Innovation management and dynamic capability

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Introduction

Innovation matters. In terms of competitiveness, whether of firms, sectors or national economies, much depends on sustaining a pattern of continuous change in what is offered to the world and the ways in which that offering is created and delivered (product and process innovation).

But this challenge raises the question of whether or not innovation can be ‘managed’? Is it simply a random, risky but essentially stochastic process – or are there things which can be done in terms of the design and operation of organizations which render them better or worse at carrying through the innovation task. The answer here appears to be a cautious ‘yes’ – decades of research on the experience of different firms from a number of different methodological perspectives suggest a convergence around a ‘good practice’ model for innovation management. Whilst there is certainly no guarantee of success and allowance needs to be made for the task of adapting and configuring these practices to particular circumstances, there is a basic recipe book from which to work.

For example, in the area of product development, ‘success’ practices include developing close understanding of user needs, strategic portfolio management, early involvement of multiple functions, systematic risk management and review via some form of ‘stage-gate’ system, etc. In engineering terms this pattern of convergent experience-based guidelines for how the process could be managed represents a set of ‘design rules’ which can be used in dealing with the problem in a particular context. The same applies in the area of process innovation, where well-tried practices aimed at delivering a steady stream of continuous improvements can be embedded in the day-to-day operations of the business. ‘Kaizen’ methods of this kind form the cornerstone of most quality management programmes and underpin much of the ‘lean’ philosophy. (Imai 1987; Womack and Jones 2005)

‘Business process re-engineering’ and its related approaches offer another set of recipes aimed at more radical changes in operating processes (Davenport 1992).

Individual firms work with these practices to develop their own particular ways of managing the different elements in the innovation process – and these firm-specific patterns of behaviour give rise to particular structures and procedures for dealing with the challenge. Nelson and Winter termed these ‘routines’ (describing a particular set of activities which are developed to deal with a particular organizational task) and they represent the ‘genes’ whose expression governs the way firms manage the innovation problem (Nelson and Winter 1982). Some are more successful than others and we see an emergent pattern of learning from and between firms. In this sense there is a
building up of a learned capability to manage the process and deliver a continuing stream of product and process innovations.

These learned capabilities are very much firm-specific and are referred to by Teece (1990) as core competences, which involves the strategic management of the firm's structures and routines and, knowledge and skills in a manner that is to the firm's competitive advantage. The dynamic capabilities approach extends this concept to consider the organisation of these capabilities in response to changes in the external environment (Teece and Pisano, 1994). In some cases, a firm's capabilities can go as far as to hinder its progress, acting as core rigidities (Leonard-Barton, 1992), requiring the destruction of existing skills and competences (Hall and Andriani, 2002).

Innovation today involves dealing with an extended and rapidly advancing scientific frontier, fragmenting markets flung right across the globe, political uncertainties, regulatory instabilities – and a set of competitors who are increasingly coming from unexpected directions. Increasingly innovation management involves bringing together different people and the knowledge they carry through building and running effective internal and external networks. This chapter analyses the such innovation networks and the importance of developing new dynamic capabilities related to the management of these networks. In doing so, the focus is on the capability of managing innovation as opposed to innovation capability. In other words, the managerial actions of harnessing and driving innovation rather than the process of generating and combining knowledge.

Drawing on research on supply chains and networks and technological collaboration, we commence with an introduction to innovation networks. The We go on to consider some of the key challenges in building and developing dynamic capabilities to manage innovation, looking towards inter-organisational relationships; concepts such as open innovation, inter-firm learning and discontinuous innovation are presented. The chapter concludes by discussing the implications for the strategic management of supply.

No firm is an island ....

A key component is at the inter-organizational level where innovation outcomes are strongly associated with the ways in which relationships and behaviour within these relationships are managed. At its heart innovation is about knowledge – and in particular, combining a wide range of knowledge elements to create something new. These elements may involve science and technology, market needs, manufacturing capabilities, competitor behaviour, regulatory issues and a host of other contents – but unless they can all be woven together the innovation is not likely to succeed.

The game has become very much a multi-player one. As a result, the innovation process has become collective and combinatorial in character (Coombs and Metcalfe, 2000). As firms struggle to internally supply all the knowledge and skills required by present day technologies, the emphasis has
shifted towards firms’ external relationships as a means of accessing and acquiring new capabilities; in order to remain competitive and in tune with technological advances, firms are now adopting a more collaborative approach. Through increased collaboration and co-operation with other firms, the firm is able to access a further range of capabilities and create a ‘pool of resources’ (Loasby, 1994).

