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*

Go online to access your interactive e-book and additional resources for this chapter at www.innovation-portal.info

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 their 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] The Innovation Portal provides a case study describing Kumba Resources' high involvement innovation activities.

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 which 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) have 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 Coruna – a region not previously noted for textile production – and the first store opened there in 1975. They now have over 5000 stores worldwide and are now the biggest clothing retailer; significantly, they are also the only manufacturer to offer specific collections for northern and southern hemisphere markets. Central to the Inditex philosophy is close linkage between design, manufacture and retailing, and their network of stores constantly feeds back information about trends which are used to generate new designs. They also experiment 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 their global orientation, most manufacturing is still done in Spain, and they have managed to reduce the turnaround time between a trigger signal for an innovation and responding to it to around 15 days.

Case Study on Zara is available in your interactive e-book at **www.innovation-portal.info**

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 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 their major new lines of development is in advertising billboards – a market worth $5bn in the USA alone – where the prospect of 'programmable hoardings' is now opened up. Magink enables high resolution images which 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 the 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 fact the world's first business computer was used to support bakery planning and logistics for the UK catering services company J. Lyons and Co). 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.com 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 like 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 we are talking here 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] Similar dramatic gains have been made in a variety of Indian healthcare operations. 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

Box 1.1 highlights some quotes about innovation. 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, and so on, the pattern is increasingly coming to favour those organizations which 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 increasingly as the wellspring for national economic growth. The economist William Baumol pointed out that 'virtually all of the economic growth that has occurred since the eighteenth century is ultimately attributable to innovation'.[11] In their regular survey of 'innovation leaders' in 25 sectors of the economy, the consultancy Innovaro report that these companies not only outpace their

BOX 1.1 Innovation – Everybody's Talking About it

- 'We have the strongest innovation program that I can remember in my 30-year career at P&G, and we are investing behind it to drive growth across our business.' – Bob McDonald, CEO, Procter & Gamble
- 'We believe in making a difference. Virgin stands for value for money, quality, innovation, fun and a sense of competitive challenge. We deliver a quality service by empowering our employees and we facilitate and monitor customer feedback to continually improve the customer's experience through innovation.' – Richard Branson, Virgin
- 'Adi Dassler had a clear, simple, and unwavering passion for sport. Which is why with the benefit of 50 years of relentless innovation created in his spirit, we continue to stay at the forefront of technology.' – Adidas about its future (www.adidas.com)
- 'Innovation is our lifeblood' – Siemens about innovation (www.siemens.com)
- 'We're measuring GE's top leaders on how imaginative they are. Imaginative leaders are the ones who have the courage to fund new ideas, lead teams to discover better ideas, and lead people to take more educated risks.' – J. Immelt, Chairman & CEO, General Electric
- 'Innovation distinguishes between a leader and a follower.' – Steve Jobs, Apple
- 'John Deere's ability to keep inventing new products that are useful to customers is still the key to the company's growth.' – Robert Lane, CEO, John Deere
- 'Only the paranoid survive!' – Andy Grove, Intel

competitors on a year by year basis but also that this has a marked effect on their share price. Over the past 10 years they have regularly outperformed the average share price index on the NASDAQ, Dow Jones and FTSE markets and in 2009, when other companies' share prices grew on average by between 40 and 70%, the Innovation Leaders average growth was 130%. (Source: Innovation Briefing, 'Innovation Leaders 2008', www.innovaro.com). Tim Jones and colleagues have made an extensive study of the practices in such companies and their book and associated website – www.growthagenda.org – contains cases of leading innovative businesses from around the world, including newcomers like Tata and Narayana Hospitals alongside Apple, Google, Amazon and Rolls-Royce.[12]

Importantly, innovation and competitive success is not simply about high technology companies; for example, the German firm of Wurth is the largest maker of screws (and other fastenings such as nuts and bolts) in the world with a turnover of £7.5bn. 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 (*Financial Times*, 5/3/2008). In similar fashion the UK Dairy Crest business has built up a turnover of nearly £250m through offering a stream of product innovations including resealable packaging, novel formats and new varieties of cheese and related dairy products, supported by manufacturing and logistics process innovations (*The Times*, 26/9/2011).

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'.[13] An Australian government website puts the case equally

RESEARCH NOTE 1.1

Hidden Innovation

In 2006 the UK organization NESTA published a report on 'The Innovation Gap' in the UK, and laid particular emphasis on 'hidden innovation' – innovation activities that are not reflected in traditional indicators such as investments in formal R&D or patents awarded. In research focusing on six widely different sectors which were not perceived to be innovative, they argued that innovation of this kind is increasingly important, especially in services, and in a subsequent study looked in detail at six 'hidden innovation' sectors – oil production, retail banking, construction, legal aid services, education and the rehabilitation of offenders. The study identified four types of hidden innovation:

- Type I: Innovation that is identical or similar to activities that are measured by traditional indicators, but which is excluded from measurement. For example, the development of new technologies in oil exploration.
- Type II: Innovation without a major scientific and technological basis, such as innovation in organizational forms or business models. For example, the development of new contractual relationships between suppliers and clients on major construction projects.
- Type III: Innovation created from the novel combination of existing technologies and processes. For example, the way in which banks have integrated their various back office IT systems to deliver innovative customer services such as Internet banking.
- Type IV: Locally-developed, small-scale innovations that take place 'under the radar', not only of traditional indicators but often also of many of the organizations and individuals working in a sector. For example, the everyday innovation that occurs in classrooms and multidisciplinary construction teams.

