# Management team and technology strategy for success in high-growth SMEs

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***Keywords*** *Small firms, success, high-growth, technology strategy, management team.*

***Abstract*** *This article explores two of the five major factors that determine success in high-growth small and medium-sized enterprises (SMEs). Research has shown that the internal characteristics of SMEs such as technology strategy and the demographics of the management team are critical and related to the organisational success.*

*High-growth SMEs have been defined as innovative technology companies that introduce new products or services, opening new channels of distribution, pioneering novel production methods and management approaches.*

*A sectorial classification* of "high technology" industries developed at the Department of Trade and Industry was used as a basis for selecting the sample in the study. This embraces the* ***communications****,* ***IT****,* ***computing, biotechnology****,* ***electronics****, and* ***medical / life sciences*** *industries.*

## Introduction

The demography of the management team is critical to the success of high-growth SMEs. The characteristics of such teams in terms of team size, tenure and previous joint working experience are important to the strategy making process and the performance of the firm as a whole, and shows a positive correlation to organisation's success. (Smith *et al*, 1994; Hambrick *et al*, 1996; Dess *et al*, 1997).

Both the management team demography and technology strategy combination can be responsible for the success of high-growth SMEs.

Technology strategy is primarily focused on the development and innovation of the firm's technology capabilities, resulting in the firm's competitive advantage. The overall corporate strategy is thus a match between technology and business strategies (Zahra and Covin, 1993; Cooper, 1993).

While most of the earlier research considered U.S industries, this study industry focused on the following sectors in the U.K: **aerospace/defence, biotechnology, communications, computing, communications, electronics**, **IT, medical / life sciences and light engineering in the U.K.**

## Management team characteristics and success

Hambrick and Mason (1984) were among the first to highlight the important role of the management team in relation to an organisation's success. Although their upper-echelons theory did not necessary focus on high-growth SMEs, the strategic importance of their findings cannot be ignored. Their theory stressed the importance of decision making by the leaders in the long-term development of the firm.

*The team's prior experience and complimentarity of skills.* Timmons (1994) states that entrepreneurs have typically developed a solid base and a wide breadth of management skills and technical know-how over the years of working in different speciality areas: sales, marketing, manufacturing and finance. What is important is having a management team whose skills are complimentary, not the possession by only one individual of absolute set of skills. Cooper and Bruno (1997) found that team members' prior experience in marketing and technology is particularly important. Roure and Keely (1989) found that team heterogeneity was a major predictor of the internal rate of return among new firms.

*Team size*. Cooper and Bruno, 1977; Eisenhardt and Schoonhoven, 1990 associate the number of members in the team with growth of start-ups. More team members mean that there are more people to perform various tasks in new firms and therefore more opportunity for specialisation in decision making. Kazanjian (1988) outlined a number of issues with new firms, with different executives resolving various problems.

*Prior joint work experience.* Founding members who have prior joint working experience demonstrate spontaneity in the decision making process (Eisenhardt and Schoohoven, 1990), with higher trust, coordination (Stinchcombe, 1965), cohesiveness (Goodstein and O'Reilly, 1988) and communication (Zenger and Lawrence, 1989), becoming particularly important in rapidly changing environments that characterise most high-growth SMEs.

*Team tenure.* This defines the average number of years that team members have stayed together. Katz (1982) found a non-linear relationship between group tenure and performance, explaining that groups go through different stages of socialisation, innovation, and stability.

## Research Methodology

The target population for the research was randomly selected from U.K based high-growth small and medium-sized enterprises.

Firms were identified first from each of the 39 Science and Technology Parks in the UK. Similarly, Dun and Bradstreet's Key British Enterprises 50,000 list was utilised to further identify firms within the high-growth sector. It was specified that the firms had to employ between 10 and 250 employees and the firms established between 1992 and 2002.

The major difference of this study from that of Smith *et al*, (1994) and Dess *et al*, (1997) is the introduction of additional criteria for the sample firms: a turnover of between £5m and £50m and that they must have received funding from at least one private or corporate investor.

