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Author

Gould, Ryan

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MAPPING THE INNOVATION SPACE CHARACTERISTICS OF SOME AUSTRALIAN MANUFACTURING SMES

Ronald C Beckett, Centre for Industry and Innovation Studies, University of Western Sydney
+61 412 264 574, r.beckett@uws.edu.au

Ryan Gould, Centre for Industry and Innovation Studies, University of Western Sydney
+61 2 9685 9482; r.gould@uws.edu.au

ABSTRACT

This paper details preliminary findings from a research project supporting the enhancement of innovation capacity in Australian Manufacturing small and medium enterprises (SMEs). Data from five interview cases, suggested a strong orientation towards customer-pull / technology adaptation and incremental innovation. Compared with a science-push / radical innovation orientation towards innovation common in technology-driven start-up firms, there was little interaction with the external R&D community. Findings are compared with those from a number of other larger surveys in relation to the dominant prospector strategy observed. One outcome of the study presented here is an 'Innovation Opportunity Matrix' which offers a map of innovation spaces linking customer needs with product, process or organisational innovation. This matrix provides a useful consulting tool for innovation practitioners to map current innovation focus areas, and to help think about strategically important complementary or alternate innovation focus areas

Key Words: Innovation, SME

INTRODUCTION

Research and development and innovation are often linked and seen as drivers of enterprise competitiveness. There are some perceptions of generally poor performance of "Small and Medium-sized Enterprises" (SMEs) in the area of R&D and innovation as indicated by various surveys in Australia. In terms of R&D, performance (as measured by expenditure) increases with size of firm. Of the total Australian Business Expenditure on R&D (BERD) in 2003-2004, 15.8% had been expended by small enterprises, 24.8% by medium-sized enterprises while the majority (59.4%) is spent by large enterprises [2]. This reinforced an earlier independent survey of members of the Australian Industry Group (a major industry association representing 10,000 employers in a range of industries): While member firms of 500 or more employees comprised 4% of the respondents, they accounted for 69% of all R&D expenditure reported. In contrast, smaller firms of up to 50 employees made up 33% of the respondents, but only accounted for 2% of R&D expenditure [4]. The situation is more or less the same for innovation performance, in that the incidence of innovative activity (i.e. the introduction of one or more of a new or significantly improved good/service, operational process or organisational/management process) increases with firm size. Thus, while only 28.4% of small businesses surveyed had introduced at least one "innovation" over the two calendar years 2004 and 2005, 46.6% of businesses employing 20 – 99 and 51.5% of those employing 100 or more had done so [3].

However, it is our opinion that the use of such measurement as a performance indicator has resulted in a skewed perception of innovation performance in SMEs. Central to the themes presented in this paper is the observation that;

“[SMEs] rarely or never innovate on the basis of scientific or technological breakthroughs emerging from a research process. Rather, the firms seek to develop new product concepts on the basis of their interaction with consumers, and their conjectures about likely patterns of demand [16:9]”

In this context, the Centre for Industry and Innovation Studies (CInIS) at the University of Western Sydney and Advanced Manufacturing Australia (AMAus) agreed to explore ways of “building SME innovation capacity”, beginning with some member interviews. AMAus members design and manufacture precision machined components and tools for clients in a number of industry sectors, with the largest client sector being automotive component manufacturers. This paper presents some preliminary findings from interviews in five cases, which highlighted a customer-pull and technology adaptation orientation and a dominant prospector [10] strategy. One outcome of the study to date is a kind of map of innovation spaces - an “innovation opportunity matrix”, linking customer needs with product, process or organizational innovation. Some suggested for further work are presented.

THE RESEARCH APPROACH

A Grounded Theory methodology [7] was used in this research. Initial interviews with the AMAus CEO suggested that members do not respond well to surveys, and that there is some variety in the extent to which they are innovative. A program of interviews was planned.

