Abstract

Track Title: creativity and innovation

Understanding Commercialisation in Entrepreneurial Firms: A Case Example

Introduction

Commercialisation is the final stage of an innovation management process that incorporates the way a firm manages its resource inputs, skills and knowledge, new product development (NPD) strategy, organisational culture and NPD portfolio, and the projects relevant to bringing an innovation into the market (Adams, Bessant & Phelps 2006). Despite its importance relatively little is known about the way in which small firms manage innovation and bring new products to market (Hemert et al. 2013; Mazzarol et al. 2014). This paper explores the process of commercialisation within small entrepreneurial firms using a single case study of an innovation that spun out of a university research centre, grew rapidly and was then acquired by a larger international firm. It is an 'exemplar' case of how to undertake the process of commercialisation and was tracked throughout its lifecycle by the research team using a process of diagnosing the firm's management's perception of the value it was creating in the innovation, and how the firm was managing the process of commercialisation.

Theoretical foundations

Key units of analysis in this study are the way in which future returns to investment in an innovation were evaluated and assessed by the firm's management team. A particular unit of analysis was the notion of 'rent' or the economic return that can be obtained from such investment (Alvarez & Barney 2004). The concept of 'economic rent' can be traced back to Ricardo (1821), who referred to the ability to receive an economic return from the allocation of land assets for economic rather than other purposes. The scarcity of an asset, if valuable, also ensures that it can achieve above average economic returns or 'rents' (Schoemaker 1990). Firms that can own or control valuable assets that are rare, have few substitutes and cannot be easily replicated, are able to secure higher rent streams from such assets (Barney 1991; Mosakowski 1998).

Types of economic rents

Two broad types of economic rent have been identified in the academic literature (Makadok 2001). The first is 'Ricardian rent' that comprises bundles of tangible and intangible assets that can be controlled by the firm and used to secure above average economic returns. The second is 'Schumpetarian rent' that comprises the firm's ability to reconfigure existing resources that it may or may not own and control in order to generate unique and valuable opportunities. This broadly conforms to the concept of 'dynamic capabilities' as it involves the way in which a firm configures its resources to secure a competitive advantage (Amit & Schoemaker 1993; Teece et al. 1997). Of these two the 'Schumpetarian rent' is more likely to be found within small highly innovative and entrepreneurial firms, while those in more stable and predictable environments are likely to engage with 'Ricardian rent' (Lim et al. 2013). For entrepreneurial firms the ability to create innovations capable of generating economic rents with 'isolating mechanisms' (e.g. intellectual property rights protections) can form the foundation of a competitive advantage (Alvarez & Barney 200; Milgrom & Roberts 1992; Miles et al. 2003).

Alvarez (2007) identified the existence of 'entrepreneurial rents' that are generated by entrepreneurs via collaboration with others and the combining of resources so as to create valuable innovations. As this is usually occurring under conditions of uncertainty it is not possible to accurately predict the likely rent return to any investment in the innovation. These 'entrepreneurial rents' are created under conditions of high uncertainty before the market has been fully assessed in terms of its acceptance of the innovation. They are therefore 'anticipated' rents. However, once the innovation has been assessed by the market the level of uncertainty is reduced and a more predictable level of risk is possible. This generates a 'quasi-rent' or 'residual rent' (Alvarez 2007; Hang Do, et al. 2014). When the firm is able to match its resources to the market opportunity the innovation is able to be properly

assessed as to its true potential value, which is the 'appropriable rent' that can be secured from the innovation (Santi et al. 2003).

Theories of commercialisation

Also of importance in this study is the application of extant concepts and theories of how the process of innovation commercialisation should be managed. It is important to note that our review of the literature suggests that there are few theories of commercialisation. In fact as noted above there are relatively few studies that have explored this important field particularly as it relates to small to medium enterprises (SMEs). For example, our examination of 1,300 peer reviewed papers published between 2006 and 2014 that contained the words 'commercialisation' and 'SMEs' found that only 25 (1.9%) dealt specifically with the process of commercialisation in small firms, and only five papers had conducted research that involved direct surveys or case studies of SMEs engaged in the commercialisation process (Kim et al. 2011; Conceicao et al. 2012; Youtie et al. 2012; Knockaert et al. 2013; Hemert et al. 2013).

