Title Innovation Management and Commercialisation in Small Firms: A Study of OECD Countries

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Abstract:

This study examines the nature of innovation within small firms across several OECD countries with a particular focus on the relationship between formality of the firm's commercialisation management systems, and the level of R&D intensity. Drawing on a sample of small to medium enterprises (SME) who were engaged in the commercialisation of at least one innovation, the study finds that the issue of innovation management in such firms is complex with formality influencing growth in different ways. The findings have implications for both government policy makers and academic researchers.

INTRODUCTION

This study seeks to understand the nature of innovation management and commercialisation practices within small to medium sized enterprises (SMEs) across multiple advanced economies from the 34 countries that comprise the Organisation for Economic Co-operation and Development (OECD). We define an SME as an enterprise that is independently owned and managed and has fewer than 250 employees and an annual turnover of less than €50 million (OECD 2004).

The process of new product development (NPD) and commercialisation within SMEs is a field of inquiry that has received relatively little attention within the academic literature (Adams, Bessant and Phelps 2006). There are few well established definitions for commercialisation. It has been generally associated with the process of taking a new product to market and undertaking the processes of marketing and selling, or licencing the product or the technologies associated with the product. In essence it describes the commercial exploitation of the investment that has been made in a given innovation that results in a profitable return to that investment (Chakravorti 2004).

Commercialisation is thus identified as one of the key activities in the whole innovation area. This key area has been less studied however than the others although it has been stated that successful commercialisation is the condition of success (Akgun et al., 2004). Of particular interest to this study is the relationship between the formality of the NPD and commercialisation process and on one hand the level of innovation intensity (as measured by percentage of annual turnover invested in R&D where >5% are classified as high-tech and those <5% as low to mid-tech) (Hirsch-Kreinsen, Hahn and Jacobsen 2008) and on the other hand the performance of the small firm. It thus examines research questions:

1. What is the relationship between the level of formality in the innovation management and Commercialisation process and the level of R&D intensity within the small firm?
2. What is the relationship between the level of formality in the innovation management and Commercialisation process and the performance of the small firm within its target markets?

INNOVATION MANAGEMENT AND COMMERCIALISATION

Small firms seeking to commercialise new technologies have a range of potential options, which include licensing, consulting, collaborative engineering and joint ventures, in addition to direct sales to customers (Adams et.al. 2006; Libaers and Hicks 2007). This need to collaborate, often with larger firms, is a result of the SME lacking the necessary resources to commercialise the innovation alone (Kollmer and Dowling 2004). Commercialisation is essentially a process of implementation of an innovation strategy and is the end stage of a more complex pipeline of innovation management.

The NPD process precedes commercialisation and is also poorly addressed within the academic literature. In some studies NPD has been simply identified as "*products in the pipeline*" (Deeds, Decarolis and Coombs 2000). Within large firms it is closely associated with the management of R&D portfolios and specific projects with some evidence that a

more formal approach to these management tasks results in superior outcomes (Cooper, Edgett and Kleinschmidt 2004a/b). According to Brown and Eisenhardt (1995) the key elements for success are senior management support and control, good communication between project teams and cross-functional team structures. The input from suppliers appears to be of less importance than the input from customers, and market feedback and marketing seem to play a critical role, especially amongst SMEs (Huang, Soutar and Brown 2002). However, within large firms NPD "best practice" in such things as project selection, goals, technological leadership, product strategy and customer involvement, have been found to be less influential over performance than "best practices" in NPD execution such as process control, metrics, documentation and change control (Dooley, Subra and Anderson 2002).

A review of the literature undertaken by Adams, Bessant and Phelps (2006) identified key areas of focus for research, but noted that significant gaps exist, particularly in the field of commercialisation. They identify seven areas for the measurement of innovation management: i) inputs - people, physical and financial resources, tools; ii) knowledge management – idea generation, knowledge repository, information flows; iii) innovation strategy – strategic orientation, strategic leadership; iv) organization and culture – culture, structure; v) portfolio management – risk/return balance, optimisation tool use; vi) project management – project efficiency, tools, communications, collaboration; and vii) commercialisation – market research, market testing, marketing and sales.