A total of 650 firms were thus identified and mailed the survey questionnaire. The respondents are shown in Table 1.0

This study categorised firms established between 1992-1996 as older firms, and firms established between 1997-2002 as newer firms. The objective measure of organisational success was derived from information and data from OneSource, Companies House, Cardiff and Dun & Bradstreet in the U.K. It represents the firm's turnover, management team size, employee size, sales, and profitability over the last three years.

The subjective measure of success for the firms was assessed using a modified version of the measure suggested by Zahra (1996b). It reflects the following goals: sales growth, market share, profitability and product development.

**Table 1.0 The Sample for the modified study**

| **Industry Category** | **Total Responses** | **% of Total** |
|---|---|---|
| Aerospace / Defence | 4 | 2.67 |
| Biotechnology | 18 | 12.00 |
| Computing | 23 | 15.33 |
| Communications | 10 | 6.67 |
| Electronics / Electrical | 19 | 12.67 |
| Information Technology | 46 | 30.67 |
| Medical / Life Sciences | 21 | 14.00 |
| Light Engineering | 9 | 6.00 |
| **Total:** | **150** | **100.00%** |

**Management team characteristics and SME success.**
The management team composition is characterised by *team size*, *functional heterogeneity*, *educational heterogeneity*, and *tenure*. Table 2.0 represents the descriptive statistics for the characteristics of the management team.

**Table 2.0 Descriptive statistics for the management team characteristics**

| | Team Size | Functional Heterogeneity | Educational Heterogeneity | Team Tenure |
|---|---|---|---|---|
| *Mean* | 5.84 | 1.48 | 2.48 | 4.10 |
| *Median* | 5.00 | 1.00 | 2.50 | 4.00 |
| *Std Deviation* | 1.703 | 0.653 | 1.18 | 1.394 |
| *Minimum* | 3 | 1 | 1 | 2 |
| *Maximum* | 11 | 4 | 9 | 8 |

*Team size:* the average team size was 5.84; the median 5.00. Figure 1.0 shows the distribution of the team size across the sample.

| ***Team*** | ***n*** | ***per cent*** |
|---|---|---|
| ≤ 5 | 75 | 50.00% |
| 6-7 | 44 | 29.33% |
| 8-9 | 28 | 18.67% |
| ≥ 10 | 3 | 2.00% |
| **Total** | **150** | **100%** |

**Figure 1.0 Team size**

The majority of the firms (50%) less than or equal to 5 persons in the management team, (29.33%) of the firms had from 6 to 7 persons, (18.67%) had from 8 to 9 persons, while only (2.00%) had teams consisting of 10 or more persons.

To measure competence / experience and educational heterogeneity, the Herfindhal-Hischman index was used (Chamanski and Waagø, 1999).

Herfindhal-Hischman $H=1-\sum_{i=1}^{n} Pi^2$, where *H* is a measure of heterogeneity, and *Pi* is the percentage of management team members in each of the functional and educational categories. The index ranges results from 0 to 1, where 0 corresponds to perfect homogeneity and 1 to perfect heterogeneity.

*Team tenure:* defined as the average number of years team members have worked together in the team, and is 4.10 in the sample.

The interdependence among the variables, the strength of the relationships and the effect of one variable on another were examined using Spearman's rank correlation coefficient and Pearson's correlation coefficient (Sparrow, 1989).

The statistical significance tests the likelihood of the relationship occurring by chance alone, if there was no difference in the population from which the sample was drawn(Robson,2002).

## Technology strategy and success

Technology strategy is a complimentary, not an alternative approach to business strategy, because organisational performance is determined by the firm's competitive advantage and position in the market and the ability to sustain this advantage through continuous innovations (Zahra and Covin, 1993). These strategies are considered as completing and reinforcing other parts of the total corporate strategy for superior performance (Zahra and Covin, 1993; Roberts, 1992; Berry and Taggart, 1998).