Despite this a number of studies have been undertaken that provide some conceptual foundations upon which to base a future investigation of how small entrepreneurial firms engage in commercialisation. Alvarez and Barney (2004; 2005) have provided conceptual foundations for the development of theories relating to the entrepreneurial firm and the generation of economic rents; as well as how such firms are managed under conditions of uncertainty. They have also provided theoretical insights into how entrepreneurial opportunities are identified classified and exploited (Alvarez & Barney 2007). The role of entrepreneurial rents and how this relates to entrepreneurial firms has also been examined by Alvarez (2007), along with considerations of the way in which small entrepreneurial firms make use of strategic alliances (Alvarez et al. 2006), particularly with larger firms (Alvarez & Barney 2001). This work draws from the resource based view (RBV) of the firm as originally developed by Barney (1991). Also relevant here is the recognition by Barney (1986) of the dichotomy of 'Chamberlinian' and 'Schumpeterian' concepts of competition. The first of these dealing with the firm's ability to control unique and valuable assets, and the second the firm's ability to operate within a task environment that is unstable and uncertain, where innovation is used to disrupt the market or industry status quo.

Models of the commercialisation process

The conceptual work discussed above is useful to help provide a theoretical foundation for research into the process of commercialisation within small entrepreneurial firms, but it does not provide a guide to how such firms should actually behave. Much of the work relating to NPD and commercialisation has focused on large firms (Cooper & Klienschmidt 1995; Cooper et al. 2001; 2004abc; 2014; Cooper & Edgett 2007; 2009). However, more recently the emergence of 'Lean Start-Up' concepts has become a framework for how small entrepreneurial firms approach the commercialisation process (Ries 2011; Blank 2013; Croll & Yoskovitz 2013; Blank & Dorf 2012). The 'Lean Start-up' model works in concert with the emerging literature on business model design and development (Chesborough & Rosembloom 2002; Osterwalder et al. 2005; Chesbrough, 2007; 2010; Zott & Amit 2007; 2010; Fiet & Patel 2008; Johson et al. 2008; Demil & Lecocq 2010; Osterwalder & Pigneur 2010; Teece 2010; Zott et al. 2011; George & Bock 2011; Amit & Zott 2012; Lingren 2012; Trimi & Bergegal-Mirabent 2012; Sahut et al. 2013).

Lean Start-up has become popular within new venture creation and entrepreneurship programs as it offers a structured and systematic approach to dealing with what is typically a highly uncertain environment. It draws its origins from the work of Deming and Ohno in the 1950s (Trimi & Bergegal-Mirabent 2012). It also builds on the work of others such as Takeuchi and Nonaka (1986), Cooper and Kleinschmidt (1995) and Miller and Morris (1999). Key elements of these earlier models were the need to listen to the voice of the customer (Griffin & Hauser 1993; Farrell 1994), and the need to make rapid changes to early prototypes once customer or market feedback is received (Urban et al. 1996; Krishnan & Ulrich 2001). Such techniques form the foundation of the Quality Function Deployment (QFD) processes that have been developed for large firms (Farrell 1994; Blaydon et al. 1999; Motwani

et al. 1996; Tan & Shen 2000). Yet Lean Start-up provides integration between the NPD process and the business model design that offers a potentially holistic framework for commercialisation. The core of the Lean Start-up model is the ability for the firm to rapidly create a minimum viable product (MVP), test it with real customers, obtain market feedback and quickly 'pivot' or change the product or even the business model if market feedback indicates that the innovation will not be adopted. This process moves through the iteration of: i) generate ideas; ii) build an MVP; iii) release the product to the market; iv) measure the response; v) analyse the data; vi) learn and repeat the cycle.

