PART 1

Managing Innovation

CHAPTER 1

Innovation – what it is and why it matters

'A slow sort of country' said the Red Queen. 'Now here, you see, it takes all the running you can do to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!'
(Lewis Carroll, Alice through the Looking Glass)

1.1 Introduction

'*We always eat elephants . . .*' is a surprising claim made by Carlos Broens, founder and head of a successful toolmaking and precision engineering firm in Australia with an enviable growth record. Broens Industries is a small/medium-sized company of 130 employees which survives in a highly competitive world by exporting over 70% of its products and services to technologically demanding firms in aerospace, medical and other advanced markets. The quote doesn't refer to strange dietary habits but to its confidence in '*taking on the challenges normally seen as impossible for firms of our size*' – a capability which is grounded in a culture of innovation in products and the processes which go to produce them.

At the other end of the scale Kumba Resources is a large South African mining company which makes another dramatic claim – '*We move mountains*'. In their case the mountains contain iron ore and their huge operations require large-scale excavation – and restitution of the landscape afterwards. Much of their business involves complex large-scale machinery – and their ability to keep it running and productive depends on a workforce able to contribute their innovative ideas on a continuing basis.[1]

Innovation is driven by the ability to see connections, to spot opportunities and to take advantage of them. When the Tasman Bridge collapsed in Hobart, Tasmania, in 1975 Robert Clifford was running a small ferry company and saw an opportunity to capitalize on the increased demand for ferries – and to differentiate his offering by selling drinks to thirsty cross-city commuters. The same entrepreneurial flair later helped him build a company – Incat – which pioneered the wave-piercing design that helped them capture over half the world market for fast catamaran ferries. Continuing investment in innovation has helped this company from a relatively isolated island build a key niche in highly competitive international military and civilian markets (`www.incat.com.au`).

But innovation is not just about opening up new markets – it can also offer new ways of serving established and mature ones. Despite a global shift in textile and clothing manufacture towards developing countries the Spanish company, Inditex (through its retail outlets under various names including Zara), has pioneered a highly flexible, fast turnaround clothing operation with over 2000 outlets in 52 countries. It was founded by Amancio Ortega Gaona who set up a small operation in the west of Spain in La Coruña – a region not previously noted for textile production – and the first store opened there in 1975. Central to the Inditex philosophy is close linkage between design, manufacture and retailing and its network of stores constantly feeds back information about trends, which are used to generate new designs. Inditex also experiments with new ideas directly on the public, trying samples of cloth or design and quickly getting back indications of what is going to catch on. Despite its global orientation,

most manufacturing is still done in Spain, and the company has managed to reduce the turnaround time between a trigger signal for an innovation and responding to it to around 15 days.

Of course, technology often plays a key role in enabling radical new options. Magink is a company set up in 2000 by a group of Israeli engineers and is now part of the giant Mitsubishi concern. Its business is in exploiting the emerging field of digital ink technology – essentially enabling paper-like display technology for indoor and outdoor displays. These have a number of advantages over other displays such as liquid crystal – low cost, high-viewing angles and high visibility even in full sunlight. One of its major new lines of development is in advertising billboards – a market worth $5 billion in the USA alone – where the prospect of 'programmable hoardings' is now opened up. Magink enables high-resolution images that can be changed much more frequently than conventional paper advertising, and permit billboard site owners to offer variable price time slots, much as television does at present.[2]

At the other end of the technological scale there is scope for improvement on an old product, often using old technologies in new ways. People have always needed artificial limbs and the demand has, sadly, significantly increased as a result of high-technology weaponry such as mines. The problem is compounded by the fact that many of those requiring new limbs are also in the poorest regions of the world and unable to afford expensive prosthetics. The chance meeting of a young surgeon, Dr Pramod Karan Sethi, and a sculptor, Ram Chandra, in a hospital in Jaipur, India, has led to the development of a solution to this problem – the Jaipur foot. This artificial limb was developed using Chandra's skill as a sculptor and Sethi's expertise and is so effective that those who wear it can run, climb trees and pedal bicycles. It was designed to make use of low-tech materials and be simple to assemble – for example, in Afghanistan craftsmen hammer the foot together out of spent artillery shells whilst in Cambodia part of the foot's rubber components are scavenged from truck tyres. Perhaps the greatest achievement has been to do all of this for a low cost – the Jaipur foot costs only $28 in India. Since 1975, nearly 1 million people worldwide have been fitted for the Jaipur limb and the design is being developed and refined, for example, using advanced new materials.[3]

Innovation is of course not confined to manufactured products; plenty of examples of growth through innovation can be found in services.[4–6] In banking the UK First Direct organization became the most competitive bank, attracting around 10 000 new customers each month by offering a telephone banking service backed up by sophisticated IT – a model which eventually became the industry standard. A similar approach to the insurance business – Direct Line – radically changed the basis of that market and led to widespread imitation by all the major players in the sector.[7,8] Internet-based retailers such as Amazon have changed the ways in which products as diverse as books, music and travel are sold, whilst firms like eBay have brought the auction house into many living rooms.

Public services such as healthcare, education and social security may not generate profits but they do affect the quality of life for millions of people. Bright ideas well implemented can lead to valued new services and the efficient delivery of existing ones – at a time when pressure on national purse strings is becoming ever tighter.[9] New ideas – whether wind-up radios in Tanzania or micro-credit financing schemes in Bangladesh – have the potential to change the quality of life and the availability of opportunity for people in some of the poorest regions of the world. There's plenty of scope for innovation and entrepreneurship – and at the limit – about real matters of life and death. For example, the Karolinska Hospital in Stockholm has managed to make radical improvements in the speed, quality and effectiveness of its care services – such as cutting waiting lists by 75% and cancellations by 80% – through innovation.[10] Public-sector innovations have included the postage stamp, the National Health Service in the UK, and much of the early development work behind technologies like fibre optics, radar and the Internet.

1.2 Why innovation matters

What these organizations have in common is that their success derives in large measure from innovation. Whilst competitive advantage can come from size, or possession of assets, etc. the pattern is increasingly coming to favour those organizations that can mobilize knowledge and technological skills and experience to create novelty in their offerings (product/service) and the ways in which they create and deliver those offerings.

Innovation matters, not only at the level of the individual enterprise but also increasingly as the wellspring for national economic growth. In a recent book Baumol pointed out that '*virtually all of the economic growth that has occurred since the eighteenth century is ultimately attributable to innovation*'.[11] The magazine *Business Week* regularly features its list of the top innovative firms in the world. It found that the median profit margin of the top 25 firms was 3.4% in the period 1995–2005 whereas the average for other firms in the S&P Global Index was only 0.4%. Similarly the median annual stock return was 14.3% for the innovators and 11.3% for the rest.[12] Another study by the consultancy Innovaro suggested that 'innovation leaders' had strong links between innovative activities and business performance. Its top five firms were Apple, Nokia, Google, Adidas and Reckitt Benckiser – all noted for different but distinctive innovation performance and the increase of their share prices over the year 2006–7 by between 25% and 135%. This was not just short-term success – these firms had sustained share price growth for the preceding seven years.[13]

Importantly innovation and competitive success are not simply about high-technology companies, for example, the German firm Wurth is the largest maker of screws (and other fastenings such as nuts and bolts) in the world with a turnover of $14 billion. Despite low-cost competition from China, the company has managed to stay ahead through an emphasis on product and process innovation across a supplier network similar to the model used by Dell in computers.[14]

Innovation is becoming a central plank in national economic policy – for example, the UK Office of Science and Innovation sees it as '*the motor of the modern economy, turning ideas and knowledge into products and services*'.[15] An Australian government website (`www.dest.gov.au/sectors/science_innovation`) puts the case equally strongly: '*Companies that do not invest in innovation put their future at risk. Their business is unlikely to prosper, and they are unlikely to be able to compete if they do not seek innovative solutions to emerging problems.*'

According to *Statistics Canada*,[16] the following factors characterize successful small- and medium-sized enterprises:

- *Innovation is consistently found to be the most important characteristic associated with success.*
- *Innovative enterprises typically achieve stronger growth or are more successful than those that do not innovate.*
- *Enterprises that gain market share and increasing profitability are those that are innovative.*

Not surprisingly this rationale underpins a growing set of policy measures designed to encourage and nurture innovation at regional and national level.

The survival/growth question poses a problem for established players but provides a huge opportunity for newcomers to rewrite the rules of the game. One person's problem is another's opportunity and the nature of innovation is that it is fundamentally about *entrepreneurship*. The skill to spot opportunities and create new ways to exploit them is at the heart of the innovation process. Entrepreneurs are risk-takers – but they calculate the costs of taking forward a bright idea against the potential gains if they succeed in doing something different – especially if that involves upstaging the players already in the game.

Innovation contributes in several ways. For example, research evidence suggests a strong correlation between market performance and new products.[17, 18] New products help capture and retain market shares, and increase profitability in those markets. In the case of more mature and established products, competitive sales growth comes not simply from being able to offer low prices but also from a variety of non-price factors – design, customization and quality.[7] And in a world of shortening product life cycles – where, for example, the life of a particular model of television set or computer is measured in months, and even complex products like motor cars now take only a couple of years to develop – being able to replace products frequently with better versions is increasingly important.[19] 'Competing in time' reflects a growing pressure on firms not just to introduce new products but also to do so faster than competitors.[20]

At the same time new product development is an important capability because the environment is constantly changing. Shifts in the socioeconomic field (in what people believe, expect, want and earn) create opportunities and constraints. Legislation may open up new pathways, or close down others, for example, increasing the requirements for environmentally friendly products. Competitors may introduce new products, which represent a major threat to existing market positions. In all these ways firms need the capability to respond through product innovation.

Whilst new products are often seen as the cutting edge of innovation in the marketplace, *process* innovation plays just as important a strategic role. Being able to make something no one else can, or to do so in ways that are better than anyone else, is a powerful source of advantage. For example, the Japanese dominance in the late twentieth century across several sectors – cars, motorcycles, shipbuilding, consumer electronics – owed a great deal to superior abilities in manufacturing – something which resulted from a consistent pattern of process innovation. The Toyota production system and its equivalent in Honda and Nissan led to performance advantages of around two to one over average car makers across a range of quality and productivity indicators.[21] One of the main reasons for the ability of relatively small firms like Oxford Instruments or Incat to survive in highly competitive global markets is the sheer complexity of what they make and the huge difficulties a new entrant would encounter in trying to learn and master their technologies.

Similarly, being able to offer better service – faster, cheaper, higher quality – has long been seen as a source of competitive edge. Citibank was the first bank to offer automated telling machinery (ATM) services and developed a strong market position as a technology leader on the back of this process innovation. Benetton is one of the world's most successful retailers, largely due to its sophisticated IT-led production network, which it innovated over a 10-year period,[22] and the same model has been used to great effect by the Spanish firm Zara. Southwest Airlines achieved an enviable position as the most effective airline in the USA despite being much smaller than its rivals; its success was due to process innovation in areas such as reducing airport turnaround times.[23] This model has subsequently become the template for a whole new generation of low-cost airlines whose efforts have revolutionized the once-cosy world of air travel.

Importantly we need to remember that the advantages which flow from these innovative steps gradually get competed away as others imitate. Unless an organization is able to move into further innovation, it risks being left behind as others take the lead in changing their offerings, their operational processes or the underlying models that drive their business. For example, leadership in banking has passed to others, particularly those who were able to capitalize early on the boom in information and communications technologies; in particular many of the lucrative financial services like securities and share dealing have been dominated by players with radical new models such as Charles Schwab.[24] As all retailers adopt advanced IT so the lead shifts to those who are able – like Zara and Benetton – to streamline their production operations to respond rapidly to the signals flagged by the IT systems.

BOX 1.1

The innovation imperative

In the mid-1980s a study by Shell suggested that the average corporate survival rate for large companies was only about half as long as that of a human being. Since then the pressures on firms have increased enormously from all directions – with the inevitable result that business life expectancy is reduced still further. Many studies look at the changing composition of key indices and draw attention to the demise of what were often major firms and in their time key innovators. For example, Foster and Kaplan point out that of the 500 companies originally making up the Standard & Poor 500 list in 1957, only 74 remained on the list through to 1997.[24] Of the top 12 companies which made up the Dow Jones Index in 1900 only one – General Electric – survives today. Even apparently robust giants like IBM, GM or Kodak can suddenly display worrying signs of mortality, whilst for small firms the picture is often considerably worse since they lack the protection of a large resource base.

Some firms have had to change dramatically to stay in business. For example, a company founded in the early nineteenth century, which had Wellington boots and toilet paper amongst its product range, is now one of the largest and most successful in the world in the telecommunications business. Nokia began life as a lumber company, making the equipment and supplies needed to cut down forests in Finland. It moved through into paper and from there into the 'paperless office' world of IT – and from there into mobile telephones.

Another mobile phone player – Vodafone Airtouch – grew to its huge size by merging with a firm called Mannesman which, since its birth in the 1870s, has been more commonly associated with the invention and production of steel tubes! TUI owns Thomson (the travel group) in the UK, and is the largest European travel and tourism services company. Its origins, however, lie in the mines of old Prussia where it was established as a public sector state lead mining and smelting company![25]

CASE STUDY 1.1

The changing nature of the music industry

1 April 2006. Apart from being a traditional day for playing practical jokes, this was the day on which another landmark in the rapidly changing world of music was reached. 'Crazy' – a track by Gnarls Barkley – made pop history as the UK's first song to top the charts based on download sales alone. Commenting on the fact that the song had been downloaded more than 31 000 times but was only released for sale in the shops on 3 April, Gennaro Castaldo, spokesman for retailer HMV, said: '*This not only represents a watershed in how the charts are compiled, but shows that legal downloads have come of age . . . if physical copies fly off the shelves at the same rate it could vie for a place as the year's biggest seller*'.

One of the less visible but highly challenging aspects of the Internet is the impact it has had – and is having – on the entertainment business. This is particularly the case with music. At one level its impacts could be assumed to be confined to providing new 'e-tailing' channels through which you can obtain the latest CD of your preference – for example from Amazon or CD-Now or 100 other websites. These innovations increase the choice and tailoring of the

music-purchasing service and demonstrate some of the 'richness/reach' economic shifts of the new Internet game.

But beneath this updating of essentially the same transaction lies a more fundamental shift – in the ways in which music is created and distributed and in the business model on which the whole music industry is currently predicated. In essence the old model involved a complex network where songwriters and artists depended on A&R (artists and repertoire) staff to select a few acts, production staff who would record in complex and expensive studios, other production staff who would oversee the manufacture of physical discs, tapes and CDs, and marketing and distribution staff who would ensure the product was publicized and disseminated to an increasingly global market.