According to Cooper et al (2004c), "*many of the decisive activities that were identified (around the commercialisation of innovations) turn out to be poorly executed, while a handful of tasks emerge as pivotal to NPD performance*." The issue did not seem to be the existence or not of a systematic formal process, but more the nature of the process and the way it is implemented. Their analysis of large firms in the United States suggested that good performance in NPD was differentiated from bad performance through the ability to

deliver a unique and superior product, use market information and "up-front homework", stable product definition, and voice-of-customer research (Cooper et.al. 2004c).

In the few papers trying to understand the link between commercialisation and innovation in small firms, many focus on high-tech small firms and analyse either their commercialisation in relation with big firms and the complementarities that they can develop (Gans and Stern 2003: Lee and Park 2010), or the role small firms can have to enhance the capacity of universities to develop the commercialisation of their innovations (Milton-Smith 2001), or the focus that small firms can put on licensing as proxy for innovation commercialisation due to their size (Kollmer and Dowling 2004).

Koskinen and Vahnaranta (2002) compared technological SMEs and large firms along the innovation process and identified six sub-processes: i) invention, ii) decision to bring the invention into development, iii) development, iv) decision to produce, v) production, and vi) marketing. They noted that steps two and four were not sufficiently researched, although these are steps where the differences between small and large firms appear important and have an influence on the other steps in the process. They identified the role of tacit knowledge and the capacity to use it along the process, including on the sixth stage of marketing, as being one of the distinctive capacities of small firms. As stated: "I*t is supposed that the small enterprises have better communication with their customers because this communication is more informal and more often takes place with persons that have decision-making power in the enterprise. However, this must be balanced against the possible market power and skills of the better trained sales force of the larger enterprises. Larger enterprises are also better known and the value of their trademarks is often greater*" (Koskinen and Vahnaranta 2002: 63).

The close proximity to the customer enjoyed by many small firms, and the resultant ability to engage in more effective communication to listen to the customer's voice has been

noted by Grönroos (1994). Small firms engaged in the commercialisation of new technological innovations must develop effective skills in marketing and internationalisation (Pellikka and Virtanen 2009). A systematic approach to the NPD and commercialisation process with a close alignment of R&D with marketing has been found to be effective within larger firms (Griffin and Hauser 1996; Dutta, Narasimha and Rajiv 1999). However, small firms generally do not follow the same systematic approach to marketing as do their larger counterparts. Decisions are made by the entrepreneurial leadership of the firm which tend to be opportunistic, informal and at time idiosyncratic (Blois and Carson 2000; Carson 1985; 1990).

NPD and commercialisation for SMEs remains one of the most challenging areas and is likely to emerge as a result of interplay between the entrepreneurial manager's own ideas and the feedback they receive from customers (Gibb and Scott 1985; Eng and Quaia 2009). Formality in the NPD process seems to be related to enhanced success (Boag and Rinholm 1989). For firms engaged in the development of technological innovations, it is also likely that they will need to forge strategic alliances in order to achieve commercialisation outcomes, although care may need to be taken in such alliances (Kotabe and Swan 1995). However, many SMEs are reactive and opportunistic in their approach to NPD and commercialisation activities rather than strategic and methodical (Lindman 2002).

Vaona and Pianta (2008), in a study of European innovation data, suggest that SMEs are more likely to display innovation behaviour built on either patenting and NPD, or process innovations aimed at reducing costs. By comparison large firms are more likely to pursue market expansion with both product and process innovations. This suggests a more systematic approach to NPD and commercialisation amongst large firms than SMEs. Terziovski (2010), in a study of Australian SME manufacturers found that innovation strategy and formality in the NPD process were better predictors of performance than customer and supplier relationships or the formation of an innovation culture. However, Liao and Rice (2010) also drawing on a sample of Australian SME manufacturers found

that investment in innovation only led to competitive performance when accompanied by "*concrete and effective changes to the market presence of a firm*". This was related to the firm's ability to respond to customer demand and market dynamics. A further study of SME manufacturers undertaken by Raymond and St-Pierre (2010) found that R&D investment in product and process innovations had a positive impact on NPD, but differences exist between low and high technology sectors. The low-tech sectors see more direct benefits from investment in process R&D while the high-tech sectors secure more benefits from product R&D.

As this review of the literature shows, there is some conflicting evidence to support the nexus between formality and NPD/Commercialisation activity within SMEs. To further address these issues and investigate the nature of this relationship our study examined the following Hypotheses:

H1. That there is a positive relationship between R&D intensity and formality in NPD and Commercialisation activity.