The response has to be one of spreading the net wide and trying to pick up and make use of a wide set of knowledge signals – in other words, learning to manage innovation at the network level. It’s something which Roy Rothwell foresaw in his pioneering work on models of innovation with a gradual move away from thinking about (and organising) a linear science/technology push or demand pull process to one which saw increasing inter-activity – at first across the firm with cross-functional teams and other boundary-spanning activities and increasingly outside the firm in its links with others. His vision of the ‘fifth generation’ innovation is essentially the one in which we now need to operate – with rich and diverse network linkages accelerated and enabled by an intensive set of information and communication technologies. (Rothwell 1992)

Emphasis is placed on developing strong networks with close linkages – for example getting close to customer to understand their needs and evolve solutions with them to address their problems, or partnering with key suppliers to enhance the range of knowledge available to the firm in meeting its particular product and process innovation challenges. (Lamming 1993). Rich and pro-ly developed external and inter-organizational links have been a regularly reported feature in innovation success studies for at least fifty years (Carter and Williams 1957; Rothwell 1992). It is clear that some form of inter-organisational co-operation can contribute benefits to members under certain conditions; of particular interest here is work on supply chains and networks, innovation networks (Tidd 1997; Oliver and Blakeborough 1998) and industrial districts and clustering (Chaston 1995; Semlinger 1995; Schmitz 1997). For example, in the case of supply chains and networks there is extensive evidence to support the view that some form of co-operation represents a viable alternative to more traditional confrontational models - although the design and implementation of such co-operative arrangements remains fraught with difficulty (Macbeth 1989; Sako 1992; Lamming 1993).

It is also important to acknowledge the existence of both co-operation and competition within and between networks. It is often the co-presence of these two dimensions that supports the process of innovation. Studies have shown that different types of relationship can exist between competing firms that can be competitive as well as harmonious often resulting in complex co-operative arrangements (Teece, 2003; Easton and Araujo, 1992; Bengtsson and Kock, 1999).

Similarly there has been much discussion about the merits of technological collaboration, especially in the context of complex product systems development (Dodgson 1991; Hobday 1994; Marceau 1994). Complexity challenge has brought with it a blurring of the borders between public and
private sectors and between company strategies and public policy (Rycroft and Kash, 1999). Innovation networks offer significant advantages, enabling the assembly of different knowledge sets and reducing the time and costs of development - but are again often difficult to implement (Tidd, 1997).

Studies of ‘collective efficiency’ have explored the phenomenon of clustering in a number of different contexts. (Piore and Sabel 1982; Humphrey and Schmitz 1996; Nadvi 1997; Porter 1997). From this work it is clear that the model is widespread - not just confined to parts of Italy, Spain and Germany but diffused around the world - and under certain conditions, extremely effective. For example, one town (Salkot) in Pakistan plays a dominant role in the world market for specialist surgical instruments made of stainless steel. From a core group of 300 small firms, supported by 1500 even smaller suppliers, 90% of production (1996) was exported and took a 20% share of the world market, second only to Germany. In another case the Sinos valley in Brazil contains around 500 small firm manufacturers of specialist high quality leather shoes. Between 1970 and 1990 their share of the world market rose from 0.3% to 12.5% and they now export some 70% of total production. In each case the gains are seen as resulting from close interdependence in a co-operative network.

The conditions under which effective networking takes place are less clearly identified, but it is becoming evident that simple factors such as proximity do not, of themselves, explain the complexities of networking. For example, Humphrey et al. (2003) identify the importance of developing trust relations, whilst Schmitz (1995) and Best (1990) both stress the importance of facilitation by network brokers, impannatore or others (Best 1990; Nadvi and Schmitz 1994; Schmitz 1995; Humphrey and Schmitz 1996).

And inter-organizational innovation networks are more than just ways of assembling and deploying knowledge in a complex world. Systems theory suggests that networks also develop what are termed ‘emergent properties’. That is, they have the interesting potential that the whole can be greater than the sum of its parts. Being in an effective innovation network can deliver a wide range of benefits beyond the collective knowledge efficiency mentioned above. These include getting access to different and complementary knowledge sets, reducing risks by sharing them, accessing new markets and technologies and pooling complementary skills and assets.

For example participating in innovation networks can help firms bump into new ideas and creative combinations – even in mature businesses. It’s well known in studies of individual creativity that the process involves making associations - and sometimes the unexpected conjunction of different perspectives can lead to surprising results. And the same seems to be true at the organisational level; studies of networks indicate that getting together in such fashion can help open up new and productive territory. For instance, recent developments in the use of titanium components in Formula 1 engines have been significantly advanced by lessons learned about the moulding process from a company producing golf which was uncovered through discussions undertaken at a networking event.
Extending the repertoire

The problem with managing innovation is that it involves trying to hit a moving target. No sooner has a firm managed to put in place routines for dealing with its environment through product and process innovation than that environment shifts. A new technology rewrites the rules of the game, a new market with different dynamics emerges, a government shifts the regulatory framework or a competitor develops a different business model. The only way in which the firm can deal with this is to extend its repertoire of routines – modifying some which work well, letting go of others which are no longer appropriate and trying to create some new ones to deal with new challenges. In other words it’s a continuing learning process, building and developing the capability to manage innovation. In the following section we’ll look at some of the frontier challenges around which new and modified innovation capability is being developed at the inter-organizational level.