Source: Based on National Endowment for Science, Technology and the Arts (NESTA), 2006, *The Innovation Gap* and 2007, *Hidden Innovation*, www.nesta.org

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 (2006), 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.

1.3 Innovation and Entrepreneurship

The survival/growth question poses a problem for established players, but 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* – a potent mixture of vision, passion, energy, enthusiasm, insight, judgement and plain hard work which enables good ideas to become a reality. As the famous management writer Peter Drucker put it:

> 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.
>
> – P. Drucker, (1985). *Innovation and Entrepreneurship*. New York, Harper and Row.

Entrepreneurship is a human characteristic which mixes structure with passion, planning with vision, tools with the wisdom to use them, strategy with the energy to execute it and judgement with the propensity to take risks. It's possible to create structures within organizations – departments, teams, specialist groups, and so on – with the resources and responsibility for taking innovation forward, but effective change won't happen without the 'animal spirits' of the entrepreneur.

Of course entrepreneurship plays out on different stages in practice. One obvious example is the new start-up venture in which the lone entrepreneur takes a calculated risk to bring something new into the world. But entrepreneurship matters just as much to the established organization which needs to renew itself in what it offers and how it creates and delivers that offering. Internal entrepreneurs – often labelled as *intrapreneurs* or working in *corporate entrepreneurship* or *corporate venture* departments – provide the drive, energy and vision to take risky new ideas forward inside that context. And of course the passion to change things may not be around creating commercial value but rather in improving conditions or enabling change in the wider social sphere or in the direction of environmental sustainability – a field which has become known as *social entrepreneurship*.

RESEARCH NOTE 1.2

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 he has done 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

(*continued*)

else looks for the next innovation which 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 established new ones – all driven by the search for new sources of profits.[14]

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 How Innovation Matters

Innovation contributes in several ways. For example, research evidence suggests a strong correlation between market performance and new products.[15, 16] 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. 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.[17] *Competing in time* reflects a growing pressure on firms not just to introduce new products but to do so faster than competitors.[18]

At the same time new product development is an important capability because the environment is constantly changing. Shifts in the socio-economic 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 which 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.[19] 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 an automated telling machinery (ATM) service 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,[20] 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 like reducing airport turnaround times.[21] 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 which 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 like Charles Schwab.[22] The UK firm Marshalls has been in existence for over 100 years and shows how constant innovation has been central to its survival and growth.

Case Study describing Marshalls is available in your interactive e-book at **www.innovation-portal.info**

BOX 1.2 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 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 and Poor 500 list in 1857, only 74 remained on the list through to 1997.[22] 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 is the company which now owns Thomson, the UK travel group, 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![23]

CASE STUDY 1.1

The Changing Nature of the Music Industry

1st 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 3rd 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.com 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 in which songwriters and artists depended on A&R (artists and repertoire) 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 whilst 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.

As a result 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, and so on. In the process they effectively create a parallel and much more direct music industry which leaves existing players and artists on the sidelines.

(continued)

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 become 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 person-to-person or P2P networking. Shawn Fanning, an 18-year-old student with the nickname 'the Napster', was intrigued by the challenge of being able to enable 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 which 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, Limewire took the P2P idea further and enabled exchange of many different file formats – text, video, and so on. In Napster's own case the phenomenally successful site concluded a deal with entertainment giant Bertelsman which paved the way for subscription-based services which 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 judgment 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 their successful iPod personal MP3 player they opened a site called iTunes which offered users a choice of thousands of tracks for download at ¢99 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

(*continued*)

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 coming 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.'

Subsequent developments have shown an acceleration in the pace of change and an explosion in the variety of new business models better adapted to create and capture value from the industry. For example, the US music download business has become dominated by Apple and Amazon (with 70% and 10% respectively of the market) – two companies which have their roots in very different worlds. Whilst the volume of downloads has increased significantly there is now competition from alternative business models; for example streaming services like Spotify allow users to rent access to millions of music and other audio titles without having to 'own' any of them. And behind the music business the same pattern is playing out in films and entertainment, computer games and other areas. With the advent of 3D printing and low cost design it becomes possible to make similar models work in the sphere of physical products as well.

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.[24]

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 dot.com 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, and so on. And, as we have seen, the early euphoria around the dot.com 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.

Activity applying strategic advantage through innovation is available in your interactive e-book at **www.innovation-portal.info**

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, on-line retailer, etc. . . . to the world
Novelty in process	Offering it in ways others cannot match – faster, lower cost, more customized, etc.	Pilkington's float glass process, Bessemer's steel process, Internet banking, on-line bookselling, etc.
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 which others cannot do unless they pay a licence or other fee	Blockbuster drugs like Zantac, Prozac, Viagra, etc.
Add/extend range of competitive factors	Move basis of competition – e.g. from price of product to price and quality, or price, quality, choice, etc.	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	Amazon.com, Google – others can follow, but the advantage 'sticks' to the early movers
	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	Personal digital assistants (PDAs), which captured a huge and growing share of the market and then found their functionality absorbed into mobile phones and tablet devices. 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 50 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, out-sourcing and co-ordination of a virtual company, etc.	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 peer-to-peer (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 sold to eBay for $2.6bn and eventually to Microsoft for $8.5bn.