At one end of the spectrum there is no clear evidence of some member firms being innovative at all. This may be the reality or it may be a communication problem. By way of example, Dalrymple [5] worked with fifteen firms in the northern suburbs of Melbourne to enhance their innovation capacity. Initially, most of these firms considered that they did not “do” innovation. Further enquiry found that there was no shortage of ideas, but no structured process for filtering these ideas and getting some benefit from them. Once this was addressed, firms involved in trying out new ways of working were able to benefit from their innovative ideas much faster.

At the other end of the spectrum, some AMAus member firms have received regional innovation awards, albeit with minimal evident interaction with the science and technology research community.

The observations, along with the assumptions mentioned above lead us to the research question – What do innovative AMAus member firms actually do? This initial starting point was later expanded to understand the

1. ways in which members currently innovate, and what drives innovation for them;
2. ways in which members think they should innovate; and
3. barriers to innovation and to the absorption (and utilization) of new knowledge that supports innovative activities

All member firms (about 150) were advised of the study by AMAus via e-mail. This initial advertisement was supported by a targeted round of advertising, from which sixteen firms were identified as being ‘innovators’ by the AMAus CEO. During this round, potential

participants were provided with a substantial information letter which included a question set and excerpt from the recent National Innovation Survey [12:16] making reference to an innovation typology:

- **Process vs. product:** Process innovations reduce the costs of producing and delivering a given good or service (a product), while product innovations improve the qualities of existing products or provide new products to be offered to consumers.
- **Radical vs. incremental:** Radical innovations lead to fundamental changes in processes or products, while incremental innovations involve adaptations of a core innovation in particular applications.
- **Technological vs. organisational:** Technological innovations are generally embodied in equipment used by labour, while organisational innovations involve the organisation and reorganisation of groups of people into effective teams in the production and delivery of goods and services.
- **Science-led vs. customer-driven:** Science-led innovations are an outcome of scientific research both in the public and private sectors, while customer-driven innovation is built upon careful market research and user interaction.

The purpose of providing this excerpt was to provide potential participants with an opportunity to engage with the national vocabulary of innovation.

From this targeted round of advertising, five available SMEs were contacted. Data collection occurred through a set of semi-structured interviews resulting in the case material presented here. In some cases additional observations were made from informal discussions and inspection of facilities, adding context and further depth to information collected during the interviews.

The interviews were roughly divided into three main areas of conversation:

- Firstly, considering the current situation of the firm, seeking to understand the ways in which members currently innovate, and what drives innovation for them. -
 - a. What does “innovation” mean for your firm?
 - b. What is the purpose of innovation for your firm?
 - c. What are your key innovation drivers?
 - d. How do you innovate in your organisation
 - e. How do you source your information?
 - f. What is involved in using this information?
- Secondly, considering the desired future position of the firm:
 - a. Do you think you need to change (narrow or broaden) the focus of innovation within your firm, do more or less?
 - b. Is your current approach to sourcing knowledge/information (both internal and external) adequate for your needs?
 - c. Given your current approach to innovation, do you think you need to look at it from a different angle?
 - d. If so, what do you think needs improving?
- Thirdly, identifying potential barriers to achieving the desired future position:
 - What gets in the way of you sourcing external knowledge?
 - What gets in the way of you using this knowledge?
 - What are the main barriers keeping you from becoming more innovative?

- What resources or capabilities might you need to access to achieve your desired future position

A form of content analysis was used to analyse the data. Transcripts were formatted for coding and some recurring themes identified. Quotations from the interviewees were used to link with identified themes, but in this paper, the source of these quotations is not revealed in order to respect confidentiality undertakings made.

SOME FINDINGS

Some characteristics of the five firms interviewed are shown in Table 1.

Case	Some Case Firm Characteristics				
	Provides a manufacturing service	Manufactures own product	Has in-house R&D capability	Links with S&T researchers	Sources of external knowledge
Alpha	Yes	No	No	Not evident	Industry Associations and customer requirements
Bravo	Yes	No	No	Not evident	Trade fairs, marketing missions and customers
Charlie	Yes	No	No	Not evident	From industry peers & magazines
Delta	Yes	No	Yes	Not evident	Customers
Echo	Yes	Yes	Yes	Informal participation in seminars	Customers, Internet and industry networks

Table 1 - Sample Firms Characteristics

Those interviewed expressed some different views about the meaning of the word “innovation”. One interviewee commented:

I don't use the word innovation. And I tell you, the longer governments keep using these 'clicky' words, the real world with which you're dealing here, manufacturers, won't get on board to the degree they perhaps should.