Technology strategy was examined along four dimensions: R&D, patenting, licensing agreements and pioneering technology. The descriptive statistics for the elements of technology strategy are shown in Table 3.0

**Table 3.0 Descriptive statistics for the components of technology strategy**

| | **R&D** | **Patenting** | **Licensing Agreements** | **Pioneering** |
|---|---|---|---|---|
| *Mean* | *5.19* | *3.48* | *3.83* | *3.86* |
| *Median* | *6.00* | *3.00* | *4.00* | *3.00* |
| *Std. Deviation* | *1.35* | *1.675* | *1.195* | *1.326* |
| *Minimum* | *2* | *1* | *2* | *2* |
| *Maximum* | *7* | *7* | *7* | *7* |
| *Cumulative Percent of Index Scores below the Midpoint (4)* | *20.0%* | *68.5%* | *48.0%* | *53.3%* |
| *Cumulative Percent of Index Scores below (5)* | *38.7%* | *37.3%* | *39.3%* | *45.3%* |

The relationship between management team characteristics and technology strategy across the whole sample in the study illustrates the interdependence between the variables and levels of relationships that determine the success of the high-growth SMEs considered.

## High-growth SMEs across the survey sample

Across the whole sample considered for this study, there is a perfect negative correlation between functional heterogeneity and educational heterogeneity($r=-1.00$, $p<0.01$). The relationship is statistically significant at the 0.01 level indicating that both functional and educational heterogeneities are related.

**Table 4.0 Management team characteristics and technology strategy across all, newer and older firms. Spearman's correlations.**

| | All | 1992-1996 | 1997-2002 |
|---|---|---|---|
| Functional heterogeneity-Educational heterogeneity | r=-*1.00*** *p*<0.05 n=150 | r=-*1.00*** *p*<0.05 n=66 | |
| Pioneering technology-Team tenure | r=.328** *p*<0.01 n=150 | | r=-.*425** *p*<0.01 n=85 |
| Pioneering technology-Licensing agreements | r=.365* *p*<0.05 n=150 | r=.438** *p*<0.01 n=66 | r=.274* *p*<0.05 n=85 |
| Pioneering technology-R&D | r=-.*572*** *p*<0.01 n=150 | r=.743** *p*<0.05 n=66 | r=.430* *p*<0.01 n=85 |
| Pioneering technology-Patents | r=-.*208** *p*<0.01 n=149 | | r=.380* *p*<0.01 n=85 |
| Team size – Licensing agreements | | r=-.*246** *p*<0.05 n=66 | |
| Team tenure-Patents | r=.565** *p*<0.01 n=150 | r=.482* *p*<0.05 n=66 | |
| Licensing agreements-RD | r=.317** *p*<0.01 n=150 | r=-.*335*** *p*<0.05 n=66 | |
| licensing agreements-team tenure | r=-.*164** *p*<0.01 n=150 | | |
| Patents-Licensing agreements | r=-.*165** *p*<0.05 n=149 | | |

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

Licensing agreements show a relationship between both team tenure and pioneering. As the firms increase licensing agreements over the long term, team tenure becomes shorter for the management team(r=-0.164, $p<.05$). This correlation is significant at the 5% level. Whereas the relationship with pioneering is a weak but positive correlation (r=.365,$p<0.01$),indicating that the two are related such that as licensing activities increase and high-growth SMEs obtain returns from such agreements, the tendency for the firms to step up pioneering technological products also increase.

High-growth SMEs across the sector have a portfolio of patents, although patents in the sample shows significant relationship between both team tenure (p=.565, $p<0.01$) and pioneering(r=-.208, $p=0.011$). A strong correlation exits between patents and

team tenure for the firms. The longer the management team tenure, the more likelihood of the development of a patent within the firm. The relationship with pioneering unlike team tenure weakly shows a negative correlation. Pioneering technological products does not necessarily increase the need for patents.

Lastly, R&D activities across all the sectors considered have a strong negative significant effect on pioneering activities(r=-.572, $p$<0.01), but shows a little positive effect on licensing agreements(r=.317, $p$<0.01). Both relationships are significant at

**High-growth SMEs established between 1992-1996**

High-growth SMEs that were established between 1992-1996 have shown correlations generally similar to those across the whole sample considered.