Several key changes have undermined this structure and brought with it significant disruption to the industry. Old competencies may no longer be relevant – whilst acquiring new ones becomes a matter of urgency. Even well-established names like Sony find it difficult to stay ahead when new entrants are able to exploit the economics of the Internet. At the heart of the change is the potential for creating, storing and distributing music in digital format – a problem which many researchers have worked on for some time. One solution, developed by one of the Fraunhofer Institutes in Germany, is a standard based on the Motion Picture Experts Group (MPEG) level 3 protocol – MP3. MP3 offers a powerful algorithm for managing one of the big problems in transmitting music files – that of compression. Normal audio files cover a wide range of frequencies and are thus very large and not suitable for fast transfer across the Internet – especially with a population who may only be using relatively slow modems. With MP3 effective compression is achieved by cutting out those frequencies which the human ear cannot detect – with the result that the files to be transferred are much smaller.

Therefore MP3 files can be moved across the Internet quickly and shared widely. Various programs exist for transferring normal audio files and inputs – such as CDs – into MP3 and back again.

What does this mean for the music business? In the first instance aspiring musicians no longer need to depend on being picked up by A&R staff from major companies who can bear the costs of recording and production of a physical CD. Instead they can use home recording software and either produce a CD themselves or else go straight to MP3 – and then distribute the product globally via newsgroups, chatrooms, etc. In the process they effectively create a parallel and much more direct music industry, which leaves existing players and artists on the sidelines.

Such changes are not necessarily threatening. For many people the lowering of entry barriers has opened up the possibility of participating in the music business, for example, by making and sharing music without the complexities and costs of a formal recording contract and the resources of a major record company. There is also scope for innovation around the periphery, for example in the music publishing sector where sheet music and lyrics are also susceptible to lowering of barriers through the application of digital technology. Journalism and related activities become increasingly open – now music reviews and other forms of commentary are possible via specialist user groups and channels on the web whereas before they were the province of a few magazine titles. Compiling popularity charts – and the related advertising – is also opened up as the medium switches from physical CDs and tapes distributed and sold via established channels to new media such as MP3 distributed via the Internet.

As if this were not enough the industry is also challenged from another source – the sharing of music between different people connected via the Internet. Although technically illegal this practice of sharing between people's record collections has always taken place – but not on the scale which the Internet threatens to facilitate. Much of the established music industry is concerned with legal issues – how to protect copyright and how to ensure that royalties are paid in the right proportions to those who participate in production and distribution. But when people can share music in MP3 format and distribute it globally the potential for policing the system and collecting royalties becomes extremely difficult to sustain.

It has been made much more so by another technological development – that of peer-to-peer or P2P networking. Sean Fanning, an 18-year-old student with the nickname 'the Napster', was intrigued by the challenge of enabling his friends to 'see' and share between their own personal record collections. He argued that if they held these in MP3 format then it should be possible to set up some kind of central exchange program which facilitated their sharing.

The result – the Napster.com site – offered sophisticated software that enabled P2P transactions. The Napster server did not actually hold any music on its files – but every day millions of swaps were made by people around the world exchanging their music collections. Needless to say this posed a huge threat to the established music business since it involved no payment of royalties. A number of high-profile lawsuits followed but whilst Napster's activities have been curbed the problem did not go away. There are now many other sites emulating and extending what Napster started – sites such as Gnutella, Kazaa and Limewire took the P2P idea further and enabled exchange of many different file formats – text, video, etc. In Napster's own case the phenomenally successful site concluded a deal with entertainment giant Bertelsman that paved the way for subscription-based services to provide some revenue stream to deal with the royalty issue.

Expectations that legal protection would limit the impact of this revolution have been dampened by a US Court of Appeal ruling which rejected claims that P2P violated copyright law. Their judgement said, '*History has shown that time and market forces often provide equilibrium in balancing interests, whether the new technology be a player piano, a copier, a tape recorder, a video recorder, a PC, a karaoke machine or an MP3 player*' (*Personal Computer World*, November 2004, p. 32).

Significantly the new opportunities opened up by this were seized not by music industry firms but by computer companies, especially Apple. In parallel with the launch of its successful iPod personal MP3 player Apple opened a site called iTunes which offered users a choice of thousands of tracks for download at 99 cents each. In its first weeks of operation it recorded 1 million hits. In February 2006 the billionth song ('Speed of Sound') was purchased as part of Coldplay's 'X&Y' album by Alex Ostrovsky from West Bloomfield, Michigan. '*I hope that every customer, artist, and music company executive takes a moment today to reflect on what we've achieved together during the past three years,*' said Steve Jobs, Apple's CEO. '*Over one billion songs have now been legally purchased and downloaded around the globe, representing a major force against music piracy and the future of music distribution as we move from CDs to the Internet.*'

This has been a dramatic shift, reaching the point where more singles were bought as downloads in 2005 than as CDs, and where new players are beginning to dominate the game – for example, Tesco and Microsoft. And the changes don't stop there. In February 2006 the Arctic

Monkeys topped the UK album charts and walked off with a fistful of awards from the music business – yet their rise to prominence had been entirely via 'viral marketing' across the Internet rather than by conventional advertising and promotion. Playing gigs around the northern English town of Sheffield, the band simply gave away CDs of their early songs to their fans, who then obligingly spread them around on the Internet. '*They came to the attention of the public via the Internet, and you had chat rooms, everyone talking about them*,' says a slightly worried Gennaro Castaldo of HMV Records. David Sinclair, a rock journalist suggests that '*It's a big wakeup call to all the record companies, the establishment, if you like . . . This lot caught them all napping . . . We are living in a completely different era, which the Arctic Monkeys have done an awful lot to bring about.*'

The writing may be on the wall for the music industry in the same way as the low-cost airline business has transformed the travel business. And behind the music business the next target may be the movie and entertainment industry where there are already worrying similarities. Or the growing computer games sector with shifts towards more small-scale developers emulating the Arctic Monkeys and using viral marketing to build a sales base.

With the rise of the Internet the scope for service innovation has grown enormously – not for nothing is it sometimes called 'a solution looking for problems'. As Evans and Wurster point out, the traditional picture of services being either offered as a standard to a large market (high 'reach' in their terms) or else highly specialized and customized to a particular individual able to pay a high price (high 'richness') is 'blown to bits' by the opportunities of web-based technology. Now it becomes possible to offer both richness and reach at the same time – and thus to create totally new markets and disrupt radically those which exist in any information-related businesses.[26]

The challenge that the Internet poses is not only one for the major banks and retail companies, although those are the stories which hit the headlines. It is also an issue – and quite possibly a survival one – for thousands of small businesses. Think about the local travel agent and the cosy way in which it used to operate. Racks full of glossy brochures through which people could browse, desks at which helpful sales assistants sort out the details of selecting and booking a holiday, procuring the tickets, arranging insurance and so on. And then think about how all of this can be accomplished at the click of a mouse from the comfort of home – and that it can potentially be done with more choice and at lower cost. Not surprisingly, one of the biggest growth areas in dotcom start-ups was the travel sector and whilst many disappeared when the bubble burst, others like lastminute.com and Expedia have established themselves as mainstream players.

Of course, not everyone wants to shop online and there will continue to be scope for the high-street travel agent in some form – specializing in personal service, acting as a gateway to the Internet-based services for those who are uncomfortable with computers, etc. And, as we have seen, the early euphoria around the dotcom bubble has given rise to a much more cautious advance in Internet-based business. The point is that whatever the dominant technological, social or market conditions, the key to creating – and sustaining – competitive advantage is likely to lie with those organizations which continually innovate.

Table 1.1 indicates some of the ways in which enterprises can obtain strategic advantage through innovation.

TABLE 1.1 **Strategic advantages through innovation**

Mechanism	Strategic advantage	Examples
Novelty in product or service offering	Offering something no one else can	Introducing the first . . . Walkman, mobile phone, fountain pen, camera, dishwasher, telephone bank, online retailer . . . to the world
Novelty in process	Offering it in ways others cannot match – faster, lower cost, more customized	Pilkington's float glass process, Bessemer's steel process, Internet banking, online bookselling
Complexity	Offering something which others find it difficult to master	Rolls-Royce and aircraft engines – only a handful of competitors can master the complex machining and metallurgy involved
Legal protection of intellectual property	Offering something others cannot do unless they pay a licence or other fee	Blockbuster drugs like Zantac, Prozac, Viagra
Add/extend range of competitive factors	Move basis of competition, e.g. from price of product to price and quality, or price, quality, choice	Japanese car manufacturing, which systematically moved the competitive agenda from price to quality, to flexibility and choice, to shorter times between launch of new models, and so on – each time not trading these off against each other but offering them all
Timing	First-mover advantage – being first can be worth significant market share in new product fields Fast-follower advantage – sometimes being first means you encounter many unexpected teething problems, and it makes better sense to watch someone else make the early mistakes and move fast into a follow-up product	Amazon, Yahoo – others can follow, but the advantage 'sticks' to the early movers Palm Pilot and other personal digital assistants (PDAs), which have captured a huge and growing share of the market. In fact the concept and design was articulated in Apple's ill-fated Newton product some five years earlier, but problems with software and especially handwriting recognition meant it flopped

(*continued*)

TABLE 1.1 **(Continued)**

Mechanism	Strategic advantage	Examples
Robust platform design	Offering something which provides the platform on which other variations and generations can be built	Walkman architecture – through minidisk, CD, DVD, MP3 Boeing 737 – over 40 years old, the design is still being adapted and configured to suit different users – one of the most successful aircraft in the world in terms of sales Intel and AMD with different variants of their microprocessor families
Rewriting the rules	Offering something which represents a completely new product or process concept – a different way of doing things – and makes the old ones redundant	Typewriters vs. computer word processing, ice vs. refrigerators, electric vs. gas or oil lamps
Reconfiguring the parts of the process	Rethinking the way in which bits of the system work together, e.g. building more effective networks, outsourcing and coordination of a virtual company	Zara, Benetton in clothing, Dell in computers, Toyota in its supply chain management
Transferring across different application contexts	Recombining established elements for different markets	Polycarbonate wheels transferred from application market like rolling luggage into children's toys – lightweight micro-scooters
Others?	Innovation is all about finding new ways to do things and to obtain strategic advantage, so there will be room for new ways of gaining and retaining advantage	Napster. This firm began by writing software which would enable music fans to swap their favourite pieces via P2P networking across the Internet. Although Napster suffered from legal issues, followers developed a huge industry based on downloading and file sharing. The experiences of one of these firms – Kazaa – provided the platform for successful high-volume Internet telephony and the company established with this knowledge – Skype – was eventually sold to eBay for $2.6 billion

1.3 Old question, new context

> *Constant revolutionizing of production, uninterrupted disturbance of all social conditions, everlasting uncertainty . . . all old-established national industries have been destroyed or are daily being destroyed. They are dislodged by new industries . . . whose products are consumed not only at home but in every quarter of the globe. In place of old wants satisfied by the production of the country, we find new wants . . . the intellectual creativity of individual nations become common property.*

This quote does not come from a contemporary journalist or politician but from the *Communist Manifesto*, published by Karl Marx and Friedrich Engels in 1848! But it serves to remind us that the innovation challenge isn't new – organizations have always had to think about changing what they offer the world and the ways they create and deliver that offering if they are to survive and grow. The trouble is that innovation involves a moving target – not only is there competition amongst players in the game but also the overall context in which the game is played out keeps shifting. And whilst many organizations have some tried and tested recipes for playing the game there is always the risk that the rules will change and leave them vulnerable. Changes along several core environmental dimensions mean that the incidence of discontinuities is likely to rise – for example in response to a massive increase in the rate of knowledge production and the consequent increase in the potential for technology-linked instabilities. But there is also a higher level of interactivity amongst these environmental elements – complexity – which leads to unpredictable emergence. For example, the rapidly growing field of voice over Internet protocol (VoIP) communications is not developing along established trajectories towards a well-defined endpoint. Instead it is a process of *emergence*. The broad parameters are visible – the rise of demand for global communication, increasing availability of broadband, multiple P2P networking models, growing technological literacy amongst users – and the stakes are high, both for established fixed-line players (who have much to lose) and new entrants (such as Skype). The dominant design isn't visible yet – instead there is a rich fermenting soup of technological possibilities, business models and potential players from which it will gradually emerge.

CASE STUDY 1.2

The difficulties of a firm like Kodak illustrate the problem. Founded around 100 years ago the basis of the business was the production and processing of film and the sales and service associated with mass-market photography. Whilst the latter set of competencies are still highly relevant (even though camera technology has shifted), the move away from wet physical chemistry conducted in the dark (coating emulsions on to films and paper) to digital imaging represents a profound change for the firm. It needs – across a global operation and a workforce of thousands – to let go of old competencies which are unlikely to be needed in the future whilst at the same time to rapidly acquire and absorb cutting-edge new technologies in electronics and communication. Although strenuous efforts are being made to shift from being a manufacturer of film to becoming a key player in the digital imaging industry and beyond, the response from stock markets suggests some scepticism as to Kodak's ability to do so.

Table 1.2 summarizes some of the key changes in the context within which the current innovation game is being played out.

TABLE 1.2 Changing context for innovation

Context change	Indicative examples
Acceleration of knowledge production	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 'break-through' technological developments may happen
Global distribution of knowledge production	Knowledge production is increasingly involving new players especially in emerging market fields like the BRIC (Brazil, Russia, India, China) nations – so the need to search for innovation opportunities across a much wider space. One consequence of this is that 'knowledge workers' are now much more widely distributed and concentrated in new locations, e.g., Microsoft's third-largest R&D Center employing thousands of scientists and engineers is now in Shanghai
Market fragmentation	Globalization has massively increased the range of markets and segments so that these are now widely dispersed and locally varied – putting pressure on innovation search activity to cover much more territory, often far from 'traditional' experiences, such as the 'bottom of the pyramid' conditions in many emerging markets[3]
Market virtualization	Increasing use of the Internet as marketing channel means different approaches need to be developed. At the same time emergence of large-scale social networks in cyber-space pose challenges in market research approaches, e.g., MySpace currently has over 100 million subscribers. Further challenges arise in the emergence of parallel world communities as a research opportunity, e.g., Second Life now has over 6 million 'residents'
Rise of active users	Although users have long been recognized as a source of innovation there has been an acceleration in the ways in which this is now taking place, e.g., the growth of LINUX has been a user-led open community development.[27] 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.