Where the data received from the market suggests that the MVP is not offering a sufficient value proposition to the customer, the management team is advised to 'pivot' by changing the business model or product offering and retesting. This is typically employed along with the 'Lean Canvas Business Model' framework (Osterwalder & Pigneur 2010), which has nine elements that comprise: i) developing a customer value proposition (CVP); ii) segmenting the customer market; iii) determining distribution channels; iv) building customer relationship networks; v) assessing costs of production and distribution; vi) forecasting future revenue streams; vii) identifying the key activities required for production; viii) identifying the key resources required; and ix) identifying any strategic alliance partnerships required.

A conceptual model of commercialisation and entrepreneurial innovation value

Figure 1 illustrates a conceptual model developed from our review of the literature relating to the creation of value through commercialisation for small firms. This model draws together the theories and concepts discussed above and it offers a framework for understanding the process by which small entrepreneurial firms may commercialise an innovation.

<INSERT FIGURE 1 ABOUT HERE>

As shown in Figure 1 the initial assessment of the 'anticipated rent' from an early-stage innovation is based on an assessment of the potential volume of sales, rate of profit and length of the lifecycle, of the innovation (Santi et al. 2003). Once this initial assessment has been made the firm will seek to insert the innovation into a market with considerations of perceived customer value and how the firm can address levels of market demand, substitution threats, regulation, lobbying and whether the innovation can be commercialised alone in isolation, or whether it needs to be fitted into a system. In the case of the latter this will require the firm to find alliance partners or complementary actors who can assist with the commercialisation process. However, if the innovation is 'systematic' and needs to be fitted into a system, the critical issue will be whether the firm has the ability to secure bargaining power with alliance partners via the creation of isolating mechanisms (Alvarez & Barney 2004; 2005). This market insertion and the feedback obtained to generate a 'residual' or 'quasi-rent' (Alvarez 2007), which should be improved through the application of the Lean Start-up process. Key outcomes for this are an improved assessment of the technical, marketing and financial resources available to the firm. This resource based view (RBV) will provide the management team with sufficient information to make decisions over their ability to commercialise the innovation alone or whether they require partners.

The development options the firm has will be: i) abandon the innovation; ii) commercialise alone; iii) find an alliance partner to help with the commercialisation; iv) delegate the commercialisation through a licencing agreement; or v) transfer the development by selling the innovation to another company (Santi & Reboud 2003). This final stage provides the firm's management with an 'appropriable' rent that will either be primarily 'Ricardian' or 'Schmpetarian' in nature. This will be determined by the ability of the firm to secure isolating mechanisms that will allow it to control the level of appropriation of ownership over the innovation (Amit & Schoemaker 1993). It should also be noted that the model suggests the firm's management should be prepared to 'pivot' at each stage of the process. This can come after market insertion and the generation of a 'residual' or 'quasi-rent' outcome, or after the internal resource assessment and the generation of an

‘appropriable’ rent outcome. Such ‘pivoting’ should be undertaken with reference to the development of a business model design.

Methodology and Case Analysis

The methodology for this study was a single case study that was undertaken as a pilot case within what is a larger and longer term research project. Yin (2014) suggests that case study design is appropriate where the main research questions are ‘how’ or ‘why’ in nature, where the researcher has limited control over the key actors and behavioural events, and where the focus of the study is on contemporary phenomena. In this study there were five research questions:

1. What is the process followed by small innovator firms in determining the ‘anticipated’ or entrepreneurial rent from an innovation prior to commercialisation?
2. How do small innovator firms assess market conditions and what impact does this have their determination of ‘residual’ or ‘quasi-rents’ from an innovation prior to commercialisation?
3. How are the internal resources and competencies for the commercialisation of an innovation assessed by small innovator firms, and what influence does this have on their determination of ‘appropriable’ rent from an innovation?
4. What role do isolating mechanisms play in determining the development options available to small innovator firms seeking to commercialise an innovation?
5. How can tools such as ‘Lean Start-up’ and ‘Lean Canvas’ assist small innovator firms to assess the value of an innovation and the potential rent return when engaged in the process of commercialisation?

