnover (n =215)	
< 20 employees	37	< £1 million turnover	38
>=20 employees < 50 employees	37	>= £1 million - < £5 million	45
>= 50 employees	26	>= £5 million turnover	17
<hr/>			
Age (n=233)	37	Ownership	
Newer: founded since 1990		Real and 'quasi' sole proprietors	29
Founded between 1980 and 1989	28	Shared (internal only)	36
Older: founded before 1980	35	Shared with external owners	34
<hr/>			
Gender (n=234)		Age of CEO (n=234)	
Male	92	Younger <=45	30
Female	8	Middle aged >45<=55	39
		Older >55	31
Qualifications (n=210)		Experience of working in HEI/research/similar (n=160)	25
Post graduate degree	32		
First degree	32		
Vocational/professional (n=235)	53		

Table A2 Niche Market Indicators

Dependence	On one customer (n=213)	On 3 customers (n=218)
	%	%
<10% of turnover	31	10
>=10% <50% of turnover	58	57
>=50% of turnover	11	33
Perception of competitors		
Number of serious competitors (n=214)	Proportion of larger competitors (n=198)	
	%	%
<5	47	<50% 21
>=5-<10	25	>=50%-<100% 25
>=10	28	100% 54

Table A3 Competitive Advantages

Competitive Advantages (n=222)	Mean Score
Product/service	3.95
Quality of product/service	4.34
Technological/scientific expertise	3.94
Specialised product/service	3.83
Design of product/service	3.65
Delivery	3.84
Personal attention/responsiveness to client needs	4.40
Speed of service	3.97
Price/cost advantages	3.19
Marketing	3.32
Established reputation	4.14
Being first in the market with new products/services	3.01
Marketing and promotion	2.87
Other	3.27
Range of products/services	3.27

Table A4 Performance

Growth	Turnover (n=208)	Employment (n=206)
	%	%
Contraction/no growth	37	49
Low growth for size	19	15
Average growth for size	24	20
High growth for size	20	16
Composite Growth (n=219)		%
Contraction/no growth (in either turnover or employment)		29
Low/uneven growth (contraction/no growth in either turnover or employment)		22
Moderate uneven growth		26
High balance growth (average or high growth in both turnover and employment)		22
Long term growth (n=151)		%
Low for age		29
In line with age		44
Good for age		27
Innovation (n=219)		
Incidence (n=219)		%
Innovator		81
Level		
Low level (non novel innovators)		26
High level (novel innovators)		56
R&D Spending as a percentage of turnover (n=221)		%
None		39
Less than 10%		43
≥10%		18

¹³ The majority of the businesses in this category were in 'rural' locations. Not all of those locations were in peripheral regions but they were relatively inaccessible.