H2. That formality of innovation management practice is positively associated with performance.

METHODOLOGY

This study draws on a sample of 531 firms 99 per cent with fewer than 250 employees from 11 OECD countries. Data for each SME was collected using a questionnaire administered face-to-face and from an in-depth follow-up interview with the senior management of the firm, usually the owner-manager or executive director/managing director. Firms were identified through an investigation within each country of innovative companies many of which were listed in government or industry databases. In some cases contacts were made via technology incubators and simple networking by the investigators.

The data collection process involved use of a case study survey methodology (Yin and Heald, 1975). A common discuss protocol and questionnaire were employed across all countries and use was made of a computer based questionnaire running in EXCEL that allowed the data to be entered during the interview and discussions to take place with the firm's managers at the same time. While this process was time consuming it allowed for a

more in-depth examination of the issues and included some opportunity to validate the responses through examination of products and product brochures with those interviewed.

Sample Structure

The sampling process was purposive rather than random in nature and involved direct approaches to each firm's senior management to secure agreement to undertake the interview. All respondent firms had to have an innovation under development that they were planning to commercialize in the next three years from time of interview.

Table 1: Country of Origin and Sample Characteristics

N = 531	% of Firms	Manufacturing	Non-Manufacturing	Micro (<9 employees)	Small (10-49 employees)	Medium (50-249 employees)
Australia	14.7%	33.3%	66.7%	44.9%	39.7%	15.4%
Austria	14.5%	29.0%	71.0%	51.9%	32.5%	15.6%
Belgium	9.6%	2.0%	98.0%	92.2%	7.8%	0.0%
Canada	8.9%	68.1%	31.9%	14.9%	10.6%	74.5%
France	12.8%	26.5%	73.5%	38.2%	29.4%	32.4%
Germany	.8%	100.0%	0.0%	0.0%	0.0%	100.0%
Italy	2.3%	75.0%	25.0%	16.7%	33.3%	50.0%
New Zealand	17.5%	39.8%	60.2%	6.5%	41.9%	51.6%
Spain	1.9%	90.0%	10.0%	20.0%	0.0%	80.0%
Switzerland	12.2%	24.6%	75.4%	4.6%	43.1%	52.3%
United States	4.9%	7.7%	92.3%	61.5%	30.8%	7.7%
Total	100.0%					

Table 1 lists the countries from which the sample was drawn along with the proportion of firms from each of the OECD countries, and the proportion of firms within each country that were engaged in manufacturing or other sectors such as services, retailing and specialised fields such as biotechnology. It also lists the proportion of firms within each country that were micro, small or large in size. It can be seen that some countries were represented predominately by micro-enterprises, while there were also differences in relation to industry types. For example, the Belgium firms were

recruited from the Flemish creative industries sector, while those from Italy were recruited from the Milanese clothing industries.

All firms were involved in the commercialisation of an innovation. Seventy per cent of these were new product innovations, 16 per cent were process technology innovations and the rest were a mix of marketing, market development and administrative innovations. The respondents were predominately male (88%) and the majority (81%) were executive managers with either all or some shareholding in the firm; the others were executive managers without shareholding. The majority of these firms (93%) had past experience of commercialising at least one innovation within the previous 3 years prior to the interview. Quite a few (19%) had commercialised between 6 and 10 innovations, while 23.4% had commercialised more than 10. The average age of these firms was 23 years with a range from 3 months to 167 years. The average number of full time employees within the sample firms was 42 and the average gross turnover was around €10.6 million.

Conceptual Framework and Measures

A conceptual framework drawing on the works of Tan et al. (2009), Tidd (2001), Cooper et al. (2004) and Adams et al. (2006) for the process of innovation management within firms was employed to guide the design of the questionnaire as was work undertaken by Mazzarol and Reboud (2005; 2006; 2008) and Reboud and Mazzarol (2006). This identified three primary perspectives that examined the systems, organisational and individual views of the firm, each of which contained further levels of analysis that examined the firm's NPD and commercialisation process.

To measure R&D intensity all firms were asked to indicate the proportion of their gross annual turnover they had invested in R&D over the previous 3 years in seeking to generate new innovations. The mean was 23 per cent and the median was 10 per cent. This level of investment into R&D represented a measure of R&D intensity. The majority (73%) of the firms had an R&D intensity levels greater than 5 per cent. Growth was measured using reported annual sales turnover for the year in which the interview took place and the turnover three years prior to the interview. These variables were used as dependent variables.