(*continued*)

TABLE 1.2 (Continued)

Context change	Indicative examples
Development of 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[28, 29]

RESEARCH NOTE Joseph Schumpeter – the 'Godfather' of innovation studies

One of the most significant figures in this area of economic theory was Joseph Schumpeter who wrote extensively on the subject. He had a distinguished career as an economist and served as Minister for Finance in the Austrian government. His argument was simple: entrepreneurs will seek to use technological innovation – a new product/service or a new process for making it – to get strategic advantage. For a while this may be the only example of the innovation so the entrepreneur can expect to make a lot of money – what Schumpeter calls 'monopoly profits'. But of course other entrepreneurs will see what has been achieved and try to imitate it – with the result that other innovations emerge, and the resulting 'swarm' of new ideas chips away at the monopoly profits until an equilibrium is reached. At this point the cycle repeats itself – our original entrepreneur or someone else looks for the next innovation that will rewrite the rules of the game, and off we go again. Schumpeter talks of a process of 'creative destruction' where there is a constant search to create something new which simultaneously destroys the old rules and establishes new ones – all driven by the search for new sources of profits.[30]

In his view '*[What counts is] competition from the new commodity, the new technology, the new source of supply, the new type of organization . . . competition which . . . strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives.*'

1.4 What is innovation?

One of America's most successful innovators was Thomas Alva Edison who registered over 1000 patents. Products for which his organization was responsible include the light bulb, 35 mm cinema film and even the electric chair. Edison appreciated better than most that the real challenge in innovation was not invention – coming up with good ideas – but in making those inventions work technically and commercially. His skill in doing this created a business empire worth, in 1920, around $21.6 billion. He put to good use an understanding of the interactive nature of innovation, realizing that both technology push (which he systematized in one of the world's first organized R&D laboratories) and demand pull need to be mobilized.

His work on electricity provides a good example of this. Edison recognized that although the electric light bulb was a good idea it had little practical relevance in a world where there was no power point to plug it into. Consequently, his team set about building up an entire electricity generation and distribution infrastructure, including designing lamp stands, switches and wiring. In 1882 he switched on the power from the first electric power generation plant in Manhattan and was able to light up 800 bulbs in the area. In the years that followed he built over 300 plants all over the world.[31]

As Edison realized, innovation is more than simply coming up with good ideas: it is the *process* of growing them into practical use. Definitions of innovation may vary in their wording, but they all stress the need to complete the development and exploitation aspects of new knowledge, not just its invention. Some examples are given in the Research Note box below.

If we only understand part of the innovation process, then the behaviours we use in managing it are also likely to be only partially helpful – even if well intentioned and executed. For example, innovation is often confused with invention – but the latter is only the first step in a long process of bringing a good

RESEARCH NOTE What is innovation?

One of the problems in managing innovation is the variation in what people understand by the term, often confusing it with invention. In its broadest sense the term comes from the Latin *innovare* meaning 'to make something new'. Our view, shared by the following writers, assumes that innovation is a process of turning opportunity into new ideas and of putting these into widely used practice.

- 'Innovation is the successful exploitation of new ideas' – Innovation Unit (2004) UK Department of Trade and Industry.
- 'Industrial innovation includes the technical, design, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment' – Chris Freeman (1982) *The Economics of Industrial Innovation*, 2nd edition, Pinter, London.
- '. . . Innovation does not necessarily imply the commercialization of only a major advance in the technological state of the art (a radical innovation) but it includes also the utilization of even small-scale changes in technological know-how (an improvement or incremental innovation)' – Roy Rothwell and Paul Gardiner (1985) Invention, innovation, re-innovation and the role of the user. *Technovation*, **3**, 168.
- 'Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or service. It is capable of being presented as a discipline, capable of being learned, capable of being practised' – Peter Drucker (1985) *Innovation and Entrepreneurship*, Harper & Row, New York.
- 'Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things' – Michael Porter (1990) *The Competitive Advantage of Nations*, Macmillan, London.
- 'An innovative business is one which lives and breathes "outside the box". It is not just good ideas, it is a combination of good ideas, motivated staff and an instinctive understanding of what your customer wants' – Richard Branson (1998) DTI Innovation Lecture.

idea to widespread and effective use. Being a good inventor is – to contradict Emerson* – no guarantee of commercial success and no matter how good the better mousetrap idea, the world will only beat a path to the door if attention is also paid to project management, market development, financial management, organizational behaviour, etc. Case study 1.3 gives some examples which highlight the difference between invention and innovation and that completing the journey is far from easy.

CASE STUDY 1.3

Invention and innovation

Some of the most famous inventions of the nineteenth century came from men whose names are forgotten; the actual names we associate with the products are of the entrepreneurs who brought them into commercial use. For example, the vacuum cleaner was invented by one J. Murray Spengler and originally called an 'electric suction sweeper'. He approached a leather goods maker in the town who knew nothing about vacuum cleaners but had a good idea of how to market and sell them – a certain W.H. Hoover. Similarly, a Boston man called Elias Howe produce the world's first sewing machine in 1846. Unable to sell his ideas despite travelling to England and trying there, he returned to the USA to find one Isaac Singer had stolen the patent and built a successful business from it. Although Singer was eventually forced to pay Howe a royalty on all machines made, the name which most people now associate with sewing machines is Singer not Howe. And Samuel Morse, widely credited as the father of modern telegraphy, actually invented only the code which bears his name; all the other inventions came from others. What Morse brought was enormous energy and a vision of what could be accomplished; to realize this he combined marketing and political skills to secure state funding for development work, and to spread the concept of something which for the first time would link people separated by vast distances on the continent of America. Within five years of demonstrating the principle there were over 5000 miles of telegraph wire in the USA, and Morse was regarded as 'the greatest man of his generation'.[31]

Innovation isn't easy . . . .

Although innovation is increasingly seen as a powerful way of securing competitive advantage and a more secure approach to defending strategic positions, success is by no means guaranteed. The history of product and process innovations is littered with examples of apparently good ideas which failed – in some cases with spectacular consequences. For example:

- In 1952 Ford engineers began working on a new car to counter the mid-size models offered by GM and Chrysler – the 'E' car. After an exhaustive search for a name involving some 20 000 suggestions the car was finally named after Edsel Ford, Henry Ford's only son. It was not a success; when the first Edsels came off the production line Ford had to spend an average of $10 000 per car (twice the vehicle's cost) to get them roadworthy. A publicity plan was to have 75 Edsels

* *'If a man has good corn, or wood, or boards, or pigs to sell, or can make better chairs or knives, crucibles or church organs than anybody else, you will find a broad-beaten road to his home, though it be in the woods.'* (Entry in his journal 1855, Ralph Waldo Emerson).

drive out on the same day to local dealers; in the event the firm only managed to get 68 to go, whilst in another live TV slot the car failed to start. Nor were these teething troubles; by 1958 consumer indifference to the design and concern about its reputation led the company to abandon the car – at a cost of $450 million and 110,847 Edsels.[31]

- During the latter part of the Second World War it became increasingly clear that there would be a big market for long-distance airliners, especially on the transatlantic route. One UK contender was the Bristol Brabazon, based on a design for a giant long-range bomber, which was approved by the Ministry of Aviation for development in 1943. Consultation with BOAC, the major customer for the new airliner, was 'to associate itself closely with the layout of the aircraft and its equipment' but not to comment on issues like size, range and payload! The budget rapidly escalated, with the construction of new facilities to accommodate such a large plane and, at one stage, the demolition of an entire village in order to extend the runway at Filton, near Bristol. Project control was weak and many unnecessary features were included, for example, the mock-up contained 'a most magnificent ladies' powder room' with wooden aluminium-painted mirrors and even receptacles for the various lotions and powders used by the 'modern young lady'. The prototype took six and a half years to build and involved major technical crises with wings and engine design; although it flew well in tests the character of the post-war aircraft market was very different from that envisaged by the technologists. Consequently in 1952, after flying less than 1000 miles, the project was abandoned at considerable cost to the taxpayer. The parallels with the Concorde project, developed by the same company on the same site a decade later, are hard to escape.
- During the late 1990s revolutionary changes were going on in mobile communications involving many successful innovations – but even experienced players can get their fingers burned. Motorola launched an ambitious venture which aimed to offer mobile communications from literally anywhere on the planet – including the middle of the Sahara Desert or the top of Mount Everest! Achieving this involved a $7 billion project to put 88 satellites into orbit, but despite the costs Iridium – as the venture was known – received investment funds from major backers and the network was established. The trouble was that once the novelty had worn off, most people realized that they did not need to make many calls from remote islands or at the North Pole and that their requirements were generally well met with less exotic mobile networks based around large cities and populated regions. Worse, the handsets for Iridium were large and clumsy because of the complex electronics and wireless equipment they had to contain – and the cost of these hi-tech bricks was a staggering $3000! Call charges were similarly highly priced. Despite the incredible technological achievement which this represented the take-up of the system never happened, and in 1999 the company filed for Chapter 11 bankruptcy. Its problems were not over – the cost of maintaining the satellites safely in orbit was around $2 million per month. Motorola who had to assume the responsibility had hoped that other telecommunications firms might take advantage of these satellites, but after no interest was shown they had to look at a further price tag of $50 million to bring them out of orbit and destroy them safely. Even then the plans to allow them to drift out of orbit and burn up in the atmosphere were criticized by NASA for the risk they might pose in starting a nuclear war, because any pieces which fell to earth would be large enough to trigger Russian anti-missile defences since they might appear not as satellite chunks but Moscow-bound missiles!

1.5 A process view of innovation

In this book we will make use of a simple model of innovation as the *process* of turning ideas into reality and capturing value from them. We will explain the model in more detail in the next chapter but it is worth introducing it here. There are four key phases, each of which requires dealing with particular challenges – and only if we can manage the whole process is innovation likely to be successful.

Phase one involves the question of *search*. To take a biological metaphor, we need to generate variety in our gene pool – and we do this by bringing new ideas to the system. These can come from R&D, 'Eureka' moments, copying, market signals, regulations, competitor behaviour – the list is huge but the underlying challenge is the same – how do we organize an effective search process to ensure a steady flow of 'genetic variety' which gives us a better chance of surviving and thriving?

But simply generating variety isn't enough – we need to *select* from that set of options the variants most likely to help us grow and develop. Unlike natural selection where the process is random we are concerned here with some form of *strategic* choice – out of all the things we could do, what are we going to do – and why? This process needs to take into account competitive differentiation – which choices give us the best chance of standing out from the crowd? – and previous capabilities – can we build on what we already have or is this a step into the unknown?

Generating and selecting still leaves us with the huge problem of actually making it happen – committing our scarce resources and energies to doing something different. This is the challenge of *implementation* – converting ideas into reality. The task is essentially one of managing a growing commitment of resources – time, energy, money and above all mobilizing knowledge of different kinds – against a background of uncertainty. Unlike conventional project management the innovation challenge is about developing something which may never have been done before – and the only way we know whether or not we will succeed is by trying it out.

Here the biological metaphor comes back into play – it is a risky business. We are betting – taking calculated risks rather than random throws of the dice but nonetheless gambling – that we can make this new thing happen (manage the complex project through to successful completion) *and* that it will deliver us the calculated value which exceeds or at least equals what we put into it. If it is a new product or service – the market will rush to our stall to buy what we are offering, or if it is a new process, our internal market will buy into the new way of doing things and we will become more effective as a result. If it is a social innovation, can we manage to make the world a better place in ways which justify the investment we put in?

Viewed in this way the innovation task looks deceptively simple. The big question is, of course, how to make it happen? This has been the subject of intensive study for a long period of time – plenty of practitioners have not only left us their innovations but also some of their accumulated wisdom, lessons about managing the process which they have learned the hard way. And a growing academic community has been working on trying to understand in systematic fashion questions about not only the core process but also the conditions under which it is likely to succeed or fail. This includes knowledge about the kinds of things which influence and help/hinder the process – essentially boiling down to having a clear and focused direction (the underpinning 'why' of the selection stage) and creating the organizational conditions to allow focused creativity.

The end effect is that we have a rich – and convergent – set of recipes which go a long way towards helping answer the practising manager's question when confronted with the problem of organizing and managing innovation – 'What do I do on Monday morning?'. Exploring this in greater detail provides the basis for the rest of the book.

VIEWS FROM THE FRONT LINE

There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.

(Niccolo Machiavelli, *The Prince*, 1532)

Anything that won't sell, I don't want to invent. Its sale is proof of utility, and utility is success.

Everything comes to him who hustles while he waits.

Genius is one percent inspiration and ninety-nine percent perspiration.

I never did anything by accident, nor did any of my inventions come by accident; they came by work.

Make it a practice to keep on the lookout for novel and interesting ideas that others have used successfully. Your idea has to be original only in its adaptation to the problem you are working on.

(Thomas A. Edison)

Managing and innovation did not always fit comfortably together. That's not surprising. Managers are people who like order. They like forecasts to come out as planned. In fact, managers are often judged on how much order they produce. Innovation, on the other hand, is often a disorderly process. Many times, perhaps most times, innovation does not turn out as planned. As a result, there is tension between managers and innovation.

(Lewis Lehro, about the first years at 3M)

In the past, innovation was defined largely by creativity and the development of new ideas. Today the term encompasses coordinated projects directed toward honing these ideas and converting them into developments that boost the bottom line.

(Howard Smith, Computer Sciences Corporation)

To turn really interesting ideas and fledgling technologies into a company that can continue to innovate for years, it requires a lot of disciplines.

(Steve Jobs, Apple Inc.)

Scope for/types of innovation

If innovation is a process we need to consider the output of that process. In what ways can we innovate – what kinds of opportunities exist to create something different and capture value from bringing those ideas into the world?

Sometimes it is about completely new possibilities, for instance, by exploiting radical breakthroughs in technology. For example, new drugs based on genetic manipulation have opened a major new front in the war against disease. Mobile phones, PDAs and other devices have revolutionized where and when we

communicate. Even the humble window pane is the result of radical technological innovation – almost all the window glass in the world is made these days by the Pilkington float glass process which moved the industry away from the time-consuming process of grinding and polishing to get a flat surface.

Equally important is the ability to spot where and how new *markets* can be created and grown. Alexander Graham Bell's invention of the telephone didn't lead to an overnight revolution in communications – that depended on developing the market for person-to-person communications. Henry Ford may not have invented the motor car but in making the Model T – 'a car for Everyman' at a price most people could afford – he grew the mass market for personal transportation. And eBay justifies its multi-billion dollar price tag not because of the technology behind its online auction idea but because it created and grew the market.