Other views presented were:

Well innovation for me is bringing on the latest technology and using those technologies in a coordinated way to bring in an outcome that provides a competitive advantage to us against our competition

Trying to look at new technology and new ways of doing things and time saving

Others suggested that innovation was more about creative and original ideas:

...if you take the (meaning) straight out of the dictionary it is simply an introduction of change... If you talk about creative change and doing things creatively in your business to get a better business result – and that's the definition of the word innovation

It's (innovation) a good idea and then turning it into something to make money. In a way, it's also always looking forward with a commercial mind. Innovation for the sake of innovation to me is not innovation. With innovation you have to create wealth somehow.

These observations are consistent with those of Eckermann, Lin and Nagilingam [8] that “Organisations must be proactive and learn to make seemingly unnatural choices that promote survival in their rapidly changing environments. Another understanding of innovation in these firms was related to time - when does innovation occur and in what context. All participants considered innovation (or rather the process that upon reflection may be considered innovation) as a continuous evolution of their firm's processes:

Innovation is an evolutionary event rather than a new bright spark. Not a revolutionary new idea just improvement...Simply trying new things. Innovation doesn't necessarily spell success or good things.

It's just a day-to-day thing that you try to implement.

From the discussions held with participants it became clear that a culture supporting innovation exists and that to these firms; innovation is a technologically focused process of continual improvement. That is the investment in technology that would increase efficiency, reduce costs or result in a competitive advantage. Such a definition was further supported in site tours which demonstrated a heavy focus on technological innovation and a clear willingness to invest in physical assets. In two of the cases conversation as we moved around the shop floor was very much centred on the investment in technology driven by the General Managers' intuition. There was a great sense of pride in such investment yet there was some hesitance to call such improvements innovation. There were three consistently mentioned drivers of innovation:

- Efficiency – reducing cost (both in time and money), supporting organisational growth and profitability
- Pride – in the context of a strong bond between the firm and the customer, and being able to compete in a difficult environment as a relatively small family business
- External Forces – the structure of the industry linked to a strong customer focus. To quote one interviewee:

It probably happens more as part of a cycle in manufacturing companies because they're often in the middle of a whole heap of other companies also working toward one end. In the areas of aerospace or automotive or whatever, they're still one cog producing for a larger company and often innovation is driven by that larger company who may have a need for something...Ah, often yes but not all the time.

There are companies now doing their own R&D, their own work to get new products out there and to own those products. In the past most of the (AMAus) companies have not owned the IP rights for the things they've produced.

External sources of information are predominantly customers and networks (personal, industry and the internet) with a focus on short-term problem resolution. The firms interviewed seemed to rely on experience and intuition in classifying this information for current or future use.

Industry networks are good to find out what's out there and who is doing what, and (to) make new contacts with customers or somebody who has a need that we may be able to help them with.

The interviewees were happy with their current approach and did not see much need for change:

So what we are doing, I think we are doing right but I am always receptive to somebody who comes in with new ideas, or want to offer something, I will at least listen and try to be considerate. Not all the time because I'm too busy, but most of the time I adopt something, if somebody has something smart that will help me they are a chance of selling something to me.

You just can't say you've got to change for changes sake. This is what worries me, everyone's got to innovate, innovate. That's what the government is pushing – but do you really have to? Do you have to change for changes sake? If changes aren't necessary in your organisation you don't do it for goodness' sake.

I'm aware of the focus that governments have had on R&D and CRCs and all of these type of things, or approach to innovation. But as you say, it doesn't help a company like me. We are a nuts and bolts manufactures, as are most of the people in AMAus, because they are all tool makers (or at least originally tool makers).