Pioneering technological products for the older firms, i.e. those established between 1992-1996 show a strong correlation with licensing agreement(r=.438, $p$<.01), but a very strong negative correlation with R&D. The relationships are both significant at the 10 % level, indicating that while firms that constantly undertake pioneering activities also increase licensing agreements, investments in R&D activities don't always match pioneering activities.

Again, as the study previously showed in the relationships across all the sectors generally, high-growth SMEs established between 1992-1996 experience a perfect negative correlation between educational and functional heterogeneity(r=-1.00,$p$<.01). It means that for the older firms, the two variables are precisely related; however, as most firms expand functional heterogeneity, the need for educational heterogeneity decreases.

Further, although average team size for the firms was 5.84, the study shows that the correlation between team size and licensing is weak and negative(r=-.246, $p$<0.05) significant at the 0.05 level. The tendency for increases in team size to decrease licensing agreements is significant at the 0.05 level.

Team tenure correlates strongly with patents for the older firms(r=.482, $p$<0.01). High-growth SMEs have typically developed a portfolio of patents and have a strong management cohesion resulting in above average team tenure. For these firms, the correlation is significant at the 0.01 level.

**High-growth SMEs established between 1997-2002**

For the high-growth firms established between 1997-2002, pioneering technology has a relationship with team tenure(r=-.425, $p$<0.01), licensing(r=.274, $p$<0.05), patents(r=-.380, $p$<0.01) and R&D(r=-.430, $p$<0.01). The effect of team tenure on pioneering activities show a strong negative correlation that is significant at the 0.01 level, but a positive correlation with licensing. R&D has the strongest effect on pioneering for the firms established between 1997-2002. Investments in R&D activities for the newer firms are still very low. The effect of this is a negative correlation with pioneering activities. These firms' resources for internal R&D is

small compared to the established firms, increasing the need for external R&D activities.

**Table 5.0 Management team characteristics and technology across all the sectors. Spearman's correlations.**

| | **Aerospace/defence, Electrical/electronics Light engineering** | **Computing, Communications, IT** | **Biotechnology, Medical/life sciences** |
|---|---|---|---|
| Patents-R&D | | r=.290** $p$<0.01 n=79 | n=33 |
| Functional heterogeneity-Educational heterogeneity | | r=-*1.00*** $p$<0.01 n=79 | n=33 |
| Team tenure-R&D | r=-.*333** $p$<0.05 n=38 | | n=33 |
| Pioneering technology-R&D | r=-.*375** $p$<0.05 n=38 | | n=33 |

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

**Aerospace/defence, electrical/electronics and light engineering sectors**

Table 7.0 examines the strength of the relationships between management team characteristics and technology strategy within aerospace/defence, electrical/electronic and light engineering sectors of the firms. R&D activities in this sector indicate a negative correlation between both team tenure(r=-.333, $p$<0.05) and licensing agreements(r=-.347, $p$<.05). Longer team tenures in this sector does not increase R&D activities nor licensing agreements.

**Biotechnology and medical/life sciences sectors**

There was no significant relationship detected between the considered components of management team and technology strategy in the biotechnology, medical/life sciences sector. This means that the composition of the management team has no significant effect on the success of firms in this sector, provided that the technology strategy adopted is relevant.

**Computing, communications and IT sectors**

Patenting activities are associated positively with R&D(r=.290,$p$<0.05), which is statistically significant at the 0.01 level. Functional heterogeneity is negatively correlated with educational heterogeneity (r=-1.00,$p$<0.0). The importance of

functional heterogeneity is underscored by educational heterogeneity in this sector and lead times are short and products have short life cycles.

**Summary and Conclusions**

Summarising the findings from analysis of the whole sample, the combined effect of technology strategy and management team characteristics has a strong effect on the success of high-growth SMEs.

The analysis shows that the correlation between pioneering technology and licensing agreements almost twice as high in the older firms than in the newer firms,(r=.438 Vs r=.274); pioneering technology and R&D (r=.743 Vs r=.430) also indicating the same levels.