Frontier themes in inter-organizational innovation

(i) Open Innovation

Perhaps the biggest shift has been the widespread recognition that innovation in the 21st century has really become a multiplayer game. Successful innovating firms have long realised the importance of linkages and connections -- getting close to customers to understand their needs, working with suppliers to deliver innovative solutions, linking up with collaborators, research centres, even competitors to build and operate innovation systems. But in an era of global operations and high-speed technological infrastructures populated by people with highly mobile skills, building and managing networks and connections becomes the key requirement for innovation. It's not about knowledge creation so much as knowledge flows and the way in which this knowledge is integrated and combined. Teece (2007) discusses moves by firms towards more decentralised structures as a means of adapting to the more global dispersion of knowledge. Even major research and development players like GlaxoSmithKline are realising that they can't cover all the knowledge bases they need and instead are looking to build extensive links and relationships with players around the globe.

Procter & Gamble is a good example of a successful innovator which is radically changing its approach. It has grown through continually renewing its product offerings across a wide palette and spends around $3 billion a year on some 7000 researchers worldwide to help them do this. But a decline in growth and a weakening share price in 1999 led them to change their game from 'research and develop' to 'connect and develop', and they have set themselves the ambitious target of sourcing 50% of their innovations from outside the company. So far the move has paid off – they now get around 35% of their innovations through a rich network of external links and seem to be leveraging significant market success as a result. The Crest Spinbrush – a battery operated toothbrush which sells for around $5 has grown a huge presence (worth around $200m per year) – originated as a derivative of a
rotating lollipop and was introduced by a small team of entrepreneurs who approached P&G. Their ideas plus P&G’s marketing and distribution strengths seem to have paid off handsomely.

At the same time they have been applying the “connect and develop” philosophy to building rich internal networks across divisions and between different global centres. A stream of product successes include Crest Whitestrips – which brought together their expertise in normally disparate fields like film technology and bleach and linked it to their oral care experience – and Olay Daily Facials, moisturising and cleansing tissues which drew on separate knowledge fields like cleansing agents and tissue production.

What’s happening with P&G, GSK, 3M and many others is a recognition of the shift towards what has been termed ‘open innovation’. The idea – first put forward by Henry Chesbrough – is that even large-scale R&D in a closed system like an individual firm isn’t going to be enough in the 21st century environment (Chesbrough 2003). Knowledge production is taking place at an exponential rate and the OECD countries spend nearly $1 trillion on R&D in the public and private sector – a figure which is probably an under-estimate since it ignores the considerable amount of ‘research’ which is not captured in official statistics. How can any single organization keep up with – or even keep tabs on – such a sea of knowledge? And this is happening in widely distributed fashion - R&D is no longer the province of the advanced industrial nations like USA, Germany or Japan but is increasing most rapidly in the newly-growing economies like India and China (Bessant and Venables 2008). In this kind of context it becomes be impossible to pick up on every development and even smart firms are going to miss a trick or two.

R&D is no longer the province of a firm’s home nation, product development is shifting from a local, cross-functional process towards one of global collaboration, employing skilled teams from across the globe (Eppinger and Chitkara, 2006). Global Product Development (GPD) involves collaboration between a number of centralised functions located in the Headquarter country and additional operational teams dispersed throughout the world. Modes of GPD may vary according to the location and ownership of resources and may include the outsourcing of engineering teams in parallel with captive offshoring engineering facilities. The advantages of GPD include improved engineering efficiency achieved through the use of lower cost resources, access to technical expertise from across the globe and products designed for an international market. GPD has been employed across a wide range of industries, most markedly in the software industry, closely followed by the electronics and manufacturing industries, with organisations such as Alcoa, General Electric, Siemens and Hewlett-Packard utilizing the skills of nations such as China, India, Thailand, Mexico, Russia and Japan.

The open innovation challenge isn’t just about the R&D side – it’s also about market knowledge around customer needs and wishes. Globalisation has meant that markets are increasingly fragmented so understanding the demand side for innovation becomes massively more complex. Although there may be significant growth in key regions – emerging markets like Brazil
or South Africa – they require very different approaches to understanding and working with them.