The independent variables comprised 40 items relating to the firm's management of marketing, innovation, resources and strategy. These were drawn from the "*Innovation Diagnostic*

Diamond" (IDD) framework developed by Mazzarol and Reboud (2006) and measured the level of formality existing within the firm's NPD and commercialisation processes. The IDD divides into four indices measuring market, innovation, resource and strategy each with 10-items that are measured using a 5-point rating scale in which 1 = not at all and 5 = completely.

Table 2 lists the items that comprise the "Market Index" measures where it can be seen that these focused primarily on whether the firm's management had undertaken a systematic approach to researching the market, evaluating the customers' likely reaction to the innovation and essentially moving through the innovation adoption stages that have been identified as important to successful innovation diffusion (Rogers 1976; 1995). It is worth noting that while most of these items produced fairly strong scores (e.g. above 3), the strongest was the item relating to whether the firm had identified a customer ready to adopt the innovation (mean = 4.23). This is evidence of the strong customer driven nature of innovation, NPD and commercialisation within many SMEs.

Table 2: Innovation Diagnostic Diamond – Market Index

MARKET INDEX MEASURES	Mean Score
Have you fully researched the benefits as perceived by the customer for this innovation?	3.70
Have you fully explored the most appropriate pricing strategy?	3.56
Have you researched how easily customers will understand it?	3.72
Have you researched how easy it will be for customers to test or trial it prior to adoption?	3.67
Have you researched how easy it will be for customers to do post adoption evaluations?	3.41
Have you fully explored how compatible it is with customers' existing technologies/systems?	3.98
Have you fully examined customer perceptions of risk and cost?	3.43
Have you fully explored the opportunities it offers customers?	3.97
Have you previously collaborated with customers over innovations?	3.75
Have you researched if there is already a customer ready to adopt this innovation?	4.23
Score: 1 = not at all; 5 = completely	

The "Innovation Index" of the IDD measures how well the firm has addressed its intellectual property (IP) rights protection, as well as the existence of a formal approach to NPD and the active engagement of customers and employees in the NPD/Commercialisation process. As Table 3 shows there was a strong overall response to the issue of whether the generation of new innovations was a major focus for the firm (mean = 4.14). It can also be seen that the active involvement of employees in the innovation process was also highly rated (mean = 4.40). There was also fairly strong claims for

having past experience of commercialisation (mean = 4.00), and the active involvement of customers in NPD (mean = 3.83). However, there was less evidence of formal IP rights management behaviour, particularly in the form of patent registrations (mean = 2.67).

Table 3: Innovation Diagnostic Diamond – Innovation Index

INNOVATION INDEX MEASURES	Mean Score
Do you have a formal process for new product development?	3.46
Do you feel that the generation of new innovations is a major focus of your firm?	4.14
Do you feel that you could fully develop the prototype technically without outside assistance?	3.44
Are you confident that the innovation has been independently tested or evaluated?	3.36
Have you fully explored with an intellectual property lawyer or patent attorney the IP management issues associated with the innovation(s)?	3.08
Does your innovation have legally protectable patents in-place or pending?	2.67
Do you use confidentiality agreements before showing your ideas to others?	3.52
Have you previous experience of commercialisation of your innovations?	4.00
Do you actively involve customers in developing your new innovation(s)?	3.83
Do you actively involve employees in developing new innovations?	4.40
Score: 1 = not at all; 5 = completely	

The "Resource Index" measures the extent to which the firm has sufficient resources to fully commercialise the innovation through the stages of prototype development, project management and financing. Also considered is whether the firm has a management board to provide strategic advice and guidance, and whether it has sought external assistance such as from government schemes designed to assist SMEs with commercialisation. As shown in Table 4 there was a reasonably strong level of confidence amongst the firms that they could generate a prototype with their existing resources (mean = 4.14), and that they knew how to find outside expert assistance if required (mean = 4.18). However, there was much less agreement with the other items within the "Resource Index". It can be seen that few had identified sources of venture capital financing (mean = 2.45), or explored government assistance programs (mean = 2.99). These findings suggest that many of these SMEs are seeking to commercialise their innovation alone and have not sought outside assistance either from financiers or government agencies.