There was no significant relationship detected between the considered components of management team and technology strategy in the biotechnology, medical/life sciences sectors. This implies that management team characteristics may be less important for this sector.

Licensing agreements in the older firms have shown a correlation between both R&D(r=-.335, $p<0.05$) and team size(r=-.246, $p<0.05$). Pioneering technology and licensing agreements are both important factors for success for the older firms, while pioneering technology consistently correlates positively with most component of technology strategy but negatively with team tenure for the newer firms. Thus the older firms have acquired knowledge and competence to improve their technological base, and consider technology strategy more important than the newer firms.

Further, for the older firms, team tenure and team size are important components in relation to the combination of management team characteristics and technology strategy. The newer firms on the other hand, only team tenure is considered an important component for the combination of the two variables of success.

Across the whole sample, pioneering technology effects R&D inversely(r=-.572,p<0.01) and on a higher correlation than in the aerospace/defence, electrical/electronics and light engineering sectors(r=-.375,p<0.05) In this sector where front-end development costs are lower and lead times from product to market launch are shorter[1]. The result is that any increases in R&D investments will lead to decreases in pioneering technology products or services.

The correlation between pioneering technology with team tenure, patenting and R&D for the firms established between 1997-2002 is almost equal but opposite to a similar relationship across the whole sample except for the relationship between pioneering technology and licensing agreements which is in the same direction: r=.365,$p<0.05$(*whole sample)* vs. *(newer firms)*r=.274,$p<0.05$. Both relationships are statistically significant at the 0.01 level.

Analysing the effect of functional heterogeneity on educational heterogeneity across the whole sample(r=-1.00, p<0.05) shows a similar pattern for the older firms(r=-1.00,

[1] Moore,B(1994): Financial constraints to the growth and development of small high-technology firms, *in Hughes, A. and Storey, D.J. (eds):Finance and the small firm.Routledge, London*

$p$<0.05). Thus both components of management team characteristics are important for the newer firms.

The empirical finding indicates a positive relationship between management team characteristics and technology strategy for the success of high-growth SMEs.

**Table 6.0 Management team characteristics and technology strategy across the whole sample. Spearman's correlations.**

| | | | Team size | Functional heterogeneity | Educational Heterogeneity | Team tenure | Pioneering | Licensing | R&D | Patents |
|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Team size | Correlation Coefficient | 1.000 | -.033 | .033 | .022 | -.044 | -.138 | .073 | .040 |
| | | Sig. (2-tailed) | . | .690 | .690 | .791 | .589 | .091 | .378 | .631 |
| | | N | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| | Functional heterogeneity | Correlation Coefficient | -.033 | 1.000 | -1.000(**) | -.076 | -.058 | -.135 | -.038 | -.001 |
| | | Sig. (2-tailed) | .690 | . | .000 | .352 | .480 | .099 | .641 | .990 |
| | | N | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| | Educational Heterogeneity | Correlation Coefficient | .033 | -1.000(**) | 1.000 | .076 | .058 | .135 | .038 | .001 |
| | | Sig. (2-tailed) | .690 | .000 | . | .352 | .480 | .099 | .641 | .990 |
| | | N | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| | Team tenure | Correlation Coefficient | .022 | -.076 | .076 | 1.000 | -.328(**) | -.164(*) | .057 | .565(**) |
| | | Sig. (2-tailed) | .791 | .352 | .352 | . | .000 | .045 | .488 | .000 |
| | | N | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| | Pioneering | Correlation Coefficient | -.044 | -.058 | .058 | -.328(**) | 1.000 | .365(**) | -.572(**) | -.208(*) |
| | | Sig. (2-tailed) | .589 | .480 | .480 | .000 | . | .000 | .000 | .011 |
| | | N | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| | Licensing | Correlation Coefficient | -.138 | -.135 | .135 | -.164(*) | .365(**) | 1.000 | -.317(**) | -.165(*) |
| | | Sig. (2-tailed) | .091 | .099 | .099 | .045 | .000 | . | .000 | .045 |
| | | N | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| | R&D | Correlation Coefficient | .073 | -.038 | .038 | .057 | -.572(**) | -.317(**) | 1.000 | .089 |
| | | Sig. (2-tailed) | .378 | .641 | .641 | .488 | .000 | .000 | . | .283 |
| | | N | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 |
| | Patents | Correlation Coefficient | .040 | -.001 | .001 | .565(**) | -.208(*) | -.165(*) | .089 | 1.000 |
| | | Sig. (2-tailed) | .631 | .990 | .990 | .000 | .011 | .045 | .283 | . |
| | | N | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 |