Innovation isn't just about opening up new markets – it can also offer new ways of serving established and mature ones. Low-cost airlines are still about transportation, but the innovations which firms like Southwest Airlines, easyJet and Ryanair have introduced have revolutionized air travel and grown the market in the process. One challenging new area for innovation lies in the previously underserved markets of the developing world – the 4 billion people who earn less than $2 per day. The potential for developing radically different innovative products and services aimed at meeting the needs of this vast population at what Prahalad calls 'the bottom of the pyramid' is huge – and the lessons learned may impact on established markets in the developed world as well.[3]

And it isn't just about manufactured products; in most economies the service sector accounts for the vast majority of activity so there is likely to be plenty of scope. Lower capital costs often mean that the opportunities for new entrants and radical change are greatest in the service sector. Online banking and insurance have become commonplace but they have radically transformed the efficiencies with which those sectors work and the range of services they can provide. New entrants riding the Internet wave have rewritten the rule book for a wide range of industrial games, for example, Amazon in retailing, eBay in market trading and auctions, Google in advertising, Skype in telephony. Others have used the web to help them transform business models around things like low-cost airlines, online shopping and the music business.[32]

Four dimensions of innovation space

Essentially we are talking about change, and this can take several forms; for the purposes of this book we will focus on four broad categories: (The video of 'Finnegan's Fish Bar' on the website provides an example of how this 4Ps approach can be used to explore opportunities for innovation in a business.)

- 'Product innovation' – changes in the things (products/services) that an organization offers.
- 'Process innovation' – changes in the ways in which they are created and delivered.
- 'Position innovation' – changes in the context in which the products/services are introduced.
- 'Paradigm innovation' – changes in the underlying mental models which frame what the organization does.

Figure 1.1 shows how these '4Ps' provide the framework for a map of the innovation space available to any organization.[33]

For example, a new design of car, a new insurance package for accident-prone babies and a new home entertainment system would all be examples of product innovation. And change in the manufacturing methods and equipment used to produce the car or the home entertainment system, or in the office procedures and sequencing in the insurance case, would be examples of process innovation.

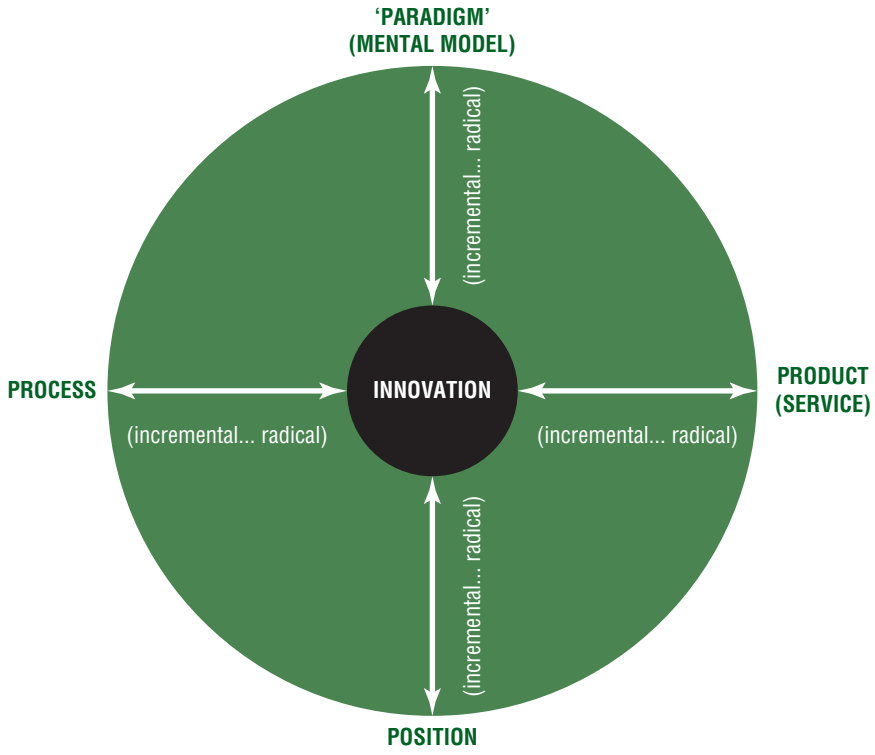


FIGURE 1.1: **The 4Ps of innovation space**

Sometimes the dividing line is somewhat blurred, for example, a new jet-powered sea ferry is both a product and a process innovation. Services represent a particular case of this where the product and process aspects often merge, for example, is a new holiday package a product or process change?

Innovation can also take place by repositioning the perception of an established product or process in a particular user context. For example, an old-established product in the UK is Lucozade – originally developed in 1927 as a glucose-based drink to help children and invalids in convalescence. These associations with sickness were abandoned by the brand owners, Beechams (now part of GSK), when they relaunched the product as a health drink aimed at the growing fitness market where it is now presented as a performance-enhancing aid to healthy exercise. This shift is a good example of 'position' innovation. In similar fashion Häagen-Dazs were able to give a new and profitable lease of life to an old-established product (ice cream) made with well-known processes. Their strategy was to target a different market segment and to reposition their product as a sensual pleasure to be enjoyed by adults – essentially telling an 'ice cream for grown-ups' story.

Sometimes opportunities for innovation emerge when we reframe the way we look at something. Henry Ford fundamentally changed the face of transportation not because he invented the motor car (he was a comparative latecomer to the new industry) or because he developed the manufacturing process to put one together (as a craft-based specialist industry car making had been established for around 20 years). His contribution was to change the underlying model from one which offered a handmade specialist product to a few wealthy customers to one which offered a car for everyone at a price they could afford. The ensuing shift from craft to mass production was nothing short of a revolution in the

way cars (and later countless other products and services) were created and delivered.[21] Of course making the new approach work in practice also required extensive product and process innovation, for example, in component design, in machinery building, in factory layout and particularly in the social system around which work was organized. See Model T case study available on the web.

Recent examples of 'paradigm' innovation – changes in mental models – include the shift to low-cost airlines, the provision of online insurance and other financial services, and the repositioning of drinks like coffee and fruit juice as premium 'designer' products. Although in its later days Enron became infamous for financial malpractice it originally came to prominence as a small gas pipeline contractor which realized the potential in paradigm innovation in the utilities business. In a climate of deregulation and with global interconnection through grid distribution systems, energy and other utilities such as telecommunications bandwidth increasingly became commodities which could be traded much as sugar or cocoa futures.[34]

In their book *Wikinomics*, Tapscott and Williams highlight the wave of innovation which follows the paradigm change to 'mass collaboration' via the Internet which builds on social networks and communities. Companies like LEGO and Adidas (see case studies available on the web) are reinventing themselves by engaging their users as designers and builders rather than as passive consumers, whilst others are exploring the potential of virtual worlds like 'Second Life'.[27, 32] Concerns about global warming and sustainability of key resources such as energy and materials are, arguably, setting the stage for some significant paradigm innovation across many sectors as firms struggle to redefine themselves and their offerings to match these major social issues. Table 1.3 gives examples of innovations mapped on to the 4Ps model.

TABLE 1.3 Some examples of innovations mapped on to the 4Ps model.

Innovation type	Incremental – 'do what we do but better'	Radical – 'do something different'
'Product' – what we offer the world	Windows Vista replacing XP – essentially improving on existing software idea VW EOS replacing the Golf – essentially improving on established car design Improved performance incandescent light bulbs	New to the world software, e.g., the first speech recognition program Toyota Prius – bringing a new concept – hybrid engines LED-based lighting, using completely different and more energy efficient principles (see Philips and lightbulb case studies available on the web)
Process – how we create and deliver that offering	Improved fixed-line telephone services Extended range of stock-broking services	Skype and other VoIP systems Online share trading eBay

(*continued*)

TABLE 1.3 **(Continued)**

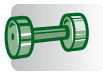
Innovation type	Incremental – 'do what we do but better'	Radical – 'do something different'
	Improved auction house operations Improved factory operations efficiency through upgraded equipment Improved range of banking services delivered at branch banks	Toyota Production System and other 'lean' approaches Mobile banking in Kenya, Philippines – using phones as an alternative to banking systems
Position – where we target that offering and the story we tell about it	Häagen Dazs changing the target market for ice cream from children to consenting adults Low-cost airlines University of Phoenix and others, building large education businesses via online approaches to reach different markets Dell and others segmenting and customizing computer configuration for individual users Banking services targeted at key segments – students, retired people, etc.	Addressing underserved markets, e.g., Tata Nano which targets the huge but relatively poor Indian market using the low-cost airline model – target cost is 1 lakh (around $3000) 'Bottom of the pyramid' approaches using a similar principle – Aravind eye care, Cemex construction products One laptop per child project – the $100 universal computer Microfinance – Grameen Bank opening up credit for the very poor
Paradigm – how we frame what we do	Bausch and Lomb – moved from 'eye wear' to 'eye care' as its business model, effectively letting go of the old business of spectacles, sunglasses and contact lenses all of which were becoming commodity businesses. Instead it moved into newer high-tech fields like laser surgery equipment, specialist optical devices and research into artificial eyesight	Grameen Bank and other microfinance models – rethinking the assumptions about credit and the poor iTunes platform – a complete system of personalized entertainment Rolls-Royce – from high-quality aero engines to becoming a service company offering 'power by the hour'

TABLE 1.3 **(Continued)**

Innovation type	Incremental – 'do what we do but better'	Radical – 'do something different'
	IBM moving from being a machine maker to a service and solution company – selling off its computer making and building up its consultancy and service side VT moving from being a shipbuilder with roots in Victorian times to a service and facilities management business	Cirque du Soleil – redefining the circus experience

Mapping innovation space

The area indicated by the circle in Figure 1.1 is the potential innovation space within which an organization can operate. (Whether it actually explores and exploits all the space is a question for innovation *strategy* and we will return to this theme later in Chapter 3.) See web for 4Ps interactive exercise.



We can use the model to look at where the organization currently has innovation projects – and where it might move in the future. For example, if the emphasis has been on product and process innovation there may be scope for exploring more around position innovation – which new or underserved markets might we play in? Or around defining a new paradigm, a new business model with which to approach the marketplace.

We can also compare maps for different organizations competing in the same market – and use the tool as a way of identifying where there might be relatively unexplored space which might offer significant innovation opportunities. By looking at where other organizations are clustering their efforts we can pick up valuable clues about how to find relatively uncontested space and focus our efforts on these – as the low-cost airlines did with targeting new and underserved markets for travel.[35]

RESEARCH NOTE Mapping innovation space

Figure 1.2 shows how the 4Ps approach was applied in a company (R&P Ltd) making garden machinery. The diamond diagram provides an indication of where and how they could construct a broad-ranging 'innovation agenda'. Nine innovation activities were listed on the diamond chart, including:

- Building totally customized products for customer's individual orders (paradigm).
- Using sensors in the next generation of lawn mowers to avoid roots and stones (product).

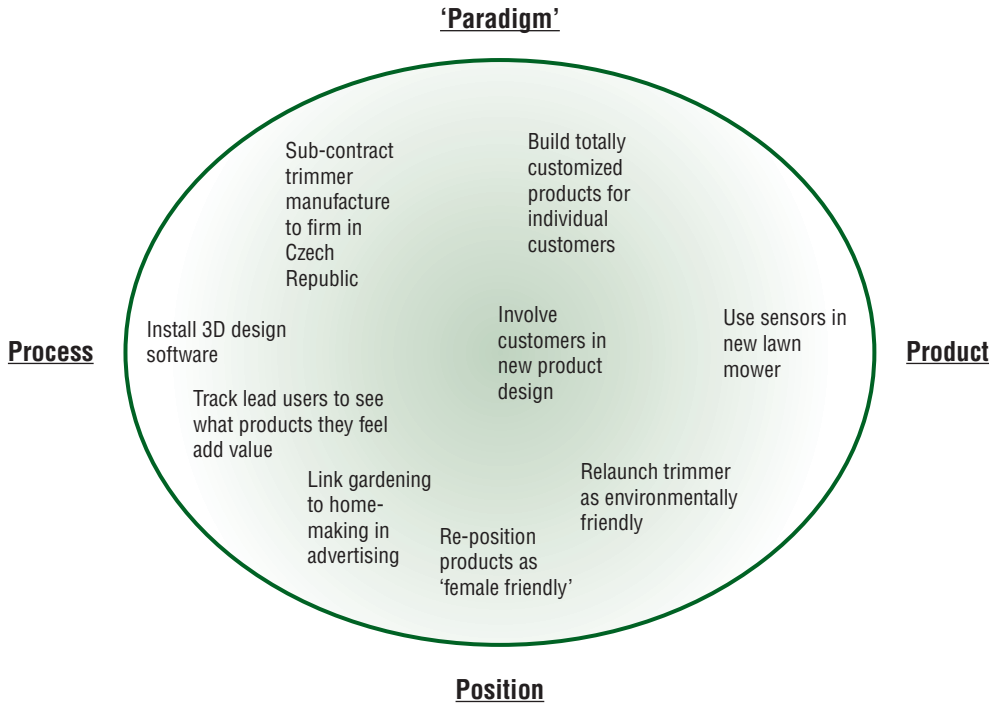


FIGURE 1.2: Suggested innovations mapped on to the 4Ps framework

- Repositioning the company's products as female-friendly as more women are keen gardeners (position).
- Installing 3D design software in the R&D department (process).

The selection of just nine major innovation initiatives gave focus to R&P's innovation management: the firm considered that 'it is important not to try to do too much at once'. Some initiatives, such as relaunching their trimmer as environmentally friendly, require both product and positional innovation. Such interdependencies are clarified by discussion on the placing of an initiative on the diamond diagram. Also, the fact that the senior management group had the 4Ps on one sheet of paper had the effect of enlarging choice – they saw completing the diagram as a tool for helping them think in a systematic way about using the innovation capability of the firm.

Source: based on Francis, D. and J. Bessant (2005) Targeting innovation and implications for capability development. *Technovation*, **25** (3), 171–83.

1.6 Exploring different aspects of innovation

The overall innovation space provides a simple map of the table on which we might place our innovation bets. But before making those bets we should consider some of the other characteristics of innovation which might shape our strategic decisions about where and when to play. These key aspects include:

- Degree of novelty – incremental or radical innovation?
- Platforms and families of innovations.
- Discontinuous innovation – what happens when the rules of the game change?
- Level of innovation – component or architecture?
- Timing – the innovation life cycle.

We will explore these – and the challenges they pose for managing innovation – a little more in the following section.

Incremental innovation – doing what we do but better

A key issue in managing innovation relates to the degree of novelty involved in different places across the innovation space. Clearly, updating the styling on our car is not the same as coming up with a completely new concept car which has an electric engine and is made of new composite materials as opposed to steel and glass. Similarly, increasing the speed and accuracy of a lathe is not the same as replacing it with a computer-controlled laser forming process. There are degrees of novelty in these, running from minor, incremental improvements right through to radical changes which transform the way we think about and use them. Sometimes these changes are common to a particular sector or activity, but sometimes they are so radical and far-reaching that they change the basis of society – for example the role played by steam power in the Industrial Revolution or the ubiquitous changes resulting from today's communications and computing technologies.