Table 4: Innovation Diagnostic Diamond – Resource Index

RESOURCE INDEX MEASURES	Mean Score
Do you already have the technological resources to create a prototype?	4.14
Do you have the competencies to fully commercialise the innovation alone?	3.70
Do you have an experienced project management team to work on the idea?	3.79
Do you know how to find external expert assistance if required?	4.18
Are staffing resources adequate for the future development of the idea?	3.45
Are physical resources adequate for the future development of the idea?	3.84
Are financial resources adequate for the future development of the idea?	3.50
Have you fully explored government assistance programs designed to help small firms with commercialisation?	2.99
Have you identified sources of venture capital financing for the innovation?	2.45
Do you have a management board to provide guidance and advice?	3.72
Score: 1 = not at all; 5 = completely	

The "Strategy Index" seeks to measure the firm's approach to formal strategy formulation and business planning. As shown in Table 5 it looks at whether the firm has a formal, written business plan for the innovation it is trying to commercialise, and whether it has considered many of the key issues identified by Porter (1980) as important to the analysis of competitive markets when seeking to develop future strategy. It can be seen that many of these items were around the average of the rating scale (e.g. 3). A comparison of the combined mean scores for each of the four IDD indices found that the highest was the "Strategy Index" was the lowest while the "Market Index" was the highest with the "Resource Index" and "Innovation Index" sharing equal second place (as measured with pairwise t-tests).

Table 5: Innovation Diagnostic Diamond – Strategy Index

STRATEGY INDEX MEASURES	Mean Score
Do you have a formal, written business plan for your innovation?	3.40
Have you fully assessed the bargaining power of your customers?	3.43
Have you fully assessed the bargaining power of your suppliers?	3.29
Have you fully assessed the threat of alternative technologies to yours?	3.66
Have you fully assessed the reaction of competitors to your innovation?	3.33
Have you fully assessed the reaction of complementary partners able to assist you?	3.20
Have you considered existing or anticipated government regulations?	3.38
Have you secured all necessary compliances and authorisations?	3.93
Have you undertaken a risk assessment in the light of potential threats?	3.32
Have you completed a comprehensive financial model	3.35
Score: 1 = not at all; 5 = completely	

DATA ANALYSIS

Two regression models were used to test Hypotheses 1 and 2. The first used growth in sales over a three year period as the dependent variable, while the second used R&D intensity. Independent variables were comprised of the 40 items from the IDD framework. Size of firm was controlled with evidence of a negative correlation between R&D intensity and growth in sales, and a negative correlation between rate of sales growth and size. The linear regression models were estimated using the SPSS statistical software package and were run as stepwise regressions. Multicolinearity tests did not indicate any problems with the data.

R&D Intensity and Formality in NPD/Commercialisation

The first linear regression model after 7 steps found significant relationships between R&D intensity and six items. As shown in Table 6, four of these items had positive coefficients.

The first of these was whether the firm had identified sources of venture capital to help finance the innovation. Second was whether the generation of new innovations was a major strategic focus for the business. Third was whether the firm had the technological resources to create a prototype, and the fourth was whether they had fully explored assistance programs offered by the government to assist SMEs with commercialisation.

The two negative coefficients were associated with whether the firm felt that it had the competencies to fully commercialise the innovation alone, and whether it had the financial resources for the future development of the idea. It can also be seen that the R^2 and Adjusted R^2 for the model were around 20 per cent suggesting a modest but reasonable level of predictive power for this type of dataset (Hosmer and Lemenshow 1989; Sykes 2000).

It is worth noting that of the six items remaining within the final regression model five were from the "Resource Index" of the IDD, while the sixth "Do you feel that the generation of new innovations is a major focus for your firm?" was drawn from the "Innovation Index". This may suggest an association between R&D intensity and the "Resource Index" that is not present between R&D intensity and the other three IDD indices. It reveals partial support for H1.