Case study selection, data collection and analysis

Eisenhardt (1989) recommends that the selection of case studies should be driven by theory rather than a random sampling approach. Garson (2013) also recommends that a case be selected that can best represent the main units of analysis that form the overall focus of the research study. The case study selection process was guided by theoretical sampling as it offered the best opportunity for theoretical insight into the topic and the ability to develop the emergent theory. Likewise the pilot case study was a means to refine data collection processes and to provide for review of the process prior to proceeding with further cases (Yin 2014).

The case selected: The case study firm is Scanalyse, a ‘spin-out’ company established in 2004 to commercialise technology developed at a university research centre in spatial science. The core technology was to apply terrestrial laser scanners to industrial machinery to monitor wear and performance in high value high cost assets. The company developed an initial product ‘MillMapper’ that monitors grinding mill liners and moved onto complimentary products ‘CrusherMapper’ and ‘TransferMapper’. The company grew rapidly to over 30 employees with company turnover exceeding $4.5 million by 2012 in its final year of independent operations, when it was sold by trade sale to its industry competitor. The choice of this case was based on it having a strong and well defined technological product innovation, and being an ‘end-to-end’ case from start-up to sale thereby allowing the research team to see the entire process of the firm’s lifecycle.

The data collection process: The research was undertaken as a longitudinal study commencing in 2006 with the first interview of the CEO. By that stage the company was only 2 years old and had a workforce of 5 full time and 1 part time employees with annual turnover of $400,000. It followed with an interview in 2012 when the firm had grown significantly and was just poised for trade sale. A key part of the data collection process was the use of a diagnostic assessment questionnaire that examined the firm’s management team’s perceptions of the ‘anticipated’ or ‘entrepreneurial’ rent that might be generated from their innovation. This assessed the ‘anticipated rent’ using a set of questions that evaluated the potential volume of sales to be made, the rate of profit earned and the length of the lifecycle of the innovation. This diagnostic assessment also examined the firm’s management of the NPD and commercialisation process using a 40 item scale across four dimensions. The first of these was an assessment of the likely market adoption and diffusion of the innovation. The second was how well the firm had generated ‘isolating mechanisms’ such as formal IP rights protections, and the

formality of its NPD and commercialisation process. The third was the firm's possession of the necessary technical, financial and human resources required to fully commercialise the innovation. The fourth was the firm's approach to the formulation of a coherent strategy for the commercialisation of the innovation. This formed the basis of an in-depth interview with the firm's CEO at the two data collection points.

Data analysis: The data collected from the two interviews comprised the quantitative information from the two diagnostic surveys and qualitative data from the interview transcripts and other documentation collected from the company. This was examined using NVIVO software with coding guided by the research questions and the conceptual framework shown in Figure 1 (Miles et al. 2014). The coding drew on the raw data which included explanations, opinions and field notes. Those items that had similar themes or relevance were grouped as one code. The search for themes was selected on the basis of those that best describe the phenomenon under study (Daly et al. 1997). These included: i) "innovation period"; ii) "strategic strength"; iii) "capital resource capacity", and vi) "market environment".

<INSERT TABLE 1 ABOUT HERE>

Discussion

The results of the pilot study reflect the expectations outlined in the conceptual model (figure 1). Over the period 2004–2006 the company began the process of making the product 'market-ready' through a number of activities. Scanalyse sought to interface with prospective customers to demonstrate the technology, pursued patent lodgements, branding and undertook market research. The value of the company was evaluated against the criteria of product status – namely a 'Champion'. This company rated highly on all four indexes, being market opportunity, innovation strength, resources capability and strategy. With the launch of 'MillMapper' into the market on trials the company went about an iterative process testing product offering against market requirements. Essentially Scanalyse operated with a minimum viable product inserting it into the market to gain feedback that allowed it over the period to modify its package. Information gained by Scanalyse included feedback on customer value, value chain, substitution threats among others. It also gained an understanding of innovation value being the anticipated rent.

The period 2007–2009 saw the product commence sales initially with 'enthusiasts' and steadily grow to targeting mainstream acceptance by 2010. The product was modified to reflect market requirements and through a select number of iterations a 'residual rent' was created. By 2011 the company had a clear measure of its need for further financial resources to be able to enter Europe and was across its technical limitations. It was at this point that the CEO decided to open communications with its key competitor and pivot the product offering to better meet market requirements. By 2012 the company had made mainstream global markets and was able to demonstrate an 'appropriable rent'. This resulted in the acquisition of the company by an international competitor by the end of the year.