As far as managing the innovation process is concerned, these differences are important. The ways in which we approach incremental, day-to-day change will differ from those used occasionally to handle a radical step change in a product or process. But we should also remember that it is the *perceived* degree of novelty which matters; novelty is very much in the eye of the beholder. For example, in a giant, technologically advanced organization like Shell or IBM advanced networked information systems are commonplace, but for a small car dealership or food processor even the use of a simple PC to connect to the Internet may still represent a major challenge.

The reality is that although innovation sometimes involves a discontinuous shift, most of the time it takes place in incremental fashion. Essentially this is product/process improvement along the lines of 'doing what we do, but better' – and there is plenty to commend this approach. For example, the Bic ballpoint pen was originally developed in 1957 but remains a strong product with daily sales of 14 million units worldwide. Although superficially the same shape, closer inspection reveals a host of incremental changes that have taken place in materials, inks, ball technology, safety features, etc. Products are rarely 'new to the world', process innovation is mainly about optimization and getting the bugs out of the system. (Ettlie suggests disruptive or new-to-the-world innovations are only 6% to 10% of all projects labelled innovation.[36]) Studies of incremental process development (such as Hollander's famous study of DuPont rayon plants) suggest that the cumulative gains in efficiency are often much greater over time than those which come from occasional radical changes.[37] Other examples include Tremblay's studies of paper mills,[38] Enos on petroleum refining[39] and Figueredo's of steel plants.[40] For more detailed examples of continuous improvement see Forte, NPI and HBL case studies on web.

Continuous improvement of this kind has received considerable attention in recent years, originally as part of the 'total quality management' movement in the late twentieth century, reflecting the significant gains which Japanese manufacturers were able to make in improving quality and productivity through sustained incremental change.[41] But these ideas are not new – similar principles underpin the

famous 'learning curve' effect where productivity improves with increases in the scale of production; the reason for this lies in the learning and continuous incremental problem-solving innovation which accompanies the introduction of a new product or process.[42] More recent experience of deploying 'lean' thinking in manufacturing and services and increasingly between as well as within enterprises underlines further the huge scope for such continuous innovation.[43] See web for example of continuous improvement tools.

Platform innovation

One way in which the continuous incremental innovation approach can be harnessed to good effect is through the concept of 'platforms'. This is a way of creating stretch and space around an innovation and depends on being able to establish a strong basic platform or family which can be extended. Rothwell and Gardiner give several examples of such 'robust designs' which can be stretched and otherwise modified to extend the range and life of the product, including Boeing airliners and Rolls-Royce jet engines.[44] Major investments by large semiconductor manufacturers like Intel and AMD are amortized to some extent by being used to design and produce a family of devices based on common families or platforms such as the Pentium, Celeron, Athlon or Duron chipsets.[45] Car makers are increasingly moving to produce models, which although apparently different in style, make use of common components and floor pans or chassis. Perhaps the most famous product platform is the 'Walkman' originally developed by Sony as a portable radio and cassette system; the platform concept has come to underpin a wide range of offerings from all major manufacturers for this market and deploying technologies such as minidisk, CD, DVD and now MP3 players.

In processes much has been made of the ability to enhance and improve performance over many years from the original design concepts – in fields like steel making and chemicals, for example. Service innovation offers other examples where a basic concept can be adapted and tailored for a wide range of similar applications without undergoing the high initial design costs – as is the case with different mortgage or insurance products. Sometimes platforms can be extended across different sectors – for example, the original ideas behind 'lean' thinking originated in firms such as Toyota in the field of car manufacturing – but have subsequently been applied across many other manufacturing sectors and into both public and private service applications including hospitals, supermarkets and banks.[43]

Platforms and families are powerful ways for companies to recoup their high initial investments in R&D by deploying the technology across a number of market fields. For example, Procter & Gamble invested heavily in its cyclodextrin development for original application in detergents but then were able to use this technology or variants on it in a family of products including odour control ('Febreze'), soaps and fine fragrances ('Olay'), off-flavour food control, disinfectants, bleaches and fabric softening ('Tide', 'Bounce'). They were also able to license out the technology for use in non-competing areas such as industrial-scale carpet care and in the pharmaceutical industry.

If we take the idea of 'position' innovation mentioned earlier then the role of brands can be seen as establishing a strong platform association which can be extended beyond an initial product or service. For example Richard Branson's Virgin brand has successfully provided a platform for entry into a variety of new fields including trains, financial services, telecommunications and food, whilst Stelios Haji-Ioannou has done something similar with his 'easy' brand, moving into cinemas, car rental, cruises and hotels from the original base in low-cost flying.

In their work on what they call 'management innovation' Hamel highlights a number of core organizational innovations (such as 'total quality management') which have diffused widely across sectors.[46]

These are essentially paradigm innovations which represent concepts that can be shaped and stretched to fit a variety of different contexts – for example Henry Ford's original ideas on mass production became applied and adapted to a host of other industries. McDonald's owed much of its inspiration to him in designing its fast-food business and in turn it was a powerful influence on the development of the Aravind eye clinics in India, which bring low-cost eye surgery to the masses.[3]

Discontinuous innovation – what happens when the game changes?

Most of the time innovation takes place within a set of rules of the game which are clearly understood, and involves players trying to innovate by doing what they have been doing (product, process, position, etc.) but better. Some manage this more effectively than others but the 'rules of the game' are accepted and do not change.[47]

However, occasionally something happens which dislocates this framework and changes the rules. By definition these are not everyday events but they have the capacity to redefine the space and the boundary conditions – they open up new opportunities and challenge existing players to reframe what they are doing in the light of new conditions.[48, 49, 50, 51] This is a central theme in Schumpeter's original theory of innovation which he saw as involving a process of 'creative destruction'.[24, 30]

CASE STUDY 1.4

The melting ice industry

Back in the 1880s there was a thriving industry in the north-eastern United States in the lucrative business of selling ice. The business model was deceptively simple – work hard to cut chunks of ice out of the frozen northern wastes, wrap the harvest quickly and ship it as quickly as possible to the warmer southern states – and increasingly overseas – where it could be used to preserve food. In its heyday this was a big industry – in 1886 the record harvest ran to 25 million tons – and it employed thousands of people in cutting, storing and shipping the product. It was an industry with a strong commitment to innovation – developments in ice cutting, snow ploughs, insulation techniques and logistics underpinned the industry's strong growth. The impact of these innovations was significant – they enabled, for example, an expansion of markets to far-flung locations such as Hong Kong, Bombay and Rio de Janeiro where, despite the distance and journey times, sufficient ice remained of cargoes originally loaded in ports like Boston to make the venture highly profitable.[52]

At the same time researchers like the young Carl von Linde were working in their laboratories on the emerging problems of refrigeration. It wasn't long before artificial ice making became a reality – Joseph Perkins had demonstrated that vaporizing and condensing a volatile liquid in a closed system would do the job and in doing so outlined the basic architecture that underpins today's refrigerators. In 1870 Linde published his research and by 1873 a patented commercial refrigeration system was on the market. In the years which followed the industry grew – in 1879 there were 35 plants and 10 years later 222 making artificial ice. Effectively this development sounded the death knell for the ice-harvesting industry – although it took a long time to go under. For a while both industries grew alongside each other, learning and innovating along their

different pathways and expanding the overall market for ice – for example, by feeding the growing urban demand to fill domestic 'ice boxes'. But inevitably the new technology took over as the old harvesting model reached the limits of what it could achieve in terms of technological efficiencies. Significantly most of the established ice harvesters were too locked into the old model to make the transition and so went under – to be replaced by the new refrigeration industry dominated by new entrant firms.

Change of this kind can come through the emergence of a new technology – like the ice industry example (see Case study 1.4). Or it can come through the emergence of a completely new market with new characteristics and expectations. In his famous studies of the computer disk drive, steel and hydraulic excavator industries Christensen highlights the problems that arise under these conditions. For example, the disk drive industry was a thriving sector in which the voracious demands of a growing range of customer industries meant there was a booming market for disk drive storage units. Around 120 players populated what had become an industry worth $18 billion by 1995 – and like their predecessors in ice harvesting – it was a richly innovative industry. Firms worked closely with their customers, understanding the particular needs and demands for more storage capacity, faster access times, smaller footprints, etc. But just like our ice industry, the virtuous circle around the original computer industry was broken – in this case not by a radical technological shift but also by the emergence of a new market with very different needs and expectations.[53] See web for patterns of discontinuous innovation exercise.

The key point about this sector was that disruption happened not once but several times, involving different generations of technologies, markets and participating firms. For example, whilst the emphasis in the mini-computer world of the mid-1970s was on high performance and the requirement for storage units correspondingly technologically sophisticated, the emerging market for personal computers had a very different shape. These were much less clever machines, capable of running simpler software and with massively inferior performance – but at a price which a very different set of people could afford. Importantly, although simpler, they were capable of doing most of the basic tasks that a much wider market was interested in – simple arithmetical calculations, word processing and basic graphics. As the market grew so learning effects meant that these capabilities improved – but from a much lower cost base. The result was, in the end, just like that of Linde and his contemporaries on the ice industry – but from a different direction. Of the major manufacturers in the disk drive industry serving the mini-computer market only a handful survived – and leadership in the new industry shifted to new entrant firms working with a very different model.

CASE STUDY 1.5

Technological excellence may not be enough . . .

In the 1970s Xerox was the dominant player in photocopiers, having built the industry from its early days when it was founded on the radical technology pioneered by Chester Carlsen and the Battelle Institute. But despite its prowess in the core technologies and continuing investment in maintaining an edge it found itself seriously threatened by a new generation of small copiers

developed by new entrants including several Japanese players. Despite the fact that Xerox had enormous experience in the industry and a deep understanding of the core technology it took them almost eight years of mishaps and false starts to introduce a competitive product. In that time Xerox lost around half its market share and suffered severe financial problems. As Henderson and Clark put it, in describing this case, '*apparently modest changes to the existing technology . . . have quite dramatic consequences*'.[54]

In similar fashion in the 1950s the electronics giant RCA developed a prototype portable transistor-based radio using technologies which it had come to understand well. However, it saw little reason to promote such an apparently inferior technology and continued to develop and build its high-range devices. By contrast Sony used it to gain access to the consumer market and to build a whole generation of portable consumer devices – and in the process acquired considerable technological experience which enabled it to enter and compete successfully in higher value, more complex markets.[55]

Discontinuity can also come about by reframing the way we think about an industry – changing the dominant business model and hence the 'rules of the game'. Think about the revolution in flying which the low-cost carriers have brought about. Here the challenge came via a new business model rather than technology – based on the premise that if prices could be kept low a large new market could be opened up. The power of the new way of framing the business was that it opened up a new – and very different – trajectory along which all sorts of innovations began to happen. In order to make low prices pay a number of problems needed solving – keeping load factors high, cutting administration costs, enabling rapid turnaround times at terminals – but once the model began to work it attracted not only new customers but also increasingly established flyers who saw the advantages of lower prices.

What these – and many other examples – have in common is that they represent the challenge of *discontinuous* innovation. None of the industries were lacking in innovation or a commitment to further change. But the ice harvesters, mini-computer disk companies and the established airlines all carried on their innovation on a stage covered with a relatively predictable carpet. The trouble was that shifts in technology, in new market emergence or in new business models pulled this carpet out from under the firms – and created a new set of conditions on which a new game would be played. Under such conditions, it is the new players who tend to do better because they don't have to wrestle with learning new tricks and letting go of their old ones. Established players often do badly – in part because the natural response is to press even harder on the pedal driving the existing ways of organizing and managing innovation. In the ice industry example the problem was not that the major players weren't interested in R&D – on the contrary they worked really hard at keeping a technological edge in insulation, harvesting and other tools. But they were blindsided by technological changes coming from a different field altogether – and when they woke up to the threat posed by mechanical ice making their response was to work even harder at improving their own ice-harvesting and shipping technologies. It is here that the so-called 'sailing ship' effect can often be observed, in which a mature technology accelerates in its rate of improvement as a response to a competing new alternative – as was the case with the development of sailing ships in competition with newly emerging steamship technology.[56]

In similar fashion the problem for the firms in the disk drive industry wasn't that they didn't listen to customers but rather that they listened too well. They built a virtuous circle of demanding customers

in their existing market place with whom they developed a stream of improvement innovations – continuously stretching their products and processes to do what they were doing better and better. The trouble was that they were getting close to the wrong customers – the discontinuity which got them into trouble was the emergence of a completely different set of users with very different needs and values.

Table 1.4 gives some examples of such triggers for discontinuity. Common to these from an innovation management point of view is the need to recognize that under discontinuous conditions (which thankfully don't emerge every day) we need different approaches to organizing and managing innovation. If we try and use established models which work under steady state conditions we find – as is the reported experience of many – we are increasingly out of our depth and risk being upstaged by new and more agile players.