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

**Table 7.0 Management team characteristics and technology strategy across the aerospace/defence, electrical/electronics, and light engineering sectors. Spearman's correlations.**

| | | | Team size | Functional heterogeneity | Educational Heterogeneity | Team tenure | Pioneering | Licensing | R&D | Patents |
|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Team size | Correlation Coefficient | 1.000 | . | . | .133 | -.119 | -.190 | .119 | -.181 |
| | | Sig. (2-tailed) | . | . | . | .427 | .475 | .254 | .476 | .283 |
| | | N | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 |
| | Functional heterogeneity | Correlation Coefficient | . | . | . | . | . | . | . | . |
| | | Sig. (2-tailed) | . | . | . | . | . | . | . | . |
| | | N | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 |
| | Educational Heterogeneity | Correlation Coefficient | . | . | . | . | . | . | . | . |
| | | Sig. (2-tailed) | . | . | . | . | . | . | . | . |
| | | N | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 |
| | Team tenure | Correlation Coefficient | .133 | . | . | 1.000 | -.028 | -.159 | -.333(*) | -.053 |
| | | Sig. (2-tailed) | .427 | . | . | . | .865 | .340 | .041 | .755 |
| | | N | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 |
| | Pioneering | Correlation Coefficient | -.119 | . | . | -.028 | 1.000 | .294 | -.375(*) | .257 |
| | | Sig. (2-tailed) | .475 | . | . | .865 | . | .073 | .020 | .124 |
| | | N | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 |
| | Licensing | Correlation Coefficient | -.190 | . | . | -.159 | .294 | 1.000 | -.156 | .190 |
| | | Sig. (2-tailed) | .254 | . | . | .340 | .073 | . | .350 | .260 |
| | | N | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 |
| | R&D | Correlation Coefficient | .119 | . | . | -.333(*) | -.375(*) | -.156 | 1.000 | .112 |
| | | Sig. (2-tailed) | .476 | . | . | .041 | .020 | .350 | . | .509 |
| | | N | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 |
| | Patents | Correlation Coefficient | -.181 | . | . | -.053 | .257 | .190 | .112 | 1.000 |
| | | Sig. (2-tailed) | .283 | . | . | .755 | .124 | .260 | .509 | . |
| | | N | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |

* Correlation is significant at the 0.05 level (2-tailed).

**Table 8.0 Management team characteristics and technology strategy across the computing, communications and IT sectors. Spearman's correlations.**

