Chapter 6

Sources of Innovation

LEARNING OBJECTIVES

By the end of this chapter you will develop an understanding of:

- **where innovations come from – the wide range of different sources which can trigger the process**
- **a framework for looking at sources in terms of 'push' and 'pull' forces**
- **the varying importance of different sources over time**
- **where and when you can search for opportunities to innovate.**

Where Do Innovations Come From?

Where do innovations come from? For many people that question will evoke images like that of Archimedes, jumping up from his bath and running down the street, so enthused by his new idea that he forgot to get dressed. Such 'eureka' moments are certainly a part of innovation folklore – and they underline the importance of flashes of insight which make new connections. They form the basis of the cartoon model of innovation which usually involves thinking bubbles and flashing light bulbs.

But of course there is much more to it than that. Innovation is a process of taking ideas forward, revising and refining them, weaving the different strands of 'knowledge spaghetti' together towards a useful product, process or service. Triggering that process is not just about occasional flashes of inspiration: innovation

Activity to help you explore the theme of sources of innovation – innovation family trees – is available on the Innovation Portal at **www.innovation-portal.info**

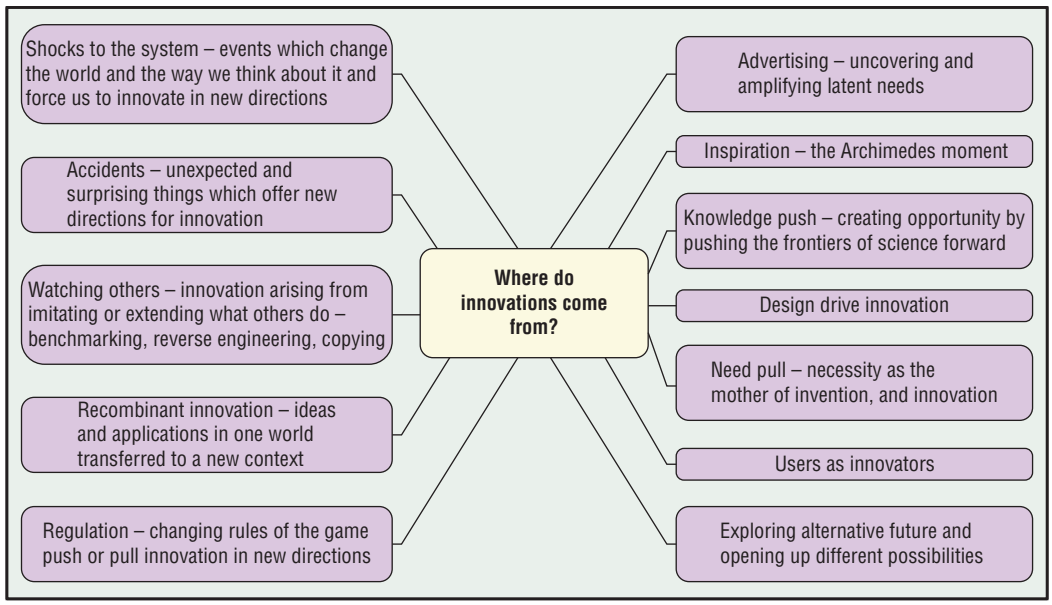

FIGURE 6.1 Where do innovations come from?

comes from many other directions, and if we are to manage it effectively we need to remind ourselves of this diversity. Figure 6.1 indicates the wide range of stimuli which can begin the innovation journey.

Let's look at some of these in more detail.

Knowledge Push

One source of innovation is scientific research. And although there have always been solo researchers, from a very early stage this process of exploring and codifying at the frontiers of knowledge became a systematic activity which involved a wide network of people sharing their ideas. In the twentieth century the rise of the large corporation brought with it the emergence of the research laboratory as a key instrument of progress. Bell Labs, ICI, Bayer, BASF, Philips, Ford, Western Electric, Du Pont – all were founded in the early 1900s as powerhouses of ideas. Their output wasn't simply around product innovation. Many of the key technologies underpinning *process* innovations, especially around

Case Studies of companies – 3M, Philips and Corning – which were founded over one hundred years ago and built their strength on extensive R&D investments are available on the Innovation Portal at **www.innovation-portal.info**

the growing field of automation and information/communications technology, also came from such organized R&D effort.

For example, the rise of the huge global pharmaceutical industry was essentially about big R&D expenditure, much of it spent on development and elaboration punctuated by the occasional breakthrough into 'blockbuster' drug territory. Similarly, the semiconductor and the computer, and other industries which depend on it, have a long-term trajectory of continuous improvement interspersed with occasional breakthroughs.

The same pattern can be seen in products, for example the camera. Originally invented in the late nineteenth century, the dominant design gradually emerged with an architecture which we would recognize: shutter and lens arrangement, focusing principles, back plate for film or plates, etc. But this design was then modified still further, with different lenses, motorized drives, flash technology, etc. – and, in the case of George Eastman's work, to create 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.

Case Study of Spirit, a key player in the technologies underpinning CISCO and other large corporations, is available on the Innovation Portal at **www.innovation-portal.info**

Need Pull. . .

Of course, simply having a bright idea is no guarantee of adoption. Knowledge push creates a field of possibilities – but not every idea finds successful application and one of the key lessons is that innovation requires some form of demand if it is to take root. Bright ideas are not, in themselves, enough; they may not meet a real or perceived need and people may not feel motivated to change.

In its simplest form this idea of 'need pull' innovation is captured in the saying 'necessity is the Mother of invention'. Innovation is often the response to a real or perceived need for change and so we need to develop a clear understanding of needs and find ways to meet those needs. For example, Henry Ford was able to turn the luxury plaything that was the early automobile into something which became 'a car for Everyman', while Procter & Gamble began a business meeting needs for domestic lighting (via candles) and moved across into an ever-widening range of household needs from soap and nappies to cleaners, toothpaste and beyond. Low-cost airlines have found innovative solutions to the problem of making flying available to a much wider market, while microfinance institutions have developed radical new approaches to help bring banking and credit within the reach of the poor.

Just as the knowledge push model involves a mixture of occasional breakthrough followed by extensive elaboration, so the same is true of need pull. Occasionally, it involves a new to the world idea, but mostly it is extensions, variations and adaptations around those core ideas. Figure 6.2 indicates a typical breakdown, and we could construct a similar picture for process innovations.

INNOVATION IN ACTION 6.1

Maintaining a Stream of Ideas

Two hundred years ago, Churchill Potteries began life in the United Kingdom making a range of crockery and tableware. That it is still able to do so today, despite a turbulent and highly competitive global market, says much for the approach which the company has taken to ensure a steady stream of innovation. Chief executive Andrew Roper highlights the way in which listening to users and understanding their needs has changed the business: 'We have taken on a lot of service disciplines, so you could think of us as less of a pure manufacturer and more as a service company with a manufacturing arm.' Staff spend a significant proportion of their time talking to chefs, hoteliers and others. 'Sales, marketing and technical people spend far more of their time than I could ever have imagined checking out what happens to the product in use and asking the customer, professional or otherwise, what they really want next.'

Source: Derived from 'Ingredients for success on a plate', Peter Marsh, *Financial Times*, 26/3/08, p. 16.

Need pull innovation is particularly important at mature stages in industry or product life cycles when there is more than one offering to choose from – competing depends on differentiating on the basis of needs and attributes, and/or segmenting the offering to suit different adopter types.

It's also important to recognize that innovation is not always about commercial markets or consumer needs. There is also a strong tradition of social need providing the pull for new