Table 6: Coefficients[a] – R&D intensity and Formality in NPD/Commercialisation

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	3.794	7.208		.526	.599
Total employment	-.087	.023	-.167	-3.791	.000
Q22I Have you identified sources of venture capital financing for the innovation?	3.191	.891	.160	3.582	.000
Q21B Do you feel that the generation of new innovations is a major focus of your firm?	3.430	1.232	.123	2.784	.006
Q22B Do you have the competencies to fully commercialise the innovation alone?	-3.712	1.130	-.153	-3.286	.001
Q22A Do you already have the technological resources to create a prototype?	4.970	1.191	.191	4.171	.000
Q22G Are financial resources adequate for the future development of the idea?	-3.681	1.188	-.146	-3.099	.002
Q22H Have you fully explored government assistance programs designed to help small firms with commercialisation?	2.195	.868	.114	2.529	.012

a. Dependent Variable: Q10B What % has been the level of investment in such innovations

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
7	.456[g]	.208	.195	25.79159

NPD/Commercialisation R&D Intensity and Performance

Table 7 lists these findings from the second regression analysis which produced a solution after 10 steps and found nine variables significantly associated with sales growth as the performance measure. Compared with the first regression these items were drawn more widely across the four IDD indices. It can be seen that the R^2 and Adjusted R^2 were relatively low suggesting that the model's predictive power is modest.

Table 7: Coefficients[a] –NPD/Commercialisation Formality and Growth

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	96.557	111.988		.862	.389
Total employment	-.839	.297	-.140	-2.825	.005
Q21J Do you actively involve employees in developing new innovations?	43.528	22.287	.102	1.953	.052
Q20B Have you fully explored the most appropriate pricing strategy?	-59.514	17.120	-.185	-3.476	.001
Q23J Have you completed a comprehensive financial model	37.569	13.721	.150	2.738	.006
Q21E Have you fully explored with an intellectual property lawyer or patent attorney the IP management issues associated with the innovation(s)?	49.853	14.096	.239	3.537	.000
Q21F Does your innovation have legally protectable patents in-place or pending?	-39.238	13.722	-.191	-2.860	.004
Q21H Have you previous experience of commercialisation of your innovations?	-47.397	15.599	-.165	-3.038	.003
Q21D Are you confident that the innovation has been independently tested or evaluated?	-34.782	13.363	-.141	-2.603	.010
Q21G Do you use confidentiality agreements before showing your ideas to others?	27.435	12.255	.129	2.239	.026
Q22C Do you have an experienced project management team to work on the idea?	34.403	16.232	.119	2.119	.035

a. Dependent Variable: turnover growth over 3 year period

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
10	.391	.153	.130	308.4442

In relation to H2, the findings from the second regression found positive relationships between actively involving employees in innovation, undertaking comprehensive financial modelling, seeking advice from legal specialists over IP rights protection, using confidentiality agreements prior to disclosing ideas, and having an experienced project management team to work on the innovation. However, negative relationships were found over formal pricing analysis, possession of patents, having past experience in commercialisation and having independent testing of the innovation.

Of the nine items found significant within the model six were drawn from the "Innovation Index" of the IDD, while two (possession of a financial model and an experienced project management team) were from the "Resource Index". The remaining item relating to pricing strategy was drawn from the "Market Index". It is worth noting that no items were drawn from the "Strategy Index" of the IDD for this model or the first regression model.

DISCUSSION OF FINDINGS

The first regression analysis suggests partial support for H1 in that higher levels of R&D intensity were associated with greater levels of searching for external support in the form of venture financing, and government assistance. By their nature these sources of external support will tend to force the firm into adopting more formal processes in NPD, commercialisation and business planning (Sapienza and DeClercq 2000; Mason and Stark 2004). For example, many SMEs that seek venture capital financing are deemed to be inadequately prepared to offer a deal of suitable attractiveness to VC investors (Mason and Harrison 2002).

The positive association between R&D intensity and viewing NPD and commercialisation as a major strategic focus is logical given that were a firm not to see these issues as of importance it is unlikely that they would make the necessary investments. However, it does not imply formality in a direct way. The negative relationships found for R&D intensity and possession of commercialisation competencies and adequate financial resources are likely a reflection on the firm's management recognising that it must seek external support such as would be sourced from government assistance programs and venture financing. This implies an indirect recognition of the need for greater formality in the NPD and commercialisation processes which such outside support would render.

The results for the second regression analysis were somewhat equivocal in relation to their ability to support H2. Positive support was found for H2 in the form of possession of such things as having explored IP rights management with legal advisors, preparation of comprehensive financial modelling for the innovation, and the use of non-disclosure agreements. The possession of an experienced project management team and the active involvement of employees in the NPD process were also positive. While the IP management and financial modelling activities indicate a level of formality, the latter two – despite their importance – are not necessarily evidence of formal systems. Further, the negative correlations between sales growth and pricing research, patenting and independent testing, suggest that formality and performance may be more complex within SMEs than some might suggest.