For example C. K. Prahalad points out that most of the world’s population – around 4 billion people – live close to or below the poverty line, with an average income of less than $2/day. It is easy to make assumptions about this group along the lines of ‘they can’t afford it so why innovate?’ In fact the challenge of meeting their basic needs for food, water, shelter and healthcare require high levels of creativity – but beyond this social agenda lies a considerable innovation opportunity. But it requires a reframing of the ‘normal’ rules of the market game and a challenging of core assumptions. Table 1 gives some examples.

**Table 1 Challenging assumptions about the bottom of the pyramid**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Reality – and opportunity</th>
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<tr>
<td><em>The poor have no purchasing power and do not represent a viable market</em></td>
<td>Although low income the sheer scale of this market makes it interesting. Additionally the poor often pay a premium for access to many goods and services – e.g. borrowing money, clean water, telecommunications and basic medicines – because they cannot address ‘mainstream’ channels like shops and banks. The innovation challenge is to offer low cost, low margin but high quality goods and services across a potential market of 4 billion people.</td>
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<tr>
<td><em>The poor are not brand-conscious</em></td>
<td>Evidence suggests a high degree of brand and value consciousness – so if an entrepreneur can come up with a high quality low cost solution it will be subject to hard testing in this market. Learning to deal with this can help migrate to other markets – essentially the classic pattern of ‘disruptive innovation’.</td>
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<td><em>The poor are hard to reach</em></td>
<td>By 2015 there are likely to be nearly 400 cities in the developing world with populations over 1 million and 23 with over 10 million. 30-40% of these will be poor – so the potential market access is considerable. Innovative thinking around distribution – via new networks or agents (such as the women village entrepreneurs used by Hindustan Lever in India or the ‘Avon ladies’ in rural Brazil) – can open up untapped markets.</td>
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<td><em>The poor are unable to use and not interested in advanced technology</em></td>
<td>Experience with PC kiosks, low cost mobile phone sharing and access to the internet suggests that rates of take-up and sophistication of use are extremely fast amongst this group. In India the e-choupal (e-meeting place) set up by software company ITC enabled farmers to check prices for their products at the local markets and auction houses. Very shortly after that the same</td>
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The rapid rise of the Internet as a virtual marketplace changes the rules radically – new markets emerge with high speed out of nowhere as information flows in and across complex networks. Social networking sites now have populations close to those of large countries (My Space with 108 million users would be the 11th largest country in the world for example!) and virtual worlds like Second Life provide powerful new space in which to explore product and service concepts or develop new forms of market relationships. These open up very different modes of interaction and challenge many conventional business models. A band like the Arctic Monkeys can rise to prominence and top the album charts with a product originally available only in digital download form and a reputation built not via conventional PR and publicity but by the sheer pace and scale of viral marketing via the Web. This has clear implications for players in the media, information and entertainment industries – but the challenges extend more widely, especially as the Internet moves to increasing levels of interactivity with what are sometimes called Web 2.0 applications. Voice over internet protocol (VOIP) not only threatens traditional fixed line and mobile models but puts increasing emphasis on users and communities as a source of innovation.

Table 2 summarises the significant contextual shifts which are driving towards open innovation.

Table 2 Changing context for search behaviour

<table>
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<tr>
<th>Context change</th>
<th>Indicative examples</th>
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<tr>
<td>Acceleration of knowledge production</td>
<td>OECD estimates that close to $1 trillion is spent each year (public and private sector) in creating new knowledge – and hence extending the frontier along which ‘breakthrough’ technological developments may happen</td>
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<tr>
<td>Global distribution of knowledge production</td>
<td>Knowledge production is increasingly involving new players especially in emerging market fields like the BRIC nations – so the need for search routines to cover a much wider search space increases</td>
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<tr>
<td>Market fragmentation</td>
<td>Globalisation has massively increased the range of markets and segments so that these are now widely dispersed and locally varied – putting pressure on search routines to cover much more territory, often far from ‘traditional’ experiences – such as the ‘bottom of the pyramid’ conditions in many emerging markets. (Prahalad 2006)</td>
</tr>
<tr>
<td>Market virtualisation</td>
<td>Increasing use of internet as marketing channel means different approaches need to be developed. At the same time emergence</td>
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of large-scale social networks in cyberspace pose challenges in market research approaches – for example, My Space currently has over 80 million subscribers. Further challenges arise in the emergence of parallel world communities as a research opportunity – for example, Second Life now has over 8 million ‘residents’.

**Rise of active users**

Although von Hippel has long identified the active role which users can play in innovation there has been an acceleration in the ways in which this is now taking place – for example, the growth of Linux has been a user-led open community development. (Von Hippel 2005)

In sectors like media the line between consumers and creators is increasingly blurred – for example, You Tube has around 100 million videos viewed each day but also has over 70,000 new videos uploaded every day from its user base.