1.5 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 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 VoIP (Voice over Internet Protocol) communications is not developing along established trajectories towards a well-defined end-point. Instead it is a process of *emergence*. The broad parameters are visible – the rise of demand for global communication, increasing availability of broadband, multiple peer-to-peer 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 describing Kodak is available in your interactive e-book at **www.innovation-portal.info**

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

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 is still highly relevant (even though camera technology has shifted) the move away from wet physical chemistry conducted in the dark (coating emulsions onto films and paper) to digital imaging represented a profound change for the firm. It needed – 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 they made strenuous efforts to shift from being a manufacturer of film to becoming a key player in the digital imaging industry and beyond, they found the transition very difficult and in 2012 they filed for Chapter 11 bankruptcy protection.

Significantly this was not the end of the company; instead it regrouped around other core technologies and developed new directions for innovation led growth in fields like high speed, high volume printing.

TABLE 1.2 Changing context for innovation (based on[25])

Context change	Indicative examples
Acceleration of knowledge production	OECD estimates that around $750bn is spent each year (public and private sector) in creating new knowledge – and hence extending the frontier along which 'breakthrough' 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 – for example, Microsoft's third largest R&D Centre employing thousands of scientists and engineers is now in Shanghai.
Market expansion	Traditionally much of the world of business has focused on the needs of around 1 billion people since they represent wealthy enough consumers. But the world's population has just passed the 7 billion mark and population – and by extension market – growth is increasingly concentrated in non-traditional areas like rural Asia, Latin America and Africa. Understanding the needs and constraints of this 'new' population represents a significant challenge in terms of market knowledge.
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] or along the so-called long tail – the large number of individuals or small target markets with highly differentiated needs and expectations.
Market virtualization	The emergence of large-scale social networks in cyberspace pose challenges in market research approaches – for example, Facebook with 800 million members is technically the third largest country in the world by population. Further challenges arise in the emergence of parallel world communities – for example, Second Life now has over 6 million 'residents', whilst World of Warcraft has over 10 million players.
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 – for example, the growth of Linux has been a user-led open community development.[26] In sectors like media the line between consumers and creators is increasingly blurred – for example, YouTube 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
Growing concern with sustainability issues	Major shifts in resource and energy availability prompting search for new alternatives and reduced consumption. Increasing awareness of impact of pollution and other negative consequences of high and unsustainable growth. Concern over climate change. Major population growth and worries over ability to sustain living standards and manage expectations. Increasing regulation on areas like emissions, carbon footprint.
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[27, 28]

Source: Based on J. Bessant and T. Venables (2008) *Creating Wealth from Knowledge: Meeting the Innovation Challenge*, Cheltenham: Edward Elgar.

1.6 What is Innovation?

One of America's most successful innovators was Thomas Alva Edison who during his life registered over 1000 patents. Products for which his organization was responsible include the light bulb, 35mm 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 them work technically and commercially. His skill in doing this created a business empire worth, in 1920, around $21.6bn. 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.[29]

As Edison realized, innovation is more than simply coming up with good ideas; it is the *process* of growing them into practical use.[30] 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 Research Note 1.3.

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 idea to widespread and effective use. Being a good inventor is – to contradict

RESEARCH NOTE 1.3

What is Innovation?

One of the problems in managing innovation is 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, UK Department of Trade and Industry (2004).

'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 edn.* Frances 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.

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 and so on. Case Study 1.3 gives some examples which highlight the difference between invention and innovation.

*'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)

CASE STUDY 1.3

Invention and Innovation

In fact, some of the most famous inventions of the nineteenth century came from men whose names are forgotten; the names which we associate with them 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 produced 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 up 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'.[29]

BOX 1.3 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 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 just 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 $450m and 110 847 Edsels.[29]
- During the latter part of the World War II it became increasingly clear that there would be a big market for long-distance airliners, especially on the trans-Atlantic route. One UK contender

(*continued*)

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 $7bn 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 needs 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 $2m per month. Motorola who had to assume the responsibility had hoped that other telecoms firms might take advantage of these satellites, but after no interest was shown they had to look at a further price tag of $50m. 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, since 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!

1.7 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's 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?

Finally we need to consider the challenge of *capturing value* from our innovative efforts. How will we ensure that the efforts have been justified – in commercial terms or in terms of creating social value? How will we protect the gains from appropriation by others? And how might we learn from the experience and capture useful leanring about how to improve the innovation process in the future?

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 a 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 kind 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 1.1

'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

1.8 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 for use to create something different and capture value from bringing those ideas into the world?

Sometimes it is about completely new possibilities – for example, 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 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 on-line 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/day. The potential for developing radically different innovative products and services aimed at meeting the needs of this vast population at what C.K. Prahalad calls 'the bottom of the pyramid' is huge – and the lessons learned may impact on established markets in the developed world as well.

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. On-line 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, on-line shopping and the music business.[31]

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:

- 'product innovation' – changes in the things (products/services) which 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.