TABLE 1.4 Sources of discontinuity

Triggers/ sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
New market emerges	Most markets evolve through a process of gradual expansion but at certain times completely new markets emerge which cannot be analysed or predicted in advance or explored through using conventional market research/analytical techniques	Established players don't see it because they are focused on their existing markets May discount it as being too small or not representing their preferred target market – fringe/cranks dismissal Originators of new product may not see potential in new markets and may ignore them, e.g. text messaging	Disk drives, excavators, mini-mills.[53] Mobile phone/SMS where market which actually emerged was not the one expected or predicted by originators
New technology emerges	Step change takes place in product or process technology – may result from convergence and maturing of several streams (e.g. industrial automation, mobile phones) or as a result of a single	Don't see it because beyond the periphery of technology search environment Not an extension of current areas but completely new field or approach	Ice harvesting to cold storage[52] Valves to solid-state electronics[57] Photos to digital images

(*continued*)

TABLE 1.4 **(Continued)**

Triggers/ sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
	breakthrough (e.g. LED as white light source)	Tipping point may not be a single breakthrough but convergence and maturing of established technological streams, whose combined effect is underestimated Not-invented-here effect – new technology represents a different basis for delivering value, e.g. telephone vs. telegraphy	
New political rules emerge	Political conditions which shape the economic and social rules may shift dramatically, e.g., the collapse of communism meant an alternative model (capitalist, competition as opposed to central planning) – and many ex-state firms couldn't adapt their ways of thinking	Old mindset about how business is done, rules of the game, etc. are challenged and established firms fail to understand or learn new rules	Centrally planned to market economy, e.g., former Soviet Union Apartheid to post-apartheid South Africa – inward and insular to externally linked[58] Free trade/globalization results in dismantling protective tariff and other barriers and new competition basis emerges[58, 59]
Running out of road	Firms in mature industries may need to escape the constraints of diminishing space for product and process	Current system is built around a particular trajectory and embedded in a steady-state set of innovation routines which militate against widespread search	Medproducts[60] Kodak Encyclopaedia Britannica[26]

(*continued*)

TABLE 1.4 **(Continued)**

Triggers/ sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
	innovation and the increasing competition of industry structures by either exit or by radical reorientation of their business	or risk-taking experiments	Preussag[25] Mannesmann
Sea change in market sentiment or behaviour	Public opinion or behaviour shifts slowly and then tips over into a new model, e.g., the music industry is in the midst of a (technology-enabled) revolution in delivery systems from buying records, tapes and CDs to direct download of tracks in MP3 and related formats	Don't pick up on it or persist in alternative explanations – cognitive dissonance – until it may be too late	Apple, Napster, Dell, Microsoft vs. traditional music industry[61]
Deregulation/ shifts in regulatory regime	Political and market pressures lead to shifts in the regulatory framework and enable the emergence of a new set of rules, e.g., liberalization, privatization or deregulation	New rules of the game but old mindsets persist and existing player unable to move fast enough or see new opportunities opened up	Old monopoly positions in fields like telecommunications and energy were dismantled and new players/combinations of enterprises emerged. In particular, energy and bandwidth become increasingly viewed as commodities. Innovations include skills in trading and distribution – a factor behind the considerable success of Enron in the late 1990s as it

(*continued*)

TABLE 1.4 **(Continued)**

Triggers/ sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
			emerged from a small gas pipeline business to becoming a major energy trade[34] – unquantifiable chances may need to be taken
Fractures along 'fault lines'	Long-standing issues of concern to a minority accumulate momentum (sometimes through the action of pressure groups) and suddenly the system switches/tips over, e.g., social attitudes to smoking or health concerns about obesity levels and fast foods	Rules of the game suddenly shift and then new pattern gathers rapid momentum wrong-footing existing players working with old assumptions. Other players who have been working in the background developing parallel alternatives may suddenly come into the limelight as new conditions favour them	McDonald's and obesity Tobacco companies and smoking bans Oil/energy companies and global warming Opportunity for new energy sources like wind power, cf. Danish dominance[62]
Unthinkable events	Unimagined and therefore not prepared for events which – sometimes literally – change the world and set up new rules of the game	New rules may disempower existing players or render competencies unnecessary	World Trade Center – 9/11
Business model innovation	Established business models are challenged by a reframing, usually by a new entrant who redefines/reframes the problem and the consequent rules of the game	New entrants see opportunity to deliver product/service via new business model and rewrite rules – existing players have at best to be fast followers	Amazon Charles Schwab[61] Southwest and other low-cost airlines[34, 61, 63]

(*continued*)

TABLE 1.4 **(Continued)**

Triggers/ sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
Shifts in 'techno-economic paradigm' – systemic changes which impact whole sectors or even whole societies	Change takes place at system level, involving technology and market shifts. This involves the convergence of a number of trends which result in a 'paradigm shift' where the old order is replaced	Hard to see where new paradigm begins until rules become established. Existing players tend to reinforce their commitment to old model, reinforced by 'sailing ship' effects	Industrial Revolution[64–66] Mass production
Architectural innovation	Changes at the level of the system architecture rewrite the rules of the game for those involved at component level	Established players develop particular ways of seeing and frame their interactions, e.g., who they talk to in acquiring and using knowledge to drive innovation – according to this set of views. Architectural shifts may involve reframing but at the component level it is difficult to pick up the need for doing so – and thus new entrants better able to work with new architecture can emerge	Photolithography in chip manufacture[54, 67]

Component/architecture innovation and the importance of knowledge

Another important lens through which to view innovation opportunities is as components within larger systems. Rather like Russian dolls we can think of innovations that change things at the level of components or those that involve change in a whole system. For example, we can put a faster transistor on a microchip on a circuit board for the graphics display in a computer. Or we can change the way several boards are put together in the computer to give it particular capabilities – a games box, an e-book, a media PC. Or we can link the computers in a network to drive a small business or office. Or we can link

the networks to others into the Internet. There's scope for innovation at each level – but changes in the higher level systems often have implications for lower down. For example, if cars – as a complex assembly – were suddenly designed to be made out of plastic instead of metal it would still leave scope for car assemblers – but would pose some sleepless nights for producers of metal components! See web for patterns of architecture/component innovation exercise.

Innovation is about knowledge – creating new possibilities through combining different knowledge sets. These can be in the form of knowledge about what is technically possible or what particular configuration would meet an articulated or latent need. Such knowledge may already exist in our experience, based on something we have seen or done before. Or it could result from a process of search – research into technologies, markets, competitor actions, etc. And it could be in explicit form, codified in such a way that others can access it, discuss it, transfer it, etc. – or it can be in tacit form, known about but not actually put into words or formulae.[68]

The process of weaving these different knowledge sets together into a successful innovation is one which takes place under highly uncertain conditions. We don't know what the final innovation configuration will look like (and we don't know how we will get there). Managing innovation is about turning these uncertainties into knowledge – but we can do so only by committing resources to reduce the uncertainty – effectively a balancing act. Figure 1.3 illustrates this process of increasing resource commitment whilst reducing uncertainty.

Viewed in this way we can see that incremental innovation, whilst by no means risk-free, is at least potentially manageable because we are starting from something we know about and developing improvements in it. But as we move to more radical options, uncertainty is higher and we have no prior idea of what we are to develop or how to develop it! Again this helps us understand why discontinuous innovation is so hard to deal with.

A key contribution to our understanding here comes from the work of Henderson and Clark who looked closely at the kinds of knowledge involved in different kinds of innovation.[54] They argue that innovation rarely involves dealing with a single technology or market but rather a bundle of knowledge,

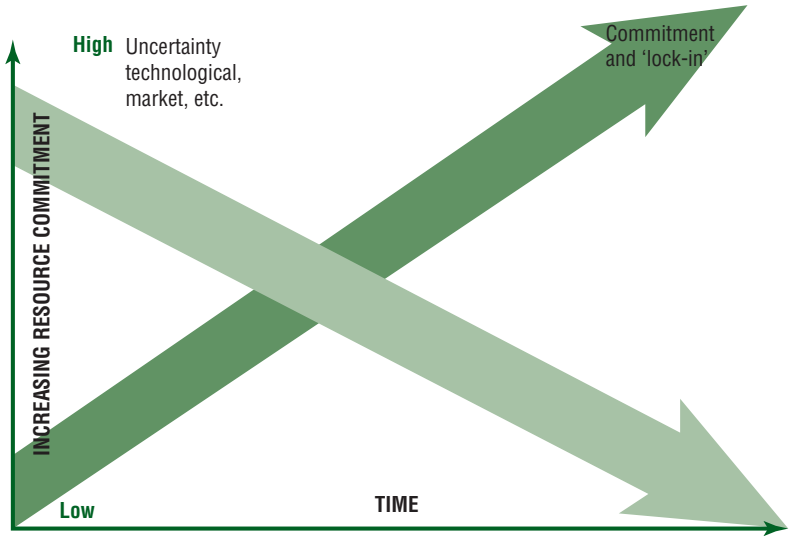


FIGURE 1.3: **Innovation, uncertainty and resource commitment**

which is brought together into a configuration. Successful innovation management requires that we can get hold of and use knowledge about *components* and also about how those can be put together – what they termed the *architecture* of an innovation.

We can see this more clearly with an example. Change at the component level in building a flying machine might involve switching to newer metallurgy or composite materials for the wing construction or the use of fly-by-wire controls instead of control lines or hydraulics. But the underlying knowledge about how to link aerofoil shapes, control systems, propulsion systems, etc. at the *system* level is unchanged – and being successful at both requires a different and higher order set of competencies.

One of the difficulties with this is that innovation knowledge flows – and the structures which evolve to support them – tend to reflect the nature of the innovation. So if it is at component level then the relevant people with skills and knowledge around these components will talk to each other – and when change takes place they can integrate new knowledge. But when change takes place at the higher system level – 'architectural innovation' in Henderson and Clark's terms – then the existing channels and flows may not be appropriate or sufficient to support the innovation and the firm needs to develop new ones. This is another reason why existing incumbents often fare badly when major system level change takes place – because they have the twin difficulties of learning and configuring a new knowledge system and 'unlearning' an old and established one.

Figure 1.4 illustrates the range of choices, highlighting the point that such change can happen at component or sub-system level or across the whole system.

A variation on this theme comes in the field of 'technology fusion', where different technological streams converge, such that products which used to have a discrete identity begin to merge into new architectures. An example here is the home automation industry, where the fusion of technologies such as computing, telecommunications, industrial control and elementary robotics is enabling a new generation of housing systems with integrated entertainment, environmental control (heating, air conditioning, lighting) and communication possibilities.[69, 70]

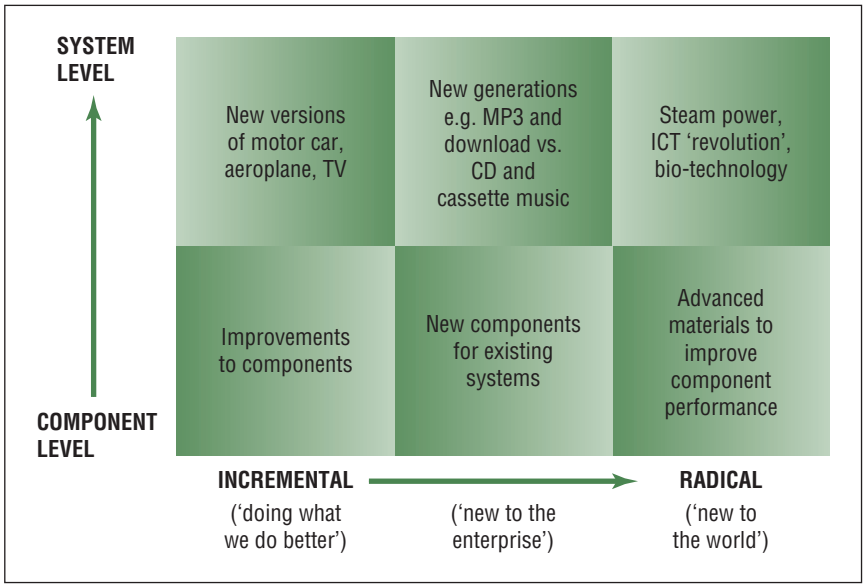


FIGURE 1.4: Dimensions of innovation

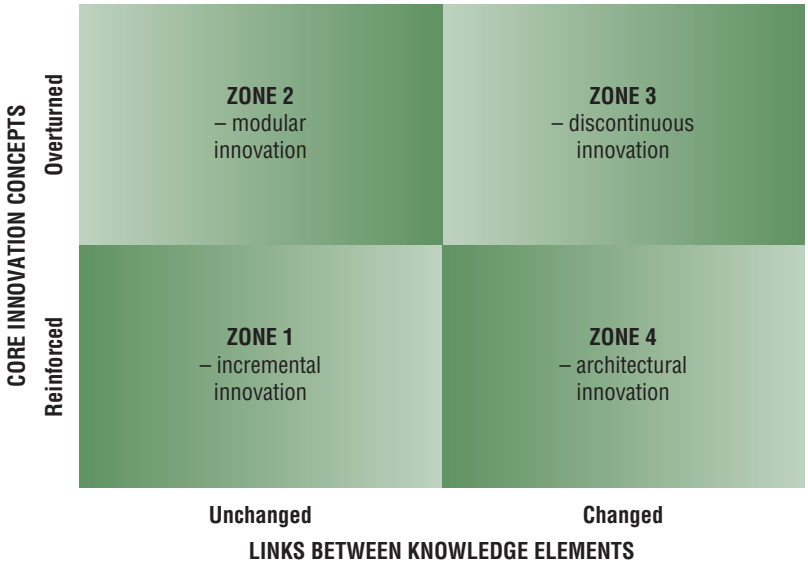


FIGURE 1.5: Component and architectural innovation
Source: Abernathy, W. and J. Utterback (1978) Patterns of industrial innovation. *Technology Review*, **80**, 40–47.

Similarly, a new addition to the range of financial services may represent a component product innovation, but its impacts are likely to be less far-reaching (and the attendant risks of its introduction lower) than a complete shift in the nature of the service package – for example, the shift to direct-line systems instead of offering financial services through intermediaries.

Many businesses are now built on business models that stress integrated solutions – systems of many components which together deliver value to end-users. These are often complex, multi-organization networks – examples might include rail networks, mobile phone systems, major construction projects or design and development of new aircraft like the Boeing Dreamliner or the Airbus A380. Managing innovation on this scale requires development of skills in what Hobday and colleagues call 'the business of systems integration'.[71]

Figure 1.5 highlights the issues for managing innovation. In Zone 1 the rules of the game are clear – this is about steady-state improvement to products or processes and uses knowledge accumulated around core components.

In Zone 2 there is significant change in one element but the overall architecture remains the same. Here there is a need to learn new knowledge but within an established and clear framework of sources and users – for example, moving to electronic ignition or direct injection in a car engine, the use of new materials in airframe components, the use of IT systems instead of paper processing in key financial or insurance transactions. None of these involve major shifts or dislocations.

In Zone 3 we have discontinuous innovation where neither the end state nor the ways in which it can be achieved are known – essentially the whole set of rules of the game changes and there is scope for new entrants.

In Zone 4 we have the condition where new combinations – architectures – emerge, possibly around the needs of different groups of users (as in the disruptive innovation case). Here the challenge is in reconfiguring the knowledge sources and configurations. We may use existing knowledge and recombine

it in different ways or we may use a combination of new and old. Examples might be low-cost airlines and direct-line insurance.

The innovation life cycle – different emphasis over time

We also need to recognize that innovation opportunities change over time. In new industries – like today's biotech, Internet-software or nano-materials – there is huge scope for experimentation around new product and service concepts. But more mature industries tend to focus on process innovation or position innovation, looking for ways of delivering products and services more cheaply or flexibly, or for new market segments into which to sell them. In their pioneering work on this theme Abernathy and Utterback developed a model describing the pattern in terms of three distinct phases (see Figure 1.6).[72]

Initially, under the discontinuous conditions, which arise when completely new technology and/or markets emerge, there is what they term a 'fluid phase' where there is high uncertainty along two dimensions:

- The *target* – what will the new configuration be and who will want it?
- The *technical* – how will we harness new technological knowledge to create and deliver this?

No one knows what the 'right' configuration of technological means and market needs will be and so there is extensive experimentation (accompanied by many failures) and fast learning by a range of players including many new entrepreneurial businesses.