The main barriers to innovation and the absorption and utilisation of new knowledge noted in interviews could be summarised as cost, disruption and some perceptions about difficulties in collaborating

Yeah, well cost and disruption. There are so many 'good ideas' that come into an organisation during the normal course of business, and there are so many consultants that want to tell you about a better way of doing something or sell you a better mousetrap; and probably looking at those individual things you might say there is a case for most of them but the trouble is you cant put them all into effect all at the same time otherwise you'll have an organisation in complete [turmoil?]. So there's cost and disruption would be the two major reasons why you don't put on what you'd say are good innovative ideas.

There are a lot of complex and complicated confidentiality agreements around. Um, they can often hinder as much as they help.

I am receptive to work with the outside world. But the world has become too interested in making something out of it. And that's perhaps how I started, when I say that innovation has to have a commercial purpose to make it viable. Particularly if you are in business; if you are just an academic and innovation is a dream really.

DISCUSSION

A strong market and customer orientation was evident in all of the firms interviewed. They get ideas from customers and collaborate with them on occasions, are driven by demanding customer requirements and by customer perceptions of what makes a supplier competitive. Better, cheaper, faster practices and products were the outcomes sought, and there was evidence of encouragement of an innovative culture to varying extents.

We are always looking for new markets, new products and how we're going to grow. Out of that is the need to be innovative in the way we do things. Not only better, faster and more quality, but cheaper and so on. We have to have the right products to be able to be sold around the world.

Piller [13] forecast a trend towards demand for more customised products and customised services that results in a broader operational skill set being required, as illustrated in Figure 1 below. In this context, the strong customer linkages noted in our case study firms makes operational sense.

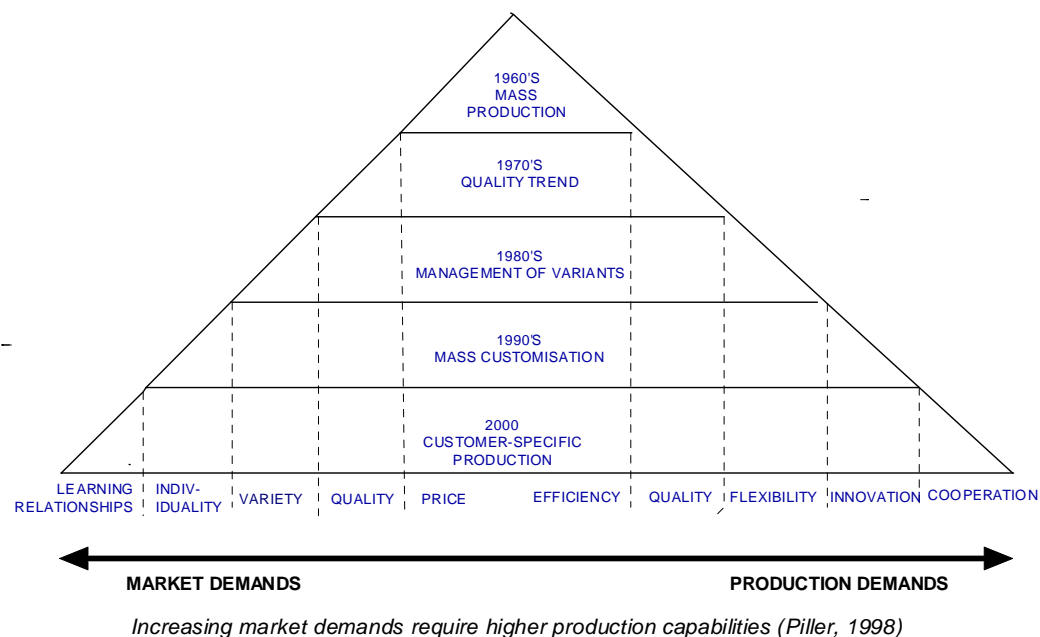


Figure 1 – The expanding demands of industrial customers

Whilst those interviewed were primarily oriented towards incremental technological innovation, the process of searching (prospecting strategy) for, selecting (matters of intuition and timing) and implementing (learning by doing) ideas resulted in emergent situations more like an adaptive complex system in operation. These two things are not commonly associated, as incremental innovation, at least in large firms, is more associated with structure and order.