Video Clip showing Finnegan's Fish Bar is available in your interactive e-book at **www.innovation-portal.info**

Figure 1.1 shows how these '4Ps' provide the framework for a map of the innovation space available to any organization[32] and one example is the framework applied to looking at a small fish and chip shop business.

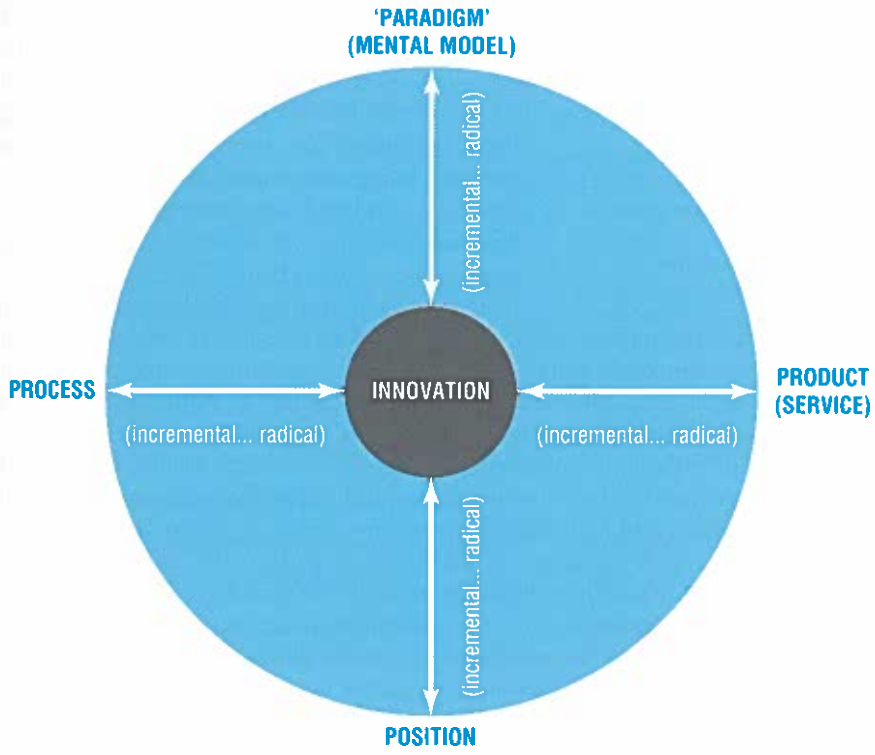

FIGURE 1.1 The 4Ps of innovation space

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.

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 Haagen 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) nor 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 Everyman 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. 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.

Case Study describing the Model T Ford is available in your interactive e-book at **www.innovation-portal.info**

Recent examples of 'paradigm' innovation – changes in mental models – include the shift to low-cost airlines, the provision of on-line 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 like telecommunications bandwidth increasingly became commodities which could be traded much as sugar or cocoa futures.[33]

In their book *Wikinomics* Tapscott and Williams highlight the wave of innovation which follows the paradigm change to 'mass collaboration' via the Internet which built on social networks and communities. Companies like Lego and Adidas 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'.[31] Concerns about global warming and sustainability of key resources like 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. The Innovation Portal provides additional material describing case studies for Threadless and Adidas. Table 1.3 provides some examples of innovations mapped on to the 4P framework.

Case Study describing Lego is available in your interactive e-book at **www.innovation-portal.info**

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 7 and 8 replacing Vista and XP – essentially improving on existing software idea	New to the world software – for example the first speech recognition program
	New versions of established car models – e.g. the VW Golf essentially improving on established car design	Toyota Prius – bringing a new concept – hybrid engines. Tesla – high performance electric car.

(*continued*)

TABLE 1.3 (*Continued*)

Innovation type	Incremental – do what we do but better	Radical – do something different
	Improved performance incandescent light bulbs	LED-based lighting, using completely different and more energy efficient principles
	CDs replacing vinyl records – essentially improving on the storage technology	Spotify and other music streaming services – changing the pattern from owning your own collection to renting a vast library of music
Process – how we create and deliver that offering	Improved fixed line telephone services	Skype and other VoIP systems
	Extended range of stock broking services	On-line share trading
	Improved auction house operations	eBay
	Improved factory operations efficiency through upgraded equipment	Toyota Production System and other 'lean' approaches
	Improved range of banking services delivered at branch banks	Online banking and now mobile banking in Kenya, Philippines – using phones as an alternative to banking systems
	Improved retailing logistics	On-line shopping
Position – where we target that offering and the story we tell about it	Haagen Dazs changing the target market for ice cream from children to consenting adults	Addressing underserved markets – for example the Tata Nano aimed at emerging but relatively poor Indian market with car priced around $2000.
	Airlines segmenting service offering for different passenger groups – Virgin Upper Class, BA Premium Economy, etc.	Low-cost airlines opening up air travel to those previously unable to afford it – create new market and also disrupt existing one
	Dell and others segmenting and customizing computer configuration for individual users	Variations on the 'One laptop per child' project – e.g. Indian government $20 computer for schools
	On line support for traditional higher education courses	University of Phoenix and others, building large education businesses via online approaches to reach different markets
	Banking services targeted at key segments – students, retired people, etc.	'Bottom of the pyramid' approaches using a similar principle but tapping into huge and very different high volume/low margin markets – Aravind eye care, Cemex construction products