Gradually these experiments begin to converge around what they call a 'dominant design' – something which begins to set up the rules of the game. This represents a convergence around the most popular (importantly not necessarily the most technologically sophisticated or elegant) solution to the emerging configuration. At this point a 'bandwagon' begins to roll and innovation options become increasingly channelled around a core set of possibilities – what Dosi calls a 'technological trajectory'.[64] It becomes increasingly difficult to explore outside this space because entrepreneurial interest and the resources which that brings increasingly focus on possibilities within the dominant design corridor.

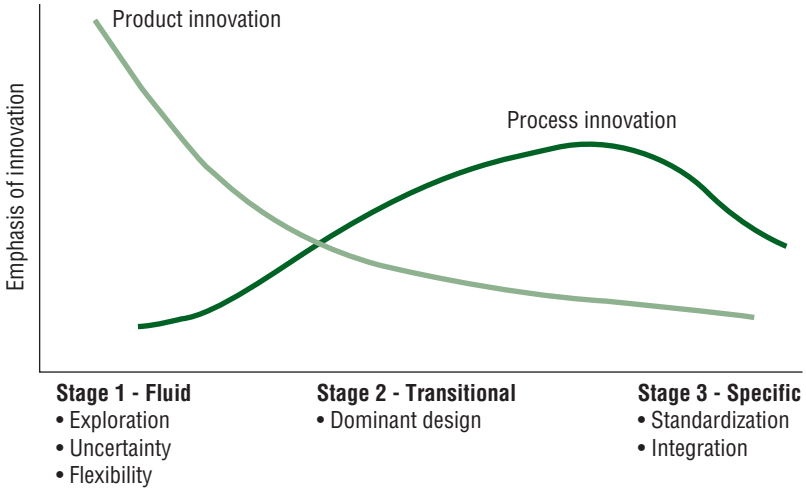


FIGURE 1.6: **Abernathy and Utterback's model of innovation life cycle**

This can apply to products or processes: in both cases the key characteristics become stabilized and experimentation moves to getting the bugs out and refining the dominant design. For example, the nineteenth-century chemical industry moved from making soda ash (an essential ingredient in making soap, glass and a host of other products) from the earliest days where it was produced by burning vegetable matter, through to a sophisticated chemical reaction which was carried out in a batch process (the Leblanc process), which was one of the drivers of the Industrial Revolution. This process dominated for nearly a century but was in turn replaced by a new generation of continuous processes using electrolytic techniques, which originated in Belgium where they were developed by the Solvay brothers. Moving to the Leblanc process or the Solvay process did not happen overnight; it took decades of work to refine and improve each process, and to fully understand the chemistry and engineering required to get consistent high quality and output.

The same pattern can be seen in products. For example, the original design for a camera is something that goes back to the early nineteenth century and – as a visit to any science museum will show – involved all sorts of ingenious solutions. The dominant design gradually emerged with an architecture which we would recognize – shutter and lens arrangement, focusing principles, back plate for film or plates, etc. But this design was then modified still further, for example, with different lenses, motorized drives, flash technology – and, in the case of George Eastman's work – to creating a simple and relatively 'idiot-proof' model camera (the Box Brownie) which opened up photography to a mass market. More recent development has seen a similar fluid phase around digital imaging devices. See web for product lifecycle analysis.

The period in which the dominant design emerges and emphasis shifts to imitation and development is termed the 'transitional phase' in the Abernathy and Utterback model. Activities move from radical concept development to more focused efforts geared around product differentiation and to delivering it reliably, cheaply, with higher quality and extended functionality.

As the concept matures still further so incremental innovation becomes more significant and emphasis shifts to factors such as cost – which means efforts within the industries that grow up around these product areas tend to focus increasingly on rationalization, on scale economies and on process innovation to drive out cost and improve productivity. Product innovation is increasingly about differentiation through customization to meet the particular needs of specific users. Abernathy and Utterback term this the 'specific phase'.

Finally the stage is set for change – the scope for innovation becomes smaller and smaller whilst outside – for example, in the laboratories and imaginations of research scientists – new possibilities are emerging. Eventually a new technology emerges, which has the potential to challenge all the by now well-established rules – and the game is disrupted. In the camera case, for example, this is happening with the advent of digital photography, which is having an impact on cameras and the overall service package around how we get, keep and share our photographs. In our chemical case this is happening with biotechnology and the emergence of the possibility of no longer needing giant chemical plants but instead moving to small-scale operations using live organisms genetically engineered to produce what we need.

Table 1.5 sets out the main elements of this model.

Although originally developed for manufactured products the model also works for services, for example the early days of Internet banking were characterized by a typically fluid phase with many options and models being offered. This gradually moved to a transitional phase, for example building a dominant design consensus on the package of services offered, the levels and nature of security and privacy support, the interactivity of website. The field has now become mature with much of the competition shifting to marginal issues such as relative interest rates. Similar patterns can be seen in VoIP telephony, online auctions such as eBay and travel and entertainment booking services such as Expedia.

TABLE 1.5 **Stages in the innovation life cycle**

Innovation characteristic	Fluid pattern	Transitional phase	Specific phase
Competitive emphasis placed on . . .	Functional product performance	Product variation	Cost reduction
Innovation stimulated by . . .	Information on user needs, technical inputs	Opportunities created by expanding internal technical capability	Pressure to reduce cost, improve quality, etc.
Predominant type of innovation	Frequent major changes in products	Major process innovations required by rising volume	Incremental product and process innovation
Product line	Diverse, often including custom designs	Includes at least one stable or dominant design	Mostly undifferentiated standard products
Production processes	Flexible and inefficient – aim is to experiment and make frequent changes	Becoming more rigid and defined	Efficient, often capital intensive and relatively rigid

We should also remember that there is a long-term cycle involved – mature businesses that have already gone through their fluid and transitional phases do not necessarily stay in the mature phase forever. Rather they become increasingly vulnerable to a new wave of change as the cycle repeats itself – for example, the lighting industry is entering a new fluid phase based on applications of solid-state LED technology but this comes after over 100 years of the incandescent bulb developed by Swan, Edison and others. Their early experiments eventually converged on a dominant product design after which emphasis shifted to process innovation around cost, quality and other parameters – a trajectory that has characterized the industry and led to increasing consolidation amongst a few big players. That may all be about to change driven by a completely new – and much more powerful – technology based on solid-state electronics.

The pattern can be seen in many studies and its implications for innovation management are important. In particular it helps us understand why established organizations often find it hard to deal with the kind of discontinuous change discussed earlier. Organizations build capabilities around a particular trajectory and those who may be strong in the later (specific) phase of an established trajectory often find it hard to move into the new one. (The example of the firms which successfully exploited the transistor in the early 1950s is a good case in point – many were new ventures, sometimes started by enthusiasts in their garage, yet they rose to challenge major players in the electronics industry such as

Raytheon.[57]) This is partly a consequence of sunk costs and commitments to existing technologies and markets and partly because of psychological and institutional barriers. They may respond but in a slow fashion – and they may make the mistake of giving responsibility for the new development to those whose current activities would be threatened by a shift.[73]

Importantly, the 'fluid' or 'ferment' phase is characterized by *coexistence* of old and new technologies and by rapid improvements of both. (It is here that the so-called 'sailing ship' effect mentioned earlier can often be observed, in which a mature technology accelerates in its rate of improvement as a response to a competing new alternative.)

Whilst some research suggests existing incumbents do badly when discontinuous change triggers a new fluid phase, we need to be careful here. Not all existing players do so – many of them are able to build on the new trajectory and deploy/leverage their accumulated knowledge, networks, skills and financial assets to enhance their competence through building on the new opportunity.[53] Equally, whilst it is true that new entrants – often small entrepreneurial firms – play a strong role in this early phase we should not forget that we see only the successful players. We need to remember that there is a strong ecological pressure on new entrants, which means only the fittest or luckiest survive.

It is more helpful to suggest that there is something about the ways in which innovation is *managed* under these conditions that poses problems. Good practice of the 'steady-state' kind described above is helpful in the mature phase but can actively militate against the entry and success in the fluid phase of a new technology.[74] How do enterprises pick up signals about changes if they take place in areas where they don't normally do research? How do they understand the needs of a market which doesn't exist but will shape the eventual package? If they talk to their existing customers the likelihood is that those customers will tend to ask for more of the same, so which new users should they talk to – and how do they find them?

The challenge seems to be to develop ways of managing innovation not only under 'steady-state' but also under the highly uncertain, rapidly evolving and changing conditions resulting from a dislocation or discontinuity. The kinds of organizational behaviour needed here will include things like agility, flexibility, the ability to learn fast and the lack of preconceptions about the ways in which things might evolve – and these are often associated with new small firms. There are ways in which large and established players can also exhibit this kind of behaviour but they often conflict with their normal ways of thinking and working.

Worryingly the source of the discontinuity which destabilizes an industry – new technology, emergence of a new market, rise of a new business model – often comes from outside that industry. So even those large incumbent firms, which take time and resources to carry out research to try and stay abreast of developments in their field, may find that they are wrong-footed by the entry of something that has been developed in a different field. The massive changes in insurance and financial services, which have characterized the shift to online and telephone provision, were largely developed by IT professionals often working outside the original industry.[7] In extreme cases we find what is often termed the 'not-invented-here' (NIH) effect, where a firm finds out about a technology but decides against following it up because it does not fit with its perception of the industry or the likely rate and direction of its technological development. Famous examples of this include Kodak's rejection of the Polaroid process and Western Union's dismissal of Bell's telephone invention. In a famous memo dated 1876 the board commented, 'this "telephone" has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us.'

Managing innovation

This chapter has begun to explore the challenges posed by innovation. It has looked at why innovation matters and opened up some perspectives on what it involves. And it has raised the idea of innovation as a core *process* which needs to be organized and managed in order to enable the renewal of any organization. We talked about this a little earlier in the chapter and Figure 1.7 sets it out as a graphic highlighting the key questions around *managing* innovation.

We've seen that the scope for innovation is wide – in terms of overall innovation space and in the many different ways this can be populated, with both incremental and more radical options. At the limit we have the challenges posed when innovation moves into the territory of discontinuous change and a whole new game begins. We've also looked briefly at concepts such as component and architecture innovation and the critical role that knowledge plays in managing these different forms. Finally we've looked at the issue of timing and of understanding the nature of different innovation types at different stages.

All that gives us a feel for what innovation is and why it matters. But what we now need to do is understand how to organize the innovation process itself. That's the focus of the rest of the book, and we deal with it in the following fashion.

Chapter 2 looks at the process model in more detail and explores the ways in which this generic model can be configured for particular types of organization. It also looks at what we've learned about success and failure in managing innovation – themes which are examined in greater detail in the subsequent chapters.

Part 2 looks at the key contextual issues around successful innovation management. In Chapter 3 we pick up the question: do we have an innovative organization? And examine the role that key concepts such as leadership, structure, communication and motivation play in building and sustaining a culture of focused creativity.

Chapter 4 looks at the question: do we have a clear innovation strategy? And explores this theme in depth. Is there a clear sense of where and how innovation will take the organization forward and is there a roadmap for this? Is the strategy shared and understood – and how can we ensure alignment of the

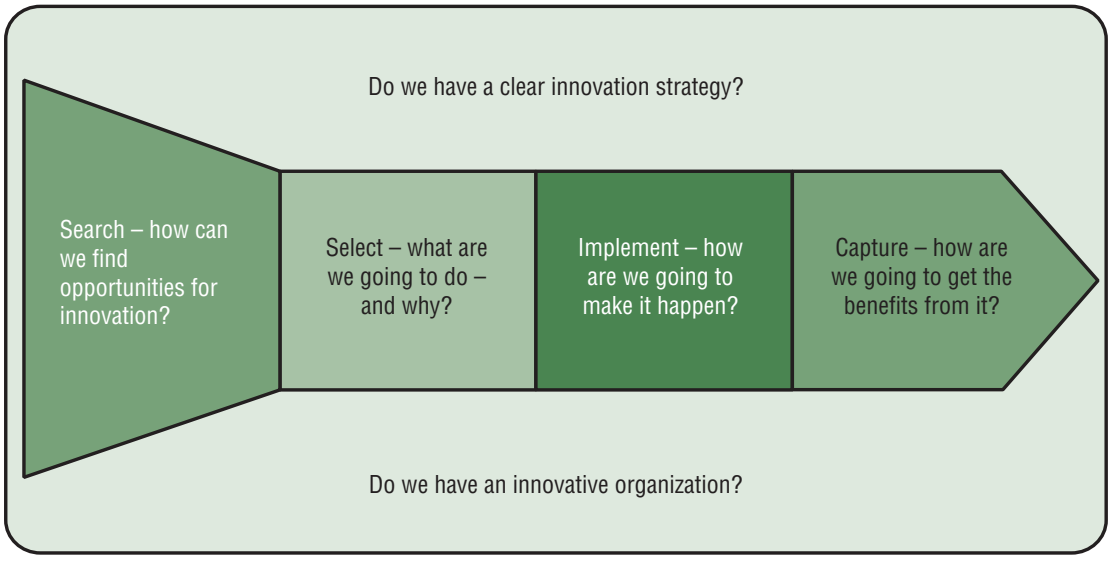


FIGURE 1.7: Simplified model of the innovation process

various different innovation efforts across the organization? What tools and techniques can be used to develop and enable analysis, selection and implementation of innovation?

Part 3 moves on to the first of the core elements in our process model – the 'search' question. Chapter 5 explores the issues around the question of what triggers the innovation process – the multiple sources which we need to be aware of and the challenges involved in searching for and picking up signals from them. Chapter 6 takes up the complementary question: *how* do we carry out this search activity? Which structures, tools and techniques are appropriate under what conditions? How do we balance search around exploration of completely new territory with exploiting what we already know in new forms? In particular it looks at the major challenge of building and sustaining rich networks to enable what has become labelled 'open innovation'.

Part 4 moves into the area of selection in the core process model. Chapter 7 looks at how the innovation decision process works – of all the possible options generated by effective search which ones will we back – and why? Making decisions of this kind is not simple because of the underlying uncertainty involved – so which approaches, tools and techniques can we bring to bear? Chapter 8 picks up another core theme: how to choose and implement innovation options whilst building and capturing value from the intellectual effort involved. Managing intellectual property becomes an increasingly significant issue in a world where knowledge production approaches the $1 trillion/year mark worldwide and where the ability to generate knowledge may be less significant than the ability to trade and use it effectively.

Part 5 looks at the 'implementation' phase, where issues of how we move innovation ideas into reality become central. Chapter 9 examines the ways in which innovation projects of various kinds are organized and managed and explores structures, tools and other support mechanisms to help facilitate this. Chapter 10 picks up the issue of new ventures, both those arising from within the existing organization (corporate entrepreneurship) and those which involve setting up a new entrepreneurial venture.