Undertaking market evaluations to determine the most appropriate pricing strategy for a new product, registering patents and getting independent tests conducted are all aspects of NPD and commercialisation processes that are all quite formal activities. That growth could be achieved by these firms without engaging in such activities is likely a reflection of the somewhat idiosyncratic and intuitive nature of innovation in many SMEs. This is a pattern highlighted by Lindman (2002) who suggests that NPD strategy in SMEs should be defined through the small firm's management team's own experience and knowledge and is likely to be ad hoc in nature, reacting to market and customer circumstances. Investment in R&D is also typically undertaken in response to success with past NPD commercialisation activities. SMEs were also found to be less formal as he explained:

"*What is even more prominent is that firms are reluctant to resort to any formal and sophisticated NPD screening methods. The lack of proper screening procedures is related to the non-existence of any dedicated and detailed market research. Firms simply trust more their own in-house market knowledge or their distributors than any outside agency*" (Lindman 2002).

As noted previously, the absence of any items from the "Strategy Index" of the IDD and the relatively low level of items from the "Market Index" within the models are worth additional comment. It suggests that the level of R&D intensity and sales growth is potentially unrelated to any formal strategic planning activity within these SMEs, including formal market assessments. Of more important are the resource and innovation management issues that are more internally focused. This

supports Lindman's (2002) findings in relation to a lack of external examination, other than perhaps a focus on satisfying a few lead customers. It also supports the work of Terziovski (2010) and Vaona and Pianta (2008) in the primary focus within SMEs on more internal R&D/NPD process activities than external strategic or marketing focused activities.

CONCLUSIONS AND CONTRIBUTIONS

These findings suggest that the issue of R&D intensity and formality in commercialisation is complex, with smaller firms more likely to invest higher proportions of annual turnover into R&D and to seek outside assistance from venture capital and government programs to fund commercialisation where they lack the competencies and financial resources to proceed alone. Further, the findings suggest that formality in commercialisation is complex and that sales growth is associated with some types of formality but not others. It seems to be associated with a degree of initial consideration of financial models, IP rights protection and the engagement of a project management team who have entered into non-disclosure agreements. However, it seems to be less likely that these same firms will have undertaken rigorous market analysis, independent testing or patent applications, which may reflect the level of experience such firms, have with commercialisation.

SMEs are prone towards informality in their planning and are unlikely to commit to significant investments in formal strategic plans, or major market research studies, unless they are facing either high levels of environmental and product uncertainty, and feel that they don't have sufficient knowledge to proceed, or if they are required to do so by outsiders such as government grant providers or venture capital investors (Mazzarol and Reboud 2009). Where the SME is able to proceed to full commercialisation without outside assistance they will do so. For many SME managers the commercialisation pathway is relatively short and involves a tight relationship with a few lead customers. Understanding the context of the firm, its relationship with the customer, level of competitive pressure within its market segments, and the level of complexity and technological innovation within its products are all important for any in-depth understanding of the innovation management behaviour of SMEs.

Government policy makers seeking to stimulate innovation in SMEs need to be aware of this more idiosyncratic approach to innovation and develop appropriate policy settings. Academics need to

find new ways to examine the innovation process in SMEs that do not conform directly to the venture capital fuelled, high-tech 'Silicon Valley' business model. This is particularly important as innovation can be found in SMEs across the full spectrum of industries and the majority of these are low to mid-tech sectors. There is now recognition across the OECD of the need to focus on innovation at all levels and not just the high-tech sectors (OECD 2010).

This study has some limitations. The sample drawn for the project was relatively small and the sampling process was not random. The predictive power of the two regression models was also modest. However, the study provides an insight into a group of SMEs drawn from across the OECD and who were all actively committed to the commercialisation of an innovation, and who generally had a good level of past experience in NPD/Commercialisation. Future research should seek to refine the measures of formality and performance and draw a sufficiently large sample to allow for structural equation modelling testing the interrelationships between these variables. However, further qualitative research drawing on more in-depth case studies of the commercialisation behaviour of such SMEs should first be undertaken to fully explore the nature of what "formality" within the SME constitutes in relation to NPD/Commercialisation activities. This would help to provide more refined frameworks upon which to build future statistical models.

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