(*continued*)

TABLE 1.3 (*Continued*)

Innovation type	Incremental – do what we do but better	Radical – do something different
Paradigm – how we frame what we do	Bausch and Lomb – moved from 'eye wear' to 'eye care' as their business model, effectively letting go of the old business of spectacles, sunglasses (Raybans) and contact lenses all of which were becoming commodity businesses. Instead they moved into newer high tech fields like laser surgery equipment, specialist optical devices and research in artificial eyesight Dyson redefining the home appliance market in terms of high performance engineered products Rolls-Royce – from high quality aero engines to becoming a service company offering 'power by the hour' IBM from being a machine maker to a service and solution company – selling off its computer making and building up its consultancy and service side.	Grameen Bank and other microfinance models – rethinking the assumptions about credit and the poor iTunes platform – a complete system of personalized entertainment Cirque de Soleil – redefining the circus experience Amazon, Google, Skype – redefining industries like retailing, advertising and telecoms through online models Linux, Mozilla, Apache – moving from passive users to active communities of users co-creating new products and services

Mapping Innovation Space

The area indicated by the circle in Figure 1.2 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).

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 we may explore around defining a new paradigm, a new business model with which to approach the marketplace.

Tool using the 4Ps to explore innovation space is available in your interactive e-book at **www.innovation-portal.info**

Activity with an interactive exercise using the 4Ps approach is available in your interactive e-book at **www.innovation-portal.info**

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.[34]

RESEARCH NOTE 1.4

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).
- 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.

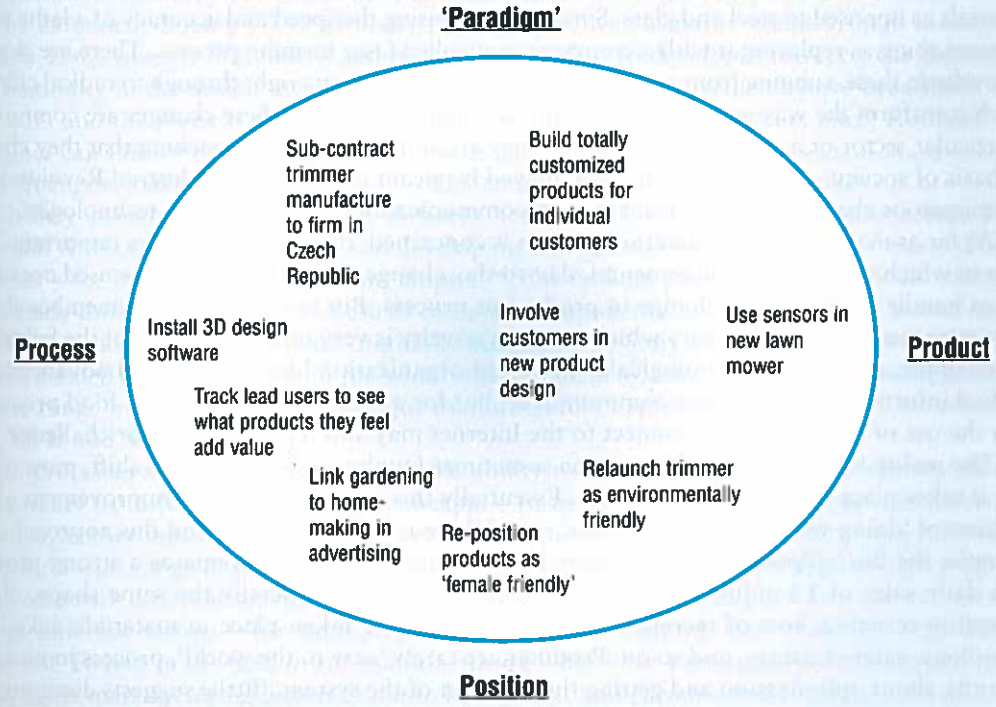

FIGURE 1.2: Suggested innovations mapped on to the 4Ps framework

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

1.9 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 – further 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 thing 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 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, and so on. 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.)[35] Studies of incremental process development (such as Hollander's famous study of Du Pont rayon plants) suggest that the cumulative gains in efficiency are often much greater over time than those which come from occasional radical changes.[36] Other examples include Tremblay's studies of paper

mills, Enos on petroleum refining and Figueredo's of steel plants.[37–39] The Innovation Portal provides additional case studies describing various examples of continuous improvement innovation – Hosiden Besson, NPI, Kumba Resources and Forte's Bakery.

Video Clip showing Veeder-Root is available in your interactive e-book at **www.innovation-portal.info**

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.[40] 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.[41] 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.[42] The Innovation Portal provides additional tools and techniques – 'lean toolbox' and 'continuous improvement'.