**Development soft technological and social infrastructure**

Increasing linkages enabled by information and communications technologies around the internet and broadband have enabled and reinforced alternative social networking possibilities. At the same time the increasing availability of simulation and prototyping tools have reduced the separation between users and producers (Schrage 2000; Gann 2004)

**Making open innovation happen**

Open innovation – although a new label – is actually an old concept. Creating and combining different knowledge sets has always been the name of the game both inside and outside the firm. The difference lies in the context which requires that we pay much closer attention to the challenge of external knowledge networking. And this requires significant efforts around creating new routines and structures to deal with the challenge. For example, P&G’s successes with ‘connect and develop’ owe much to their mobilising rich linkages between people who know things within their giant global operations and increasingly outside it. They use communities of practice – internet-enabled ‘clubs’ where people with different knowledge sets can converge around core themes, and the deploy a small army of innovation ‘scouts’ who are licensed to act as prospectors, brokers and gatekeepers for knowledge to flow across the organization’s boundaries. Intranet technology links around 10,000 people in an internal ‘ideas market’ whilst sites like www.innocentive.com extend the principle outside the firm and enable a world of new collaborative possibilities.

3M – another firm with a strong innovation pedigree dating back over a century – similarly put much of their success down to making and managing connections Larry Wendling, Vice President for Corporate Research talks of
3M’s ‘secret weapon’ – the rich formal and informal networking which links the thousands of R&D and market-facing people across the organization. Their long-history of breakthrough innovations – from masking tape, through Scotchgard, Scotch tape, magnetic recording tape to Post-Its and their myriad derivatives – arise primarily out of people making connections.

The logic of open innovation is that organizations need to open up their innovation processes and the challenge becomes one of improving the knowledge flows in and out of the organisation, trading in knowledge as much as goods and services. Perhaps the key to effective innovation management in the 21st century is going to be developing ‘spaghetti skills’ – building and running complex and rich networks along which knowledge flows. This is certainly the view of many senior managers. In a recent IBM survey of 750 CEOs around the world 76% ranked business partner and customer collaboration as top sources for new ideas whilst internal R&D ranked only eighth. The study also indicated that ‘outperformers’ – in terms of revenue growth - used external sources 30% more than underperformers. It’s not hard to see why – the managers interviewed listed the clear benefits from collaboration with partners as things like reduced costs, higher quality and customer satisfaction, access to skills and products, increased revenue, and access to new markets and customers. As one CEO put it, "We have at our disposal today a lot more capability and innovation in the marketplace of competitive dynamic suppliers than if we were to try to create on our own" while another stated simply "If you think you have all of the answers internally, you are wrong." (IBM 2006)

(ii) Inter-firm learning

Another way in which networking can help innovation is in providing support for inter-firm learning (Bessant and Tsekouras, 2001; Dent, 2001). Much process innovation is about configuring and adapting what has been developed elsewhere and applying it – for example, in the many efforts which firms have been making to adopt world class manufacturing (and increasingly service) practice. Whilst it is possible to go it alone in this process an increasing number of firms are seeing the value in using networks to give them some extra traction on the learning process. Inter-firm learning within a network helps in a number of ways:

- in inter-firm learning there is the potential for challenge and structured critical reflection from different perspectives
- different perspectives can bring in new concepts (or old concepts which are new to the learner)
- shared experimentation can reduce perceived and actual costs risks in trying new things
- shared experiences can provide support and open new lines of inquiry or exploration
inter-firm learning helps explicate the systems principles, seeing the patterns - separating ‘the wood from the trees’

inter-firm learning provides an environment for surfacing assumptions and exploring mental models outside of the normal experience of individual organisations - helps prevent ‘not invented here’ and other effects

These principles are increasingly being used to help diffuse innovative practices along supply chains; companies like IBM and BAe Systems have made extensive efforts to make ‘supply chain learning’ the next key thrust in their supplier development programmes (Bessant, Kaplinsky et al. 2003). They also underpin policy initiatives aimed at getting firms to work together on innovation-related learning. For example, the UK Society of Motor Manufacturers and Traders has run the successful Industry Forum for many years helping a wide range of firms adopt and implement process innovations around world class manufacturing, and this model has been rolled out to sectors as diverse as ceramics, aerospace, textiles and tourism. Regional development agencies – for example in South Africa or now try and use networks and clusters as a key aid to helping stimulate economic growth through innovation. (Morris, Bessant et al. 2006) Using a process of benchmarking to identify key areas for development, linked to regular inputs of training and plant level change projects the industry has managed to close the gap against suppliers from outside the country to the extent that in a number of key areas the country is a net exporter. Significantly whilst the sector as a whole has been going through a process of rapid learning and development the rate of improvement amongst firms which are members of this actively managed learning network appear to be significantly higher than the industry average. (Kaplinsky 2001)