The complexity view will not be considered here, as more data collection and analysis may be needed to support further discussion.

The firms interviewed had a focus on process innovation, with increasing involvement in product innovation plus some evidence of organisational innovation, but more as an intuitive rather than a structured process.

I tend to run my organisation based on past experience and I guess through models I've learned through doing masters degrees and stuff like that...sometimes you just don't know where you get knowledge from to make decisions and I guess its just its just the basis of the experience I've had in life to make those organisational changes.

Eckermann and Lin [7:283] argue, “ It is no longer adequate to compete on price, quality, delivery and service alone. To set itself apart, a company must innovate.” From a strategic point of view, it is suggested here that we could characterise the innovative activities of these firms (and others) by mapping generic kinds of innovation against customer benefits sought, as illustrated in Table 2. Larger firms or technology-driven start-ups might have some other kinds of activities in this matrix, such as external R&D or supply chain innovation

Customer Outcome Sought	Type of innovation		
	Product	Process	Organisational
Better	Creating something distinctive through in-house research and customisation	Doing something different through the acquisition and clever adaptation of leading edge technology	Doing business differently and reducing internal costs
Cheaper	Creating something distinctive through in-house research and customisation	Doing something different through the acquisition and clever adaptation of leading edge technology	Doing business differently and reducing internal costs
Faster	Creating something distinctive through in-house research and customisation	Doing something different through the acquisition and clever adaptation of leading edge technology	Doing business differently and reducing internal costs

Table 2 – Combining customer expectations with innovation focus areas

Kickul and Gundry [10] surveyed 107 small Mid-Western USA businesses to explore the link between the practices of the entrepreneur owner, a prospector strategy [11]and innovation. A strong statistical correlation was evident. They characterised proactive entrepreneurial behaviour as scanning for opportunities, showing initiative, taking action and persevering until closure was achieved. Such firms were seen as creators of change in their industry. It was noted that a prospector strategy commonly involved an investment in R&D and market research, an emphasis on forecast data and close monitoring of business outcomes [11]. Whilst we did not ask specific questions about these matters in the five cases presented here,

anecdotal evidence from the interviews suggested similar patterns of behaviour were the norm. Kickul and Grundry [10] observed a correlation between the prospector strategy and three innovation outcomes:

- an innovation targeting process that identified opportunities for new products, process and sales channels, and for participation in new markets.
- Innovative organisational systems, both in terms of internal practices and management practices
- Innovative boundary supports in the provision of services, in financing and in the use of information technology

Subramnian and Nilakanta [15] surveyed 143 enterprises of various size in the finance sector considering the influence of technological (new products and processes) administrative innovations on market share. They found that administrative innovations did not seem to impact market share, but had a return-on-assets benefit linked to the number of innovations. They found that technological innovations had a positive impact on market share that was linked to the speed of introduction, and positive impact on return-on-assets that was linked to the number of innovations and their timing (leading or lagging the opposition)

Innovation on a number of fronts is a recurring theme. This supports a perspective of complexity in the scope for innovation and its impact. Against this backdrop, we have expanded Table 1 to included some more specific innovation focus areas to present an “innovation opportunity matrix” (Table 3) where customer perceptions of what might constitute better, cheaper or faster are introduced. We will not go into the details here, but the ideas presented are based on what automotive and aerospace industry clients are currently seeking from their suppliers. Some cells of Table 3 have been shaded to illustrate a finer grain mapping of the innovation profile of some of the firms interviewed. Reflection on a particular firm’s current focus areas can support decision-making about where to focus innovation efforts in the future and thinking about alternate possibilities.