Part 6 looks at the last phase: how can we ensure that we capture value from our efforts at innovation? Chapter 11 examines questions of adoption and diffusion and the ways we can develop and work with markets for innovation. It picks up on both commercially driven value capture and also the question of 'social entrepreneurship' where concern is less about profits than about creating sustainable social value.

Finally Chapter 12 looks at how we can assess the ways in which we organize and manage innovation and use these to drive a learning process to enable us to do it better next time. The concern here is not just to build a strong innovation management capability but to recognize that – faced with the moving target that innovation represents in terms of technologies, markets, competitors, regulators and so on – the challenge is to create a learning and adaptive approach which constantly upgrades this capability. In other words we are concerned to build 'dynamic capability'.

VIEWS FROM THE FRONT LINE

Where do you see the top three challenges in managing innovation?

1. Creating and sustaining a culture in which innovation can flourish. This includes a physical and organizational space where experimentation, evaluation and examination can take place. The values and behaviours that facilitate innovation have to be developed and sustained.
2. Developing people who can flourish in that environment; people who can question, challenge and suggest ideas as part of a group with a common objective, unconstrained by the day-to-day operational environment.

3. Managing innovation in the midst of a commercial enterprise that is focused on exploitation – maximum benefit from the minimum of resource, that requires repeatability and a right-first-time process approach.

(Patrick McLaughlin, Managing Director, Cerulean – an extended interview with Patrick is on the website)

1. The level at which long-term innovation activities are best conducted, without losing connectedness with the business units at which the innovations should finally be incubated and elaborated
2. Having diverse type of individuals in the company motivated for spending time on innovation-related activities
3. Having the right balance between application-oriented innovation and more fundamental innovation

(Wouter Zeeman, CRH Insulation Europe)

1. Innovation is too often seen as a technically driven issue; in other words the preserve of those strange 'scientific' and 'engineering' people, so it's for them not 'us' the wider community. The challenge is in confronting this issue and hopefully inspiring and changing people's perception so that innovation is OK for all of 'us'.
2. Raising awareness. Coupled with the above people do not fully understand what innovation is or how it applies to their world.
3. Managing in my opinion is either the wrong word or the wrong thing to do; managing implies command and control and whilst important it does not always fit well with the challenge of leading innovation which is far more about inspiring, building confidence and risk taking. Most senior managers are risk averse therefore a solid management background is not always a best fit for the challenge of leading innovation.

(John Tregaskes, Technical Specialist Manager, Serco)

1. Culture – encouraging people to challenge the way we do things and generate creative ideas.
2. Balancing innovation with the levels of risk management and control required in a financial services environment.
3. Ensuring that innovation in one area does not lead to sub-optimization and negative impact in another.

(John Gilbert, Head of Process Excellence, UBS)

1. Alignment of expectations on innovation with senior management. A clear definition of the nature of innovation is required, i.e. radical vs. incremental innovation and the 4Ps. What should be the primary focus?
2. To drive a project portfolio of both incremental (do better) and radical (do different) innovation. How do you get the right balance?
3. To get sufficient, dedicated, human and financial resources up-front.

(John Thesmer, Managing Director, Ictal Care, Denmark)

1. Finding R&D money for far-sighted technology projects at a time when shareholders seem to apply increasing amounts of pressure on companies to deliver short-term results. Every industry needs to keep innovating to stay competitive in the future – and the rate of technological change is accelerating. But companies are being forced to pursue these objectives for less and less money. Managing this difficult balance of 'doing more with less' is a major challenge in our industry, and I am certain that we are not alone.
2. Building a corporate culture that doesn't punish risk-takers. Managers in many organizations seem to be measured almost exclusively according to how well they are performing according to some fairly basic measurements, e.g. sales or number of units. No one would disagree that absorbing new technologies can potentially help to improve these statistics in the long term, but new technologies can be a rather daunting obstacle in the short term. Sometimes technology trials fail. An organization needs to recognize this, and has to lead its teams and managers in a way that encourages a healthy amount of risk without losing control of the big picture.
3. Striking the right balance between in-house R&D and leveraging external innovations. The scope and scale of innovation is growing at a pace that makes it all but unthinkable that any single company can do it all themselves. But which elements should be retained internally vs. which ones can be outsourced? There's never a shortage of people writing papers and books that attempt to address this very topic, but managers in the field are hungrier than ever for useful and practical guidance on this issue.

(Rob Perrons, Shell Exploration, USA)

VIEWS FROM THE FRONT LINE

George Buckley, CEO of 3M, is a PhD chemical engineer by training. 3M has global sales of around $23 billion and historically has aimed to achieve a third of sales from products introduced in the past five years. The famous company culture, the '3M way', includes a policy of allowing employees to spend 15% of their time on their own projects, and has been successfully emulated by other innovative companies such as Google.

He argues that '*Invention is by its very nature a disorderly process, you cannot say I'm going to schedule myself for three good ideas on Wednesday and two on Friday. That's not how creativity works*'.[75] After a focus on improving efficiency, quality and financial performance 2001–6, under its new CEO, 3M is now refocusing on its core innovation capability. Buckley believes that the company had become too dominated by formal quality and measurement processes, to the detriment of innovation: '*. . . you cannot create in that atmosphere of confinement or sameness, perhaps one of the mistakes we have made as a company . . . is that when you value sameness more than you value creativity, I think you potentially undermine the heart and soul of a company like 3M . . .*', and since becoming CEO has significantly increased the spending on R&D from some $1 billion to nearer to $1.5 billion, and is targeting the company's 45 core technologies such as abrasives to nanotechnology, but has sold the non-core pharmaceutical business.

RESEARCH NOTE

Mohanbir Sawhney, Robert Wolcott and Inigo Arroniz from the Center for Research in Technology and Innovation at the Kellogg School of Management at Northwestern University, USA, interviewed innovation managers at a number of large firms, including Boeing, DuPont, Microsoft, eBay, Motorola and Sony, and from these developed a survey questionnaire which was sent to a further 19 firms, such as General Electric, Merck and Siemens.[76]

Analysing these data, they derived an 'innovation radar' to represent the 12 dimensions of business innovation they identified. Their definition of 'business innovation' does not focus on new things, but rather anything that creates new value for customers. Therefore creating new things is neither necessary nor sufficient for such value creation. Instead they propose a systematic approach to business innovation, which may take place in 12 different dimensions:

- Offerings – new products or services.
- Platform – derivative offerings based on reconfiguration of components.
- Solutions – integrated offerings which customers value.
- Customers – unmet needs or new market segments.
- Customer experience – redesign of customer contact and interactions.
- Value capture – redefine the business model and how income is generated.
- Processes – to improve efficiency or effectiveness.
- Organization – change scope or structures.
- Supply chain – changes in sourcing and order fufillment.
- Presence – new distribution or sales channels.
- Brand – leverage or reposition.
- Networking – create integrated offerings using networks.

Summary and further reading

Few other texts cover the technological, market and organizational aspects of innovation in an integrated fashion. Drucker's *Innovation and Entrepreneurship* (Harper & Row, 1985), provides an accessible introduction to the subject, but perhaps relies more on intuition and experience than on empirical research. A number of interesting texts have also been published since the first edition of this book appeared in 1997. Trott's *Innovation Management and New Product Development* (fourth edition, Prentice Hall, 2008), particularly focuses on the management of product development, books by von Stamm (*Managing Innovation, Design and Creativity,* second edition, John Wiley & Sons, Ltd, 2008) and Bruce and Bessant (*Design in Business*, Pearson Education, 2001) have a strong design emphasis and Jones' book targets practitioners in particular (*Innovating at the Edge*, Butterworth Heinemann, 2002). Dogson, Gann and Salter (*The Management of Technological Innovation*, Oxford University Press, 2008) examine innovation strategy and the 'new innovation toolkit', whilst Goffin and Mitchell (*Innovation Management*, Pearson, 2005) also look from a management tools perspective. Brockhoff *et al.* (*The Dynamics of Innovation,* Springer, 1999) and Sundbo and Fugelsang (*Innovation as Strategic Reflexivity*, Routledge,

2002) provide some largely European views, whilst Ettlie's *Managing Technological Innovation* (John Wiley & Sons, Inc., 1999) is based on the experience of US firms, mainly from manufacturing, as are Mascitelli (*The Growth Warriors*, Technology Perspectives, 1999) and Schilling (*Strategic Management of Technological Innovation*, McGraw Hill, 2005). A few books explore the implications for a wider developing country context, notably Forbes and Wield (*From Followers to Leaders*, Routledge, 2002) and Prahalad (*The Fortune at the Bottom of the Pyramid*, Wharton School Publishing, 2006) and a couple look at public policy implications (Branscomb, L. and J. Keller, eds. *Investing in Innovation,* MIT Press, 1999; Dodgson, M. and J. Bessant, *Effective Innovation Policy*, International Thomson Business Press, 1996).

There are several compilations and handbooks covering the field, the best known being *Strategic Management of Technology and Innovation* (Burgelman, R., C. Christensen, and S. Wheelwright, eds., McGraw-Hill, 2004) now in its fourth edition and containing a wide range of key papers and case studies, though with a very strong US emphasis. A more international flavour is present in Dodgson and Rothwell (*The Handbook of Industrial Innovation*, Edward Elgar, 1995) and Shavinina (*International Handbook on Innovation*, Elsevier, 2003). The work arising from the Minnesota Innovation Project also provides a good overview of the field and the key research themes contained within it (Van de Ven, A., *The Innovation Journey*, Oxford University Press, 1999).

Case studies of innovation provide a rich resource for understanding the workings of the process in particular contexts. Good compilations include those of Baden-Fuller and Pitt (*Strategic Innovation*, Routledge, 1996), Nayak and Ketteringham (*Breakthroughs: How leadership and drive create commercial innovations that sweep the world*, Mercury, 1986) and von Stamm (*The Innovation Wave*, John Wiley & Sons, Ltd, 2003), whilst other books link theory to case examples, for example Tidd and Hull (*Service Innovation*, Imperial College Press, 2003). Several books cover the experiences of particular companies including 3M, Corning, DuPont, Toyota and others (Kanter, R., ed., *Innovation: Breakthrough thinking at 3M, DuPont, GE, Pfizer and Rubbermaid*, Harper Business, 1997; Graham, M. and A. Shuldiner, *Corning and the Craft of Innovation*, Oxford University Press, 2001; Kelley, T., J. Littman, and T. Peters, *The Art of Innovation: Lessons in Creativity from Ideo, America's Leading Design Firm*, Currency, 2001). Internet-related innovation is well covered in a number of books mostly oriented towards practitioners, for example, Evans and Wurster (*Blown to Bits: How the New Economics of Information Transforms Strategy*, Harvard Business School Press, 2000), Loudon (*Webs of Innovation*, FT.Com, 2001), Oram (*Peer-to-Peer: Harnessing the Power of Disruptive Technologies*, O'Reilly, 2001) Alderman (*Sonic Boom*, Fourth Estate, 2001) and Pottruck and Pearce (*Clicks and Mortar*, Jossey Bass, 2000). The implications of the Internet for greater user involvement in the innovation process and the emergence of new models is dealt with by von Hippel (*The Democratization of Innovation*, MIT Press, 2005) and others (e.g., Tapscott, D. and A. Williams, *Wikinomics*, Portfolio, 2006).

Most other texts tend to focus on a single dimension of innovation management. In *The Nature of the Innovative Process* (Pinter Publishers, 1988), Dosi adopts an evolutionary economics perspective and identifies the main issues in the management of technological innovation. On the subject of organizational innovation, Galbraith and Lawler (*Organizing for the Future*, Jossey Bass, 1988) summarize recent thinking on organizational structures and processes, although a more critical account is provided by Wolfe (Organizational innovation, *Journal of Management Studies*, 31 (3), 405–432, 1994). For a review of the key issues and leading work in the field of organizational change and learning see Cohen and Sproull (Organizational Learning, Sage, 1996). Bessant (*High Involvement Innovation*, John Wiley & Sons, Ltd, 2003), Boer *et al.* (*CI Changes,* Ashgate, 1999), Imai (*Kaizen*, Random House, 1987) Schroeder and Robinson (*Ideas are Free*, Berrett Koehler, 2004) look at the issue of high involvement incremental innovation.

Most marketing texts fail to cover the specific issues related to innovative products and services, although a few specialist texts examine the more narrow problem of marketing so-called 'high-technology' products, for example, Jolly (*Commercialising New Technologies*, Harvard Business School Press, 1997) and Moore (*Crossing the Chasm*, Harper Business, 1999). Helpful coverage of the core issues are to be found in the chapter, 'Securing the future' in Hamel and Prahalad's *Competing for the Future* (Harvard Business School Press, 1994) and the chapter 'Learning from the market' in Leonard's *Wellsprings of Knowledge* (Harvard Business School Press, 1995). There are also extensive insights into adoption behaviour from a wealth of studies drawn together by Rogers and colleagues (*Diffusion of Innovations*, Free Press, 1995).

Particular themes in innovation are covered by a number of books and journal special issues, for example, services (Best, M., *The New Competitive Advantage*, Oxford University Press, 2001), networks and clusters (Cooke, P. and K. Morgan, *The Intelligent Region: Industrial and Institutional Innovation in Emilia-Romagna*, University of Cardiff, 1991), sustainability (Dodgson, M. and A. Griffiths, Sustainability and innovation – Special issue, *Innovation Management, Policy and Practice*, 2004) and discontinuous innovation (Day, G. and P. Schoemaker, *Wharton on Managing Emerging Technologies*, John Wiley & Sons, Inc., 2000; Foster, R. and S. Kaplan, *Creative Destruction*, Harvard University Press, 2002). Various websites offer news, research, tools, etc., for example AIM (`www.aimresearch.org`) and NESTA (`www.nesta.org.uk`). A full and updated list is available on the website accompanying this book `www.managing-innovation.com.`

Web links

Here are the full details of the resources available on the website flagged throughout the text:

Case studies:

- Kumba Resources
- Inditex/Zara
- Aravind Eye Clinics
- Freeplay Radio
- Karolinska Hospital
- Model T Ford
- LEGO
- Threadless
- Philips Atmosphere provider
- The dimming of the light bulb
- Continuous improvement cases

Interactive exercises:

- Strategic advantage through innovation
- Using the 4Ps
- Patterns of discontinuous innovation
- Architectural and component innovation

Tools:

4Ps for mapping innovation space
Continuous improvement tools and techniques
Product life cycle analysis

Video podcast:

Finnegans Fish Bar (4Ps)
Patrick Mchaughlin, Cerulean

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