A growing body of evidence suggests that there are considerable systemic benefits to be achieved via inter-firm learning. For example the CRINE (Cost Reduction Initiative for the New Era) programme was a joint effort involving government and key industry players in the UK oil and gas sector representing contractors, suppliers, consultants, trade associations and others. The project was successful on a number of dimensions – for example, by 1997 the cost of field developments had fallen by 40% on a barrel/barrel basis. ‘Since its inception CRINE has had a dramatic effect on the safety, efficiency and economics of North Sea oil and gas field development and operation.’ was the response of one senior manager. (Chambers 1996) As a consequence, CRINE-based programmes are now under development or in operation in Brazil, Mexico, Venezuela, India and Australia.

One of the most notable examples is the case of Toyota where an active supplier association has been responsible for sustained learning and development over an extended period of time. (Dyer and Nobeoka 2000). Hines reports on other examples of supplier associations which have contributed to sustainable growth and development in a number of sectors particularly engineering and automotive. Marsh and Shaw (2000) describe
collaborative learning experiences in the wine industry including elements of supply chain learning (SCL), whilst the AFFA study reports on other experiences in the agricultural and food sector in Australia. (AFFA, 1998). Case studies of SCL in the Dutch and UK food industries, the construction sector and aerospace provide further examples of different modes of SCL organisation. (Fearne and Hughes, 1999; AFFA, 2000; Dent, 2001)

In each of the above examples the gains emerged as a result of shared and co-operative activities and in particular shared learning processes. Inter-firm learning of this kind represents a significant potential resource but we need to understand further the dynamics and problems involved in making it happen. (Bessant 2004).

(iii) The problem with discontinuous conditions

Whilst it is possible to define a model of ‘good practice’ for innovation management it is also clear that even ‘good’ firms – those which have developed their own effective routines and resulting structure and procedures for innovation management - can run into difficulties. In particular the picture is one in which such firms stumble over what can be seen to be discontinuities – for example the emergence of a dramatically different technology or a totally new market. Evidence suggests that under such discontinuous conditions existing incumbents often do badly and the winners are often new (and usually small) entrants.

Christensen’s work on the innovator’s dilemma, for example, suggests that at certain times the close interaction with players within the value network may act as a filter which blocks firms seeing the salience of new signals about emerging but very different potential technical or market trajectories (Christenson 1997). This echoes earlier work such as that of Henderson and Clark which highlights knowledge management problems when fundamental architectural links in a product concept are reconfigured (Henderson and Clark 1990). There is also the well-known issue of “not invented here” suggesting that under conditions in which significant shifts occur in the technological trajectory existing incumbents often fail to capitalise or even to adopt (Utterback 1994). The problem is not simply one of missing important signals about emerging shifts in innovation trajectories in the environment. In a number of cases the information was available to the enterprise but its decision – making and resource allocation processes failed to deal adequately with the new information (Tripsas and Gavetti 2000; Foster and Kaplan 2002). Arguably there are internal filters which act in a fashion analogous to cognitive dissonance in human psychology.

These and other experiences suggest that whilst firms can learn capabilities around what might be termed “steady state” innovation conditions they need to extend these capabilities to deal with the uncertainties arising from discontinuous shifts in their technological, market or regulatory environments. In part this reflects the long-standing discussion in the literature about routines which deal with what March and others have called ‘exploitation’ and those
which deal with ‘exploration’, and the tensions between these when carried out within the same organization – the challenge of ‘ambidexterity’ (March 1991; Tushman and O'Reilly 1996; Benner and Tushman 2003). It is also possible to argue that the notion of ‘routines’ to deal with highly uncertain and unpredictable conditions may be inappropriate since it is difficult to have in place reproducible patterns of rehearsed behaviour on which to draw. Instead the process of developing and codifying routines for these conditions will require extensive experimentation – essentially trial and error learning towards a relatively structured set of approaches for dealing with them.

For example, firms which decide to explore radical new directions often find themselves having to manage contradictions and challenges to their existing ways of managing innovation. Portfolio management and resource allocation techniques which operate well for ensuring good fit with the strategic directions and competencies of the firm may not be appropriate for reviewing apparently wild and unexpected ideas which might establish completely new directions. Risk management systems operating with stage gate reviews over the development life of a new project may not deal well with apparently high risk projects with a high level of market and technological uncertainty.