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. Boeing's 737 airliner, for example, was a major breakthrough innovation back in 1967 when it first flew – and it cost a great deal to develop. However, the robustness and flexibility in the design means that many variants and improvements have been made over the years and the plane is still being manufactured today, nearly 60 years later! Rothwell and Gardiner call this kind of platform a 'robust design' and examples can be seen in many areas.[43] Aircraft engine makers like Rolls-Royce and General Electric work with families of core designs which they stretch and adapt to suit different needs, while semiconductor manufacturers like Intel and AMD spread the huge cost of developing new generations of chip across many product variants – for example in the Pentium chipset.[44] Car makers produce models which, although apparently different in style, make use of common components and floor pans or chassis. And in consumer products the 'Walkman' originally developed by Sony as a portable radio and cassette system defined a platform concept (personal entertainment systems) which continues to underpin a wide range of offerings from all major manufacturers deploying technologies like minidisk, CD, DVD and 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 like 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.[45]

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 their 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', etc.). They were also able to license out the technology for use in non-competing areas like 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' Julian Birkinshaw and Gary Hamel highlight 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 which 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. McDonalds owed much of their inspiration to him in designing their fast food business and in turn they were a powerful influence on the development of the Aravind eye clinics in India which bring low-cost eye surgery to the masses.[3] The Innovation Portal provides additional case studies describing cross-sector diffusion – NHL Hospitals and Lifespring Hospitals.

Case Study describing Aravind Eye Clinics is available in your interactive e-book at **www.innovation-portal.info**

Discontinuous Innovation – What Happens When the Game Changes?

Activity using patterns of discontinuous innovation is available in your interactive e-book at **www.innovation-portal.info**

Most of the time innovation takes place within a set of rules 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]

But occasionally something happens which dislocates this framework and changes the rules of the game. 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, but also challenge existing players to reframe what they are doing in the light of new conditions.[48, 49] This is a central theme in Schumpeter's original theory of innovation which he saw as involving a process of 'creative destruction'.[14, 22]

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

(continued)

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. And it was an industry with 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 like 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.[50]

But at the same time as this highly efficient system was growing 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 which 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 in to 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 which 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 $18bn 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, and so on. 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 by the emergence of a new market with very different needs and expectations.[51]

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 much 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 which 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.[51]

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 their 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'.[52]

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 them to enter and compete successfully in higher value more complex markets.[53]

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 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 or 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 the

carpet out from under the firms – and created a new set of conditions on which a new game would be played out. 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.[54]

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 marketplace 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[51] Mobile phone/SMS where market which actually emerged was not the one expected or predicted by originators

(continued)

TABLE 1.4 (*Continued*)

Triggers/sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
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 breakthrough (e.g. LED as white light source)	Don't see it because beyond the periphery of technology search environment. Not an extension of current areas but completely new field or approach 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	Ice harvesting to cold storage[50] Valves to solid state electronics[55] Photos to digital images
New political rules emerge	Political conditions which shape the economic and social rules may shift dramatically – for example, 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[56] Free trade/globalization results in dismantling protective tariff and other barriers and new competition basis emerges[56, 57]
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	Coloplast[58] Kodak, Polaroid Encyclopaedia Britannica[24]

(*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	which militate against widespread search or risk taking experiments	Preussag[59]
Sea change in market sentiment or behaviour	Public opinion or behaviour shifts slowly and then tips over into a new model – for example, 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[60]
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 emerged from a small gas pipeline business to becoming a major energy trade[61] – unquantifiable chances may need to be taken.

(*continued*)

TABLE 1.4 (*Continued*)

Triggers/sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
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 – for example, 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	McDonalds and obesity Tobacco companies and smoking bans Oil/energy and others and global warming Opportunity for new energy sources like wind-power – c.f. 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	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.com Charles Schwab Southwest and other low-cost airlines[24, 63]
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 – for example, 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	Photo-lithography in chip manufacture[64]

(*continued*)

TABLE 1.4 (*Continued*)

Triggers/sources of discontinuity	Explanation	Problems posed	Examples (of good and bad experiences)
		better able to work with new architecture can emerge.	
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[65–67] Mass production

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 which change things at the level of components or those which 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 into the computer to give it particular capabilities – a games box, an e-book, a media PC. Or we can link the computers into 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!

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 of this 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, and so on. And it could be in explicit form, codified in such a way that others can access it, discuss it, transfer it, and so on – 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 about 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.

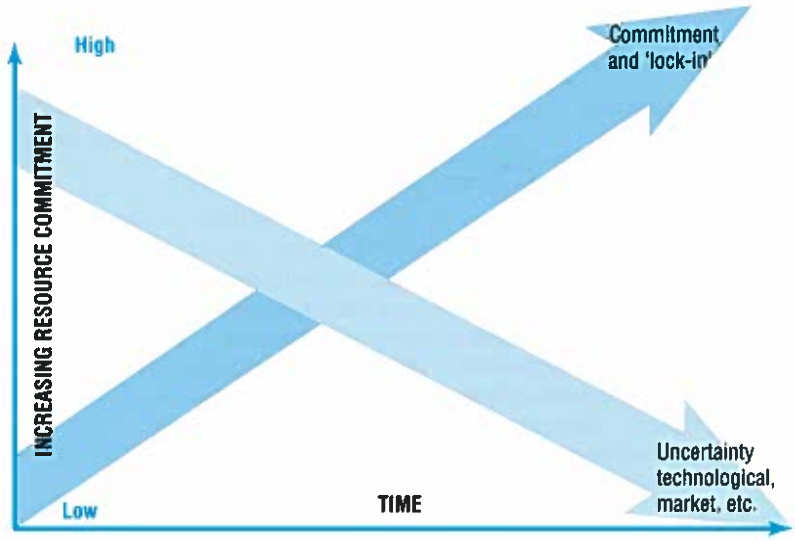

FIGURE 1.3 Resource commitment and uncertainty in innovation

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, so uncertainty is higher and at the limit 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.[52] They argue that innovation rarely involves dealing with a single technology or market, but rather a bundle of knowledge which is brought together into a configuration. Successful innovation management requires that we can get hold of and use knowledge about *components* but 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, and so on 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.