| | | | Team size | Functional heterogeneity | Educational Heterogeneity | Team tenure | Pioneering | Licensing | R&D | Patents |
|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Team size | Correlation Coefficient | 1.000 | -.063 | .063 | -.198 | .215 | -.104 | -.019 | .027 |
| | | Sig. (2-tailed) | . | .578 | .578 | .080 | .057 | .364 | .865 | .813 |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| | Functional heterogeneity | Correlation Coefficient | -.063 | 1.000 | -1.000(**) | -.080 | -.070 | -.183 | -.138 | .088 |
| | | Sig. (2-tailed) | .578 | . | .000 | .482 | .539 | .107 | .224 | .442 |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| | Educational Heterogeneity | Correlation Coefficient | .063 | -1.000(**) | 1.000 | .080 | .070 | .183 | .138 | -.088 |
| | | Sig. (2-tailed) | .578 | .000 | . | .482 | .539 | .107 | .224 | .442 |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| | Team tenure | Correlation Coefficient | -.198 | -.080 | .080 | 1.000 | -.202 | .116 | -.043 | .048 |
| | | Sig. (2-tailed) | .080 | .482 | .482 | . | .074 | .308 | .704 | .676 |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| | Pioneering | Correlation Coefficient | .215 | -.070 | .070 | -.202 | 1.000 | -.111 | -.207 | -.072 |
| | | Sig. (2-tailed) | .057 | .539 | .539 | .074 | . | .330 | .068 | .531 |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| | Licensing | Correlation Coefficient | -.104 | -.183 | .183 | .116 | -.111 | 1.000 | .151 | -.085 |
| | | Sig. (2-tailed) | .364 | .107 | .107 | .308 | .330 | . | .184 | .456 |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| | R&D | Correlation Coefficient | -.019 | -.138 | .138 | -.043 | -.207 | .151 | 1.000 | .290(**) |
| | | Sig. (2-tailed) | .865 | .224 | .224 | .704 | .068 | .184 | . | .009 |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |
| | Patents | Correlation Coefficient | .027 | .088 | -.088 | .048 | -.072 | -.085 | .290(**) | 1.000 |
| | | Sig. (2-tailed) | .813 | .442 | .442 | .676 | .531 | .456 | .009 | . |
| | | N | 79 | 79 | 79 | 79 | 79 | 79 | 79 | 79 |

** Correlation is significant at the 0.01 level (2-tailed).

**Table 9.0 Management team characteristics and technology strategy across the firms established between 1992-1996. Spearman's correlations.**

| | | | Team size | Functional heterogeneity | Educational Heterogeneity | Team tenure | Pioneering | Licensing | R&D | Patents |
|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Team size | Correlation Coefficient | 1.000 | -.007 | .007 | .007 | -.175 | -.246(*) | .183 | -.092 |
| | | Sig. (2-tailed) | . | .957 | .957 | .954 | .160 | .047 | .142 | .467 |
| | | N | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 |
| | Functional heterogeneity | Correlation Coefficient | -.007 | 1.000 | -1.000(**) | -.103 | -.100 | -.201 | -.034 | .021 |
| | | Sig. (2-tailed) | .957 | . | .000 | .409 | .426 | .105 | .787 | .868 |
| | | N | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 |
| | Educational Heterogeneity | Correlation Coefficient | .007 | -1.000(**) | 1.000 | .103 | .100 | .201 | .034 | -.021 |
| | | Sig. (2-tailed) | .957 | .000 | . | .409 | .426 | .105 | .787 | .868 |
| | | N | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 |
| | Team tenure | Correlation Coefficient | .007 | -.103 | .103 | 1.000 | -.141 | -.033 | .055 | .482(**) |
| | | Sig. (2-tailed) | .954 | .409 | .409 | . | .257 | .792 | .660 | .000 |
| | | N | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 |
| | Pioneering | Correlation Coefficient | -.175 | -.100 | .100 | -.141 | 1.000 | .438(**) | -.743(**) | .072 |
| | | Sig. (2-tailed) | .160 | .426 | .426 | .257 | . | .000 | .000 | .569 |
| | | N | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 |
| | Licensing | Correlation Coefficient | -.246(*) | -.201 | .201 | -.033 | .438(**) | 1.000 | -.335(**) | -.111 |
| | | Sig. (2-tailed) | .047 | .105 | .105 | .792 | .000 | . | .006 | .381 |
| | | N | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| R&D | Correlation Coefficient | .183 | -.034 | .034 | .055 | -.743(**) | -.335(**) | 1.000 | -.084 |
| | Sig. (2-tailed) | .142 | .787 | .787 | .660 | .000 | .006 | . | .505 |
| | N | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 |
| Patents | Correlation Coefficient | -.092 | .021 | -.021 | .482(**) | .072 | -.111 | -.084 | 1.000 |
| | Sig. (2-tailed) | .467 | .868 | .868 | .000 | .569 | .381 | .505 | . |
| | N | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 |