Customer Benefit	Innovation Focus	Type of Innovation		
		Product	Process	Organisation
Better (Now and in the future)	Performance			
	Delivered quality			
	Quality of support			
	Social benefit			
	Financial stability			
	Sustainable knowledge base			
	Environmental sustainability			
	Continuous innovation			
Cheaper (In all aspects of the business)	Cost of purchasing			
	Cost of Material			
	Cost of consumables			
	Cost of setup			
	Recurring labour			
	Cost of infrastructure			
	Administration cost			
	Cost of finance			
	Cost of delivery			
	Cost of service			
Faster (Starting up, delivering and responding to change)	Order placement			
	Customisation			
	Set-up time			
	Cycle time			
	Logistics			
	Service response			
	Adaptability			
	Cash flow			

Table 3 - Innovation Opportunity Matrix

Cost and disruption were commonly reported barriers to innovation. When it came to investing in sophisticated equipment, the case study firms seemed willing to commit significant funds, so funding per-se does not seem to be the issue. As an aside these funds might be borrowed, with a lien on the equipment being secured by the lender. Such financing arrangements do not seem to be practical when investing in intellectual assets, and this may be a limitation on investing in R&D. We suspect the cost and disruption issues referred to relate to extra resources required to introduce an innovation, and the fact that it takes some time before the performance with the innovation introduced improves on the previous level of performance, as illustrated in figure 2. This scenario favours rapid-fire, small-scale innovation (as practiced in lean manufacturing) over taking large steps.

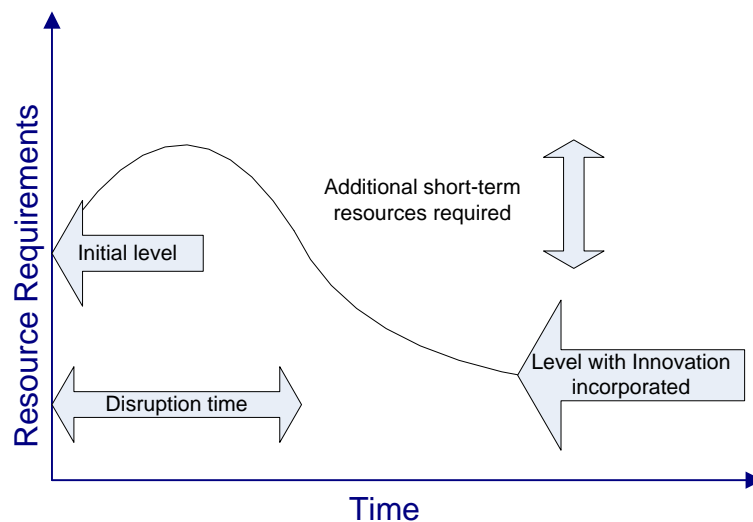


Figure 2 Resource dynamics in introducing an innovation

Even though our sample is small, we see some similarities with larger studies. Amara, Landry, Becheikh and Ouimet [1] collected data from a survey of 639 SME manufacturing firms in the Montreal region of Canada to explore the extent to which they were innovative, and the extent of novelty in their innovations. About 20% of the firms were not regarded as innovative in that they had not introduced some changed or new product or process into the market in the preceding three years. These firms tended to be the older ones. On average, the firms surveyed had been in business about 20 years, employed about 27 people and over the whole group, averaged about 15% of sales outside the country. We think this profile is similar to that of AMAus members overall, except that the average firm size is about half that of comparable Canadian ones. From previous projects with AMAus members we have observed that the Australian firms are about half the size of their European counterparts and about one-fifth the size of their USA counterparts, and this has a significant impact on their capacity to innovate. The Canadian firms also saw networking as an important activity, with business networks being ranked as relatively important, followed by information networks and research networks. A comprehensive statistical analysis of the survey data by Amara et al [1] suggested:

- Firms that were exporting, that were involved in R&D, who used a larger number of advanced technologies, and who provided innovation-relevant training were most likely to innovate.

- Firms that relied on a small number of suppliers tended to have a lower degree of novelty in their innovations.
- Firms with higher levels of involvement in information networks and research networks tended to have a higher degree of novelty in their innovations.