The five research questions give reinforcement to the conceptual model in terms of the way Scanalyse operated over the periods above. For example, under research question one Scanalyse sought to determine the size of the market very early after the first prototypes were constructed and identified the opportunity with Alcoa of Australia in terms of anticipated product life and expected rate of profit. The innovation was rated a 'Champion' at this point and the innovation value was based around a strong innovative competitive advantage. Under research question two Scanalyse assessed market conditions by demonstrating the technology in trials to early enthusiasts and carried out a series of iterative modifications to the product to fine tune it to customer requirements. The impact of the environment on determining a 'residual rent' saw the scaling back of the initial market considerations after accounting for features additional to those originally considered. For example the findings discovered the additional reporting requirements and the need for significant investigations in each global market caused a review on product cost structures and profitability projections. Also of interest was the innovation classification shift from one of developing a new standard or system across

to an innovation compatible with the existing systems operating in the market. Research question three saw Scanalyse reach out to its customers for assistance in seeking to strengthen its internal competencies as the company realised they were unable to fund a global footprint at this time. Additionally language and distance constraints saw them locate agents in certain key markets to endeavour to secure a base customer order level. The influence on the 'appropriable rent' value is directly related to the level of product completeness – i.e. market ready status and the ability to deliver to the market. This relates to the "innovation period" concept that saw a sustained innovation program spanning over eight years continually refining the offering to the market.

In relation to research question four the company put in place patents and branding to isolate their products from direct product competitive forces. These isolating mechanisms were instrumental in positioning the products in the market so that they were able to reach sales targets sufficient to gain a strong global foothold. This positioning eventually caused a competitor to make a compelling successful offer for the business. The CEO of Scanalyse thought the money received from the trade sale of the business was more than expected and was assisted by the strong intellectual property protection regime. In effect the return shifted from a "Schumpetarian rent" to one more reflecting a "Ricardian rent". Lean Start-up and associated tools have shown in the Scanalyse case they have a clear role in perfecting the product (or service) offering to the market. The capacity to fine tune a product to the needs of the market over a short space of time is a critical importance. In terms of the findings from the Scanalyse case it was also found that the CEO was a professional manager rather than an amateur or novice entrepreneur. It is considered with this skill set and the strong corporate governance structure embedded with the initial VC investment, Scanalyse would have been aware of the use of current business management techniques. This included putting in place the necessary systems and structures required to allow the firm to meet the exacting standards required by global markets. Although techniques such as "Lean Start-Up" were still evolving during the life of Scanalyse, the actual behaviour of the firm in its evolution broadly mirror the general principles of that process.

Further insights from the pilot study show the capital resource capacity improved over the period between the first two interviews and suggested more confidence from management in decision making without recourse to outside consultants. It is thought this capacity reflects a more mature understanding of the business and its customer archetype. Coupled with this insight is the contradiction in the inability of Scanalyse to secure all market opportunities in the initial period of the insertion to the market of its innovative products. The lack of marketing skills and capacity in the early period is consistent with NPD research into Australian firms (Huang et al. 2002). CEO Peter Clarke identified "'selling and marketing" as an area of weakness in the early period. This was strengthened over the later years with a significant uplift in results. The findings identified the culture of the firm moved to have all staff actively involved in NPD and for their customers to be also involved in NPD. The ability of Scanalyse to successfully secure an 'appropriable rent' was seen to reflect the ability of the firm to sustain operations over the eight years of operations.