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

**Table 10.0 Management team characteristics and technology strategy across the firms established between 1997-2002. Spearman's correlations.**

| | | | Team size | Functional heterogeneity | Educational Heterogeneity | Team tenure | Pioneering | Licensing | R&D | Patents |
|---|---|---|---|---|---|---|---|---|---|---|
| Spearman's rho | Team size | Correlation Coefficient | 1.000 | . | . | -.001 | .083 | -.029 | -.052 | .102 |
| | | Sig. (2-tailed) | . | . | . | .996 | .449 | .792 | .635 | .353 |
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| | Functional heterogeneity | Correlation Coefficient | . | . | . | . | . | . | . | . |
| | | Sig. (2-tailed) | . | . | . | . | . | . | . | . |
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| | Educational Heterogeneity | Correlation Coefficient | . | . | . | . | . | . | . | . |
| | | Sig. (2-tailed) | . | . | . | . | . | . | . | . |
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| | Team tenure | Correlation Coefficient | -.001 | . | . | 1.000 | -.425(**) | -.191 | .016 | .591(**) |
| | | Sig. (2-tailed) | .996 | . | . | . | .000 | .080 | .884 | .000 |
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| | Pioneering | Correlation Coefficient | .083 | . | . | -.425(**) | 1.000 | .274(*) | -.430(**) | -.380(**) |
| | | Sig. (2-tailed) | .449 | . | . | .000 | . | .011 | .000 | .000 |
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| | Licensing | Correlation Coefficient | -.029 | . | . | -.191 | .274(*) | 1.000 | -.282(**) | -.169 |
| | | Sig. (2-tailed) | .792 | . | . | .080 | .011 | . | .009 | .122 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| | R&D | Correlation Coefficient | -.052 | . | . | .016 | .430(**) | -.282(**) | 1.000 | .166 |
| | | Sig. (2-tailed) | .635 | . | . | .884 | .000 | .009 | . | .130 |
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |
| | Patents | Correlation Coefficient | .102 | . | . | .591(**) | -.380(**) | -.169 | .166 | 1.000 |
| | | Sig. (2-tailed) | .353 | . | . | .000 | .000 | .122 | .130 | . |
| | | N | 85 | 85 | 85 | 85 | 85 | 85 | 85 | 85 |

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

# Appendix I

***Classification of SMEs**

The following definitions have been drawn from a range of data. Some of the most commonly used are set out below:

**EUROPEAN COMMISSION**

| | **Micro Firm** | **Small Firm** | **Medium Firm** |
|---|---|---|---|
| **Turnover** | ≤ €2 million | ≤ €10million | ≤ €50million |
| **Balance Sheet** | ≤ €2 million | ≤€10million | ≤ €43million |
| **Employees** | < 10 | < 50 | <250 |
| **Independence Criteria* *** | not applicable | 25% | 25% |

**The independence criterion refers to the maximum percentage that may be owned by one, or jointly owned by several enterprises not satisfying the same criteria.

To qualify as an SME, both the employee and the independence criteria must be satisfied, and either the turnover or the balance sheet total criteria. A large firm is any not satisfying the above criteria.

**COMPANIES ACT**

| | **Small Company** | **Medium Company** |
|---|---|---|
| Turnover | max £2.8mn | max £11.2mn |
| Balance Sheet | max £1.4mn | max £5.6mn |
| Employees | max 50 | max 250 |

A company qualifies as small or medium if it meets two of the three criteria above in any year.

**DEPARTMENT OF TRADE AND INDUSTRY**

| | **Employees** |
|---|---|
| Micro Firm | 0-9 |
| Small Firm | 0-49 |
| Medium Firm | 50-249 |
| Large Firm | 250+ |

In practice, Government schemes that are nominally targeted at small firms adopt a variety of working definitions depending on their particular objectives.

**BRITISH BANKERS ASSOCIATION**

For statistical purposes, the British Bankers Association (BBA) defines small businesses as those having an annual turnover of up to **£1 million.**

Source: Bank of England (2001)

**Table 1.0 SME definition**

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