The problem is compounded because so much of innovation now operates at a system level involving networks of suppliers and partners configuring knowledge and other resources to create a new offering. Discontinuous innovation (DI) is often problematic because it may involve building and working with a significantly different ‘value network’ to the normal pattern which the innovating firm is used to.

Table 3 highlights some of the key differences between the kind of approaches we might take to managing ‘steady state’ innovation and those we need to develop for dealing with discontinuous challenges.

**Table 3: Different organizations for steady state and discontinuous innovation**

(Bessant and Francis, 2005)

<table>
<thead>
<tr>
<th>Type 1 Innovation organization</th>
<th>Type 2 Innovation organization</th>
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<tr>
<td>Operates within mental framework based on clear and accepted set of rules of the game</td>
<td>No clear rules – these emerge over time</td>
</tr>
<tr>
<td></td>
<td>High tolerance for ambiguity</td>
</tr>
<tr>
<td>Strategies path dependent</td>
<td>Path independent, emergent, probe and learn</td>
</tr>
<tr>
<td>Clear selection environment</td>
<td>Fuzzy, emergent selection environment</td>
</tr>
<tr>
<td>Selection and resource allocation linked to clear trajectories and criteria for fit</td>
<td>Risk taking, multiple parallel bets, tolerance of (fast) failure</td>
</tr>
<tr>
<td>Operating routines refined and stable</td>
<td>Operating patterns emergent and ‘fuzzy’</td>
</tr>
<tr>
<td>Strong ties and knowledge flows along clear channels</td>
<td>Weak ties and peripheral vision important</td>
</tr>
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</table>
One of the implications of this is the need to review search behaviour – the process of finding, forming and building effective operating relationships at the inter-organizational level. If the problem were simply one of extending the space being searched that might be manageable, but a key issue is that many of the discontinuous shifts in the environment don’t appear as clear images on the radar screen. In innovation terms the new dominant design – a configuration of technology means and market needs – doesn’t suddenly appear perfectly formed and clearly defined (Abernathy and Utterback 1975), instead it emerges gradually as a result of trial and error, feedback and learning within a rich soup of players and possibilities. Complexity theory talks about gradual emergence of new configurations of elements - the new dominant design - not as the result of planned and targeted search but rather one of co-evolution with a changing environment.

Discontinuous innovation is an experimental process, learning through trial and error. Lynn et al (1996) put forward the notion of “probe and learn” and it may be the case that for discontinuous innovation, firms must consider working with a wide range of different actors that do not operate within the organisations “comfort zone”. Focusing on supply relationships, Phillips et al (2006) suggest organisations develop a broad range of non-committal supply relationships or strategic dalliances, which may be pursued alongside longer-term strategic partnerships. Such strategic dalliances would enable a greater degree of flexibility, allowing organisations to respond swiftly to changes in the external environment, whilst maintaining long-term relationships with existing suppliers, protecting the interest of the core business (Birkinshaw, Bessant and Delbridge 2007).

This continuing work suggests that whilst firms are experimenting with new approaches, there is a degree of commonality in their actsins and experiences. Amongst common themes are the following:

- A common first step is the creation of slack resources to focus on the extended search task – for example, establishing a special unit or team or designating a new role for an established group.

- Another common set of approaches seeks to (re)create entrepreneurial capability through setting up specialist venture units, corporate venture funds, etc – and at the limit to consider spinning these off as separate entities.

- Many experiments are along pathways already established as ‘mainstream’ exploration routines – for example, the use of futures and forecasting methods. But there is also a degree of stretching the boundaries of these and modifying them to suit more open-ended search behaviour – for example, cross-sectoral forecasting.

- Whilst many search experiments are essentially variations on established routines a number of new approaches are also being
developed involving approaches and technologies which would simply not have been possible in earlier models – for example, the use of interactive Web 2.0 approaches or advanced user involvement in co-design.

- Whilst there is still wide variation in the ways in which they are deployed there seems to be convergence around 12 core ‘strategies’ shaping experiments towards new search routines (Bessant and Von Stamm 2007). These are described in outline in table 4.