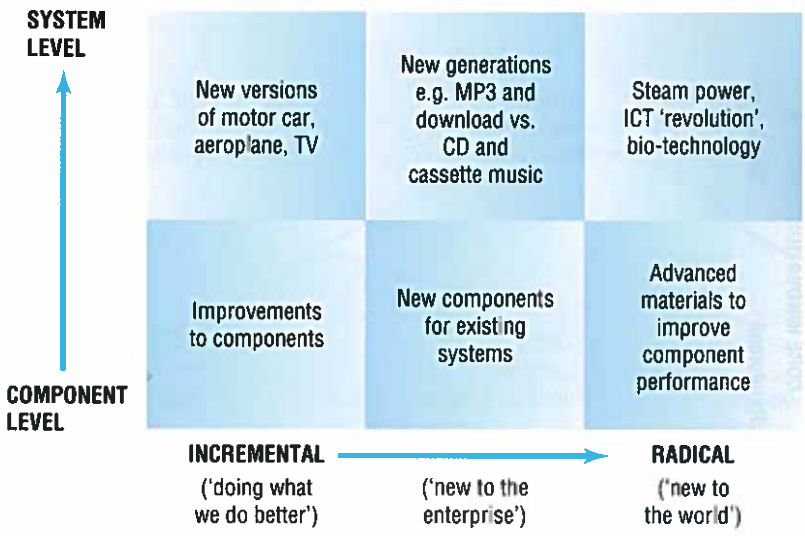

FIGURE 1.4 Dimensions of innovation

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 like computing, telecommunications, industrial control and elementary robotics is enabling a new generation of housing systems with integrated entertainment, environmental control (heating, air conditioning, lighting, etc.) and communication possibilities.[69, 70]

Similarly, in services 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 which 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 A-380. Managing innovation on this scale requires development of skills in what Mike 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, and so on. None of these involve major shifts or dislocations.

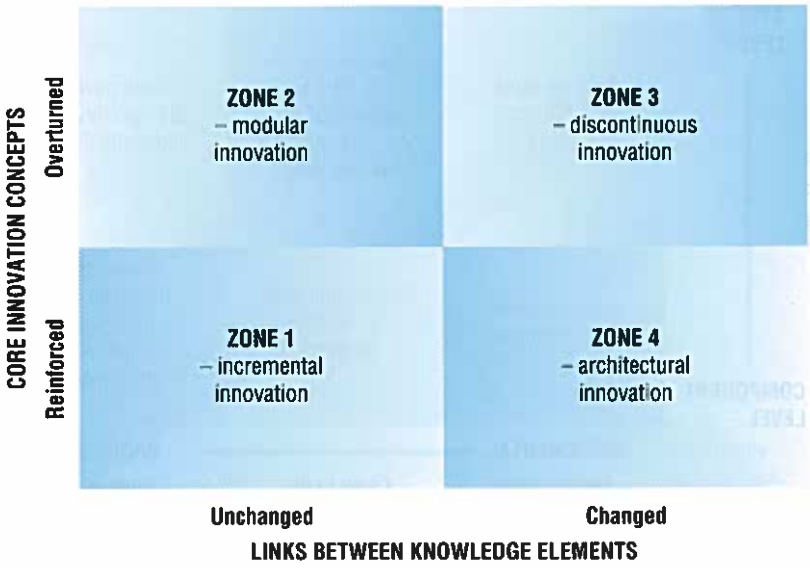

FIGURE 1.5 Component and architectural innovation
Source: Adapted from Abernathy, W. and J. Utterback (1978) Patterns of industrial innovation. *Technology Review*, **80**, 40–47.

In Zone 3 we have discontinuous innovation where neither the end state nor the ways in which it can be achieved are known about – 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, direct line insurance, others.

Activity using architectural and component innovation is available in your interactive e-book at **www.innovation-portal.info**

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 more around 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).

Initially, under the discontinuous conditions which arise when completely new technology and/or markets emerge, there is what they term a 'fluid phase' during which 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?