Conclusions

The Scanalyse case offers an 'end-to-end' example of a new technology start-up, growth and trade-sale lifecycle. As shown in the data generated from the case, the pattern that emerges is reflective of the conceptual model outlined in figure 1. This highlights the importance of engaging in an iterative, trial-and-error process of assessing future rent returns to investment in innovation, seeking feedback from actual market insertion, assessing this against resources and adjusting or "pivoting" the business model to find the best configuration to offer value to customers. Even a firm with the professional leadership and strong corporate governance and IP rights regime of Scanalyse was forced to adapt rapidly in the face of a market insertion reality check. This research offers insights for entrepreneurs, researchers and those involved in commercialisation policy. Firms such as Scanalyse require strong IP protection, capable management teams and the guidance of experienced board directors. However, these are expensive assets to acquire and even then they cannot guarantee success. Flexibility and a willingness to adapt the business model are critical. Future research will explore multiple cases to see if this pattern is replicated from other firms.

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Figure 1: Towards a theory of Entrepreneurial Innovation Value

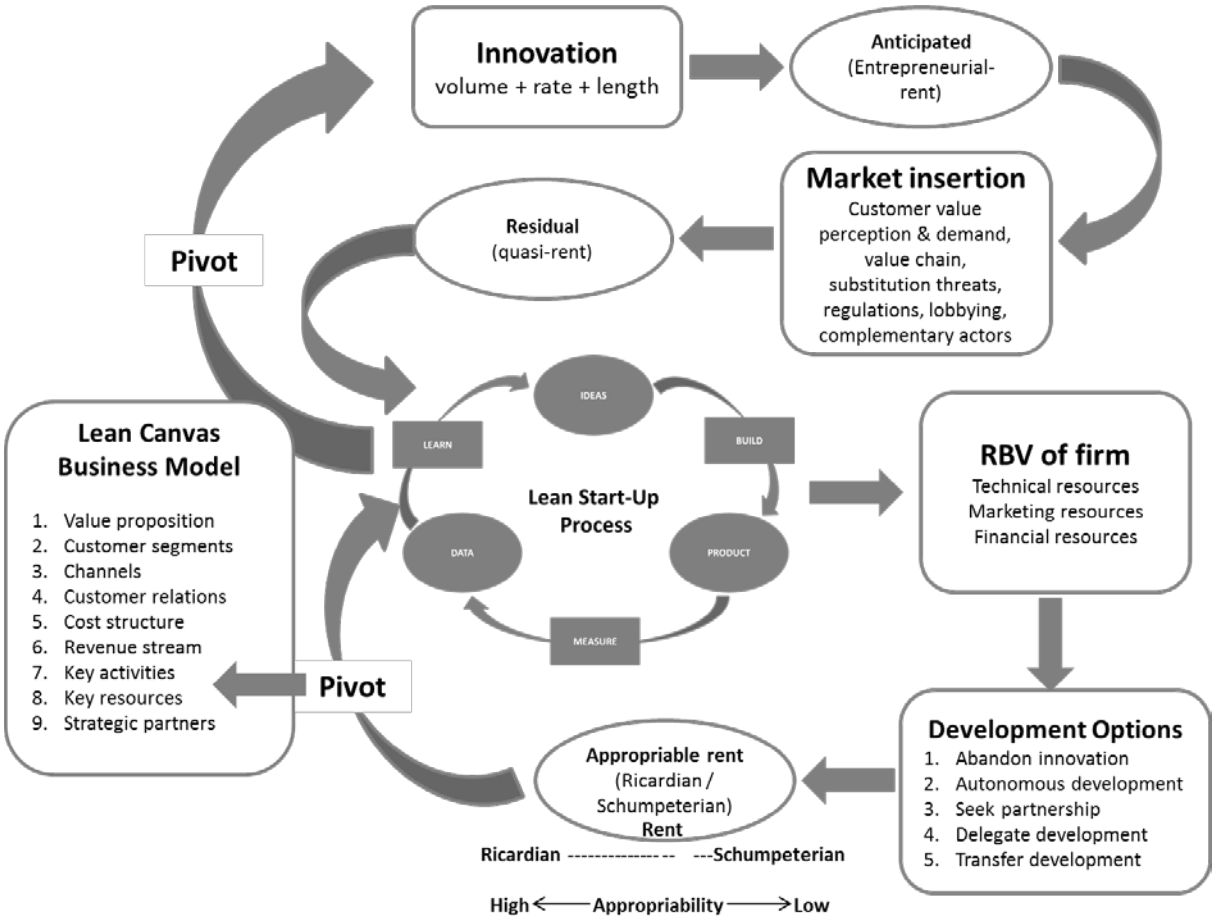

Table 1: Units of Analysis Mapped Against Conceptual Model

Units of Analysis	**Situation 2006**	**Situation 2012**
Years in operation	2 years	8 years
Employees	6 employees (5 full time, 1 part time)	33 employees (30 full time, 3 part time)
Annual turnover	AUD $400,000	AUD $4,500,000
# innovations brought to market over past 3 years	1-5	1-5
% of turnover invested in R&D	100%	30%
Preferences for financing	Retained profits = very important Debt financing = of little importance Equity financing = very important	Retained profits = very important Debt financing = not important Equity financing = not important
Value placed on alliances and networks	Leading customers = valuable Key suppliers = limited value Of most value: *"Joint product development with lead customers".* *"Joint marketing and promotion with lead customers".* *"Obtaining technology transfer from key suppliers".*	Leading customers = of some value Key suppliers = of no value Of most value: *"Joint research projects with lead customers".* *"Government sponsorship and support".*
'Anticipated' rent profile	"Champion" (high volume, high rate & high length)	"Champion" (high volume, high rate & high length)
Nature of innovation	Technological product innovation Operates alone 'isolated' not in a system Creates a new market Creates a new standard or system Developed with research centres	Technological product innovation Operates alone 'isolated' not in a system Creates a new market Compatible with existing systems Developed via wider network
Potential sales volume	Very wide market Estimated $16m to $20m AUD Target potential 10 or more segments	Wide market Estimated $5m to $10m AUD Target potential 2 to 4 segments