A broad study of Australian manufacturing industry [6:5] observed: *“Australian manufacturing firms have successfully adopted innovation practices. They are, for example, ably managing many of the challenges of process innovation. They are focusing on reducing costs in production and assembly and balancing the technological investments and organisational changes required to respond to their customers’ demands quickly and effectively. They are highly encouraging of teamwork and employee consultation and are involved in the restructuring and redesign of jobs, both of which are actions conducive to innovation. However, their main shortcomings lie in not managing the challenges of innovation in product development and in business models. There is little evidence of investment in advanced technologies for product design, techniques for organising new product development, effective linkages with innovation-demanding customers, and the packaging of services around product offerings. The Australian firms in the sample have short-term planning horizons and are not adopting the formal continuous improvement processes that drive sustained step-change improvements as a coherent innovation strategy for long term competitive advantage.”* These observations are consistent with those made in the cases presented here, however in our cases there is a growing appreciation of the strategic value of having ones own product, of getting leverage from intellectual property and of the value of entering export markets.

CONCLUDING REMARKS

Many researchers focus on factor conditions internal and external to the firm that support innovative practices. In this study, we interviewed firms considered by their peers to be innovative, so they had established some kind of appropriate culture. This paper makes a contribution to the literature by adding case material and considering where some firms do or could focus their innovation efforts. The world of innovation is presented from a pragmatic SME viewpoint. All of the firms participating in this study are embedded in supply chains that condition their basis of competition. Better / cheaper / faster are requisite norms, and how this is achieved is an internal matter for each firm. Some of the firms interviewed preferred to think of their response to this environment as requiring constant change rather than being innovative. What to change next was dependent on current status and mix of issues and opportunities. Opportunities may be suggested through business networking, information gathering and interaction with technology providers.

During the interviews there was a significant amount of resistance to the technical vocabulary commonly associated with the study of innovation. Such resistance may have contributed to the perception of ‘poor performance’ created through earlier works. However, in relation to this project, we suggest that such resistance to the language implies a difficulty in mapping innovation within the SME context rather than a lack of innovation itself.

As noted in the discussion above, a strong market and customer orientation was evident in all of the firms interviewed. Incremental innovation on a number of fronts was the norm. They get ideas from customers and collaborate with them on occasions, are driven by demanding customer requirements and by customer perceptions of what makes a supplier competitive. Better, cheaper, faster practices and products were the outcomes sought, and there was

evidence of encouragement of an innovative culture to varying extents. This led us to the development of an “innovation opportunity matrix” (Table 3) that shows innovation focus areas in some level of detail. It is suggested that this matrix may be of value in practitioner strategic planning of innovation initiatives, highlighting the current situation and the future targets. What has been the historical pattern of innovation? What should the future pattern be, for example embracing some aspect of product innovation? Where might interaction with the external research community provide a benefit? The idea is to think strategically, but in a pragmatic, outcome-oriented way

The main barriers to innovation cited in the cases presented here were disruption and cost. Drawing on prior experience, we have characterised disruption in terms of the additional resource required to introduce an innovation and the time taken until the innovation is performing to at least the level of the previous status quo. Some researchers express this as a requirement for organisational ‘slack’ [14]. This helps illustrate why firms with limited resources favour incremental innovations that can be introduced quickly.

The process of innovating involves a number of stages, expressed in the simplest way as searching for ideas, selecting which one to proceed with then implementing it. Our Grounded Theory approach led us to the hypothesis that: *for many SMEs the dominant innovation search process is based on prospecting, the dominant selection process is a complex adaptive one, and the dominant implementation strategy is incremental change* and that this provided a good fit with their operating environment.

LIMITATIONS AND FURTHER RESEARCH

The small sample size used here raises concerns about any generalisation of findings, and in fact the majority of AMAus member firms were deliberately excluded from this initial investigation. Further case studies will be made with other AMAus member firms in the future. It is not the intention of the authors to suggest that the observations made here can be broadly contributed to the Australian manufacturing industry; however, we have identified parallels between our cases and other research based on larger samples. In this paper it has been suggested that although there are limited formal systems or procedures in place, the sampled SMEs considered here did in fact have rather sophisticated (albeit highly informal) innovation systems in place, particularly in their use of intuition and their assimilation of external knowledge. A Complexity Theory (or a complex systems perspective) should provide an opportunity to articulate such sophistication and will form the focus of future works.]

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