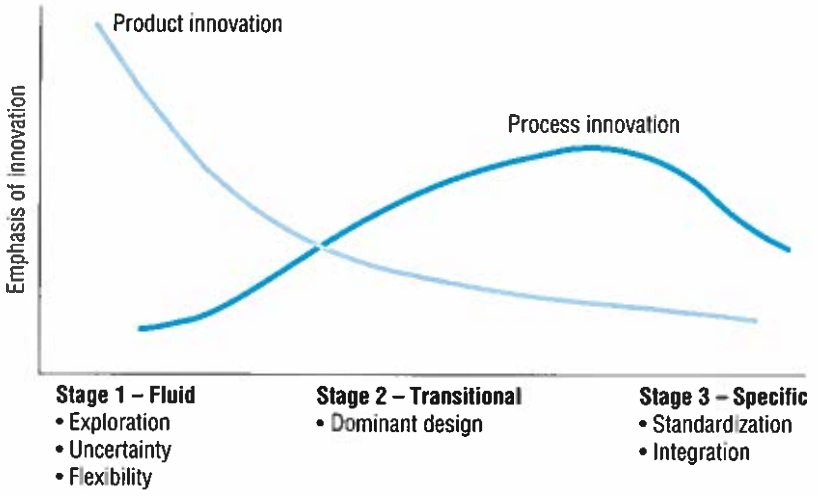

FIGURE 1.6 The innovation life cycle[73]

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 channeled around a core set of possibilities – what Dosi calls a 'technological trajectory'.[65] 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.

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 on 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 which used electrolytic techniques and 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.

A similar pattern can be seen in products. For example, the original design for a camera is something which 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, and so on. 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.

The period in which the dominant design emerges and emphasis shifts to imitation and development around it 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, extended functionality, and so on.

As the concept matures still further so incremental innovation becomes more significant and emphasis shifts to factors like cost – which means efforts within the industries which 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. The Innovation Portal provides additional tools material – 'brainstorming' and 'problem-solving'.

Table 1.5 sets out the main elements of this model.

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

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, building a dominant design consensus on the package of services offered, the levels and nature of security and privacy support, the interactivity of website, and so on. The field has now become mature with much of the competition shifting to marginal issues like relative interest rates. Similar patterns can be seen in Internet VoIP telephony, on-line auctions like eBay and travel and entertainment booking services like expedia.com.

We should also remember that there is a long term cycle involved – mature businesses which have already gone through their fluid and transitional phases do not necessarily stay in the mature phase for ever. 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 Swann, 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 which has characterized the industry and led to increasing consolidation amongst a few big players. But – as the 'dimming of the lightbulb' case on the Innovation Portal shows – that maturity has now given way to a new phase involving different players, technologies and markets.

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 like Raytheon.[55]) 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 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 *co-existence* of old and new technologies and by rapid improvements of both. (It is here that the so-called 'sailing ship' effect which we 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.)[54]

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 badly – 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.[51] 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 which 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 yet but which will shape the eventual package which becomes the dominant design? 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 which result from a dislocation or discontinuity. The kinds of organizational behaviour needed here will include things like agility, flexibility, the ability to learn fast, the lack of preconceptions about the ways in which things might evolve, and so on – 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 it does 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 which has been developed in a different field. The massive changes in insurance and financial services which have characterized the shift to on-line 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 their 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 or 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.'

1.10 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 which highlights 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 like component and architecture innovation and the critical role which 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.

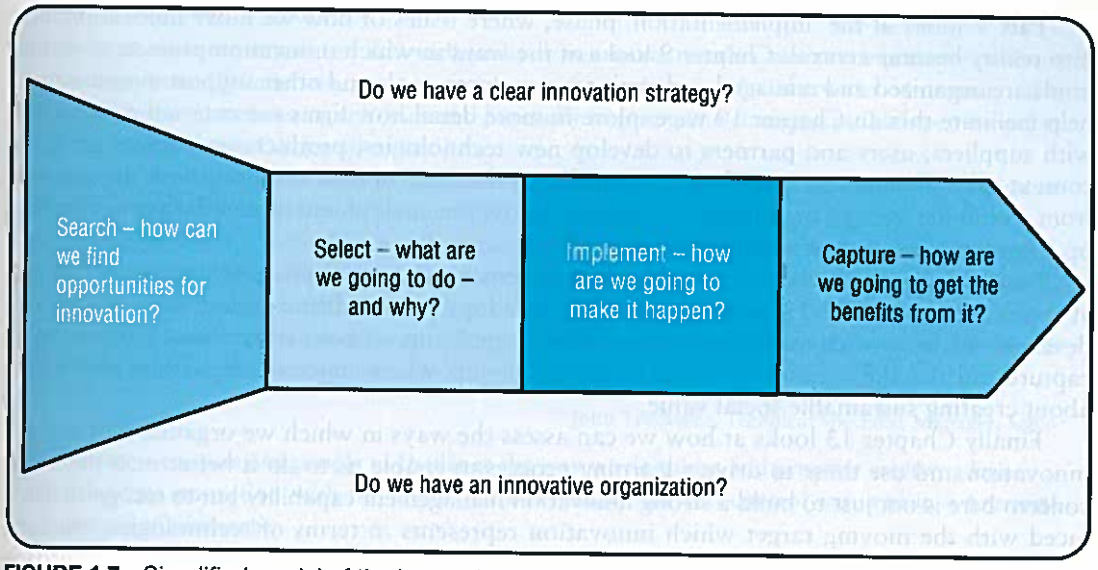

FIGURE 1.7 Simplified model of the innovation process

Part II 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 which key concepts like 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 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 III 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 IV 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 are 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 then – 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 $1bn/year mark worldwide and where the ability to generate knowledge may be less significant than the ability to trade and use it effectively.