Potential profit rate	Gross profit estimated 61-80% Net profits estimated over 40% Will create a new market by creating a new dominant design	Gross profit estimated 61-80% Net profits estimated 21-30% Will create a new market by creating a new dominant design
Potential lifecycle	Offers a new technical platform Technically hard to copy Legally hard to copy	Offers a new technical platform Technically easy to copy Legally hard to copy
Market index	Above average (8/10)	Above average (7.6/10)
Key market challenges:	*"Biggest issue is production of clear case studies demonstrating the value proposition of the technology".* *"Also our ability to demonstrate the*	*"Securing clear and direct links to target customers of the product".* *"Allocating sufficient resources to marketing and sales".*

	value of the technology". *"Linking with partners in the international market place, because our service will be delivered by local agents at mine sites".*	*"Listening to the voice of the customer".*
Innovation index	Above average (7/10)	Above average (8.8/10)
Key innovation challenges:	*"Top issue is dealing with the unknowns associated with developing new information and data and determining how to extract real information and knowledge from that data".* *"No one else has produced this data so we are learning how to extract and read the data".* *"Highly automating the data processing so as to reduce our costs and to enable us to scale up very rapidly in response to demand".*	*"Unlike many SMEs Scanalyse has no problems with a lack of IP protection".* *"Also anomalous and worth further investigation is Scanalyse's own perceived decrease in formality with success and age which is not demonstrated by the IDD scores".* (field note)
Resource index	Above average (7.6/10)	Above average (8.4/10)
Key resource challenges:	*"Lack of capital for market development and for new product development".* *"Real challenges are getting onto the radar because we are presenting a profitable business but not with the blue sky potential to give very high returns".* *"Possible joint venture with large mining service companies as alliance partners and deal with marketing and site delivery".*	*"Scanalyse has received venture capital investment but continues to prefer retained profits for funding future growth."* (field note) *"Scanalyse still expects higher returns and continued or better than 50% per annum growth than it has achieved to date".* (field note)
Strategy index	Above average (8.2/10)	Above average (7.4/10)
Key strategy challenges:	*"Identifying and partnering with the best industry partners for delivery of onsite services".* *"Developing the in-house capability to provide expert advisory services in data analysis".* *"Dealing with competition as it arises".*	*"The Champion innovation of Scanalyse has required a CEO planning behaviour response and has pushed Scanalyse to maintain its formal, strategic and externally oriented approaches".* (field note)