### Table 4  Search Strategies for Discontinuous Innovation

<table>
<thead>
<tr>
<th>Search Strategy</th>
<th>Mode of operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sending out scouts</td>
<td>Dispatch idea hunters to track down new innovation triggers.</td>
</tr>
<tr>
<td>Exploring multiple futures</td>
<td>Use futures techniques to explore alternative possible futures; and develop innovation options from that</td>
</tr>
<tr>
<td>Using the web</td>
<td>Harness the power of the web, through online communities, and virtual worlds, for example, to detect new trends.</td>
</tr>
<tr>
<td>Working with active users</td>
<td>Team up with product and service users to see the ways in which they change and develop existing offerings.</td>
</tr>
<tr>
<td>Deep diving</td>
<td>Study what people actually do, rather than what they say they do.</td>
</tr>
<tr>
<td>Probe and learn</td>
<td>Use prototyping as mechanism to explore emergent phenomena and act as boundary object to bring key stakeholders into the innovation process</td>
</tr>
<tr>
<td>Mobilise the mainstream</td>
<td>Bring mainstream actors into the product and service development process.</td>
</tr>
<tr>
<td>Corporate venturing</td>
<td>Create and deploy venture units</td>
</tr>
<tr>
<td>Corporate entrepreneurship and intrapreneuring</td>
<td>Stimulate and nurture the entrepreneurial talent inside the organisation.</td>
</tr>
<tr>
<td>Use brokers and bridges</td>
<td>Cast the ideas net far and wide and connect with other industries.</td>
</tr>
<tr>
<td>Deliberate diversity</td>
<td>Create diverse teams and a diverse workforce.</td>
</tr>
<tr>
<td>Idea generators</td>
<td>Use creativity tools</td>
</tr>
</tbody>
</table>

**Building dynamic capability**

These challenges highlight the core concern with innovation management – the need to update our mental models of how the process works. Put simply, how we think about something shapes what we do about it – what we pay
attention to and how we choose to organise and manage around it. The risk is that we may be trying to manage innovation in the 21st century with mental models which haven’t caught up – a managerial version of generals always fighting the battles of the last war rather than the current one. Table 5 gives some examples where we might need to update or challenge our thinking about innovation.

Table 5: Thinking about innovation – challenging some myths

<table>
<thead>
<tr>
<th>The old model ....</th>
<th>Today’s reality – innovation is....</th>
<th>What this means for managing the process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation is all about invention – the ‘Eureka’ moment, the flash of inspiration</td>
<td>Innovation is an extended process, a journey from initial trigger idea through to successful implementation as a new product/service or process which people use and buy into. And its one which involves a wide range of different inputs on the way.</td>
<td>Operate a process which involves people from across the organization and involve them from early on in the process</td>
</tr>
<tr>
<td>Innovation is about R&amp;D</td>
<td>It’s about creating and combining a wide range of different knowledge sets – technical, marketing, etc.</td>
<td>Mobilise and involve different players and deploy them in cross-functional teams</td>
</tr>
<tr>
<td>Innovation is the responsibility of a ‘licensed’ few specialists</td>
<td>It’s about high involvement – vertically and laterally. Everyone can – and should – be involved.</td>
<td>Develop awareness of innovation and create opportunities –structures and process – to enable high involvement</td>
</tr>
<tr>
<td>Innovation is a solo act</td>
<td>It always has been inter-organisational and now in open innovation era the ability to make and use connections is critical</td>
<td>Develop external networking and relationship management skills</td>
</tr>
<tr>
<td>Users are passive</td>
<td>Users are active</td>
<td>Engage users as part of the process – co-designers</td>
</tr>
<tr>
<td>Suppliers are passive</td>
<td>Supplier always were active and in open innovation world can be significant and pro-active players</td>
<td>Engage suppliers as part of the process – co-innovators</td>
</tr>
</tbody>
</table>

In developing dynamic capabilities for managing innovation, The key message is that innovation is increasingly a corporate wide task and one which extends beyond the boundaries of the enterprise. So the people with skills and experience in creating and managing relationships and networks on an inter-firm basis could play an increasingly significant role. This puts functions like
procurement centre-stage in the emerging innovation agenda – and, of course, there is plenty of track record on which to build. We know that process innovation – for example, around the lean agenda of improving on cost, quality and delivery – can be accelerated through supply chain learning and initiatives like the Industry Forum in the auto components, aerospace, textiles and other sectors. And there is growing evidence of the important role which suppliers can and do play in extending product development.

This chapter has outlined approaches that may support the development of dynamic capabilities for managing innovation. Much of the emphasis has been on the need to develop multi-party relationships and the role of the supply manager may be crucial here, in both creating a diverse range of supplier relationships that extend beyond the firm’s normal comfort zone and the management of these relationships to ensure that they extend beyond simply the transfer of goods and services to include the transfer of knowledge, ideas and potential product offerings. In the future, the focus of many supply managers may be on the development and maintenance of complex and rich networks along which knowledge flows and the support of inter-firm learning. In doing so, firms may be better placed to deal with discontinuous conditions, to extend beyond the firm’s existing boundaries and cooperate within a different value network.

References
AFFA (2000). *Supply chain learning: Chain reversal and shared learning for global competitiveness*. Canberra, Department of Agriculture, Fisheries and Forestry Australia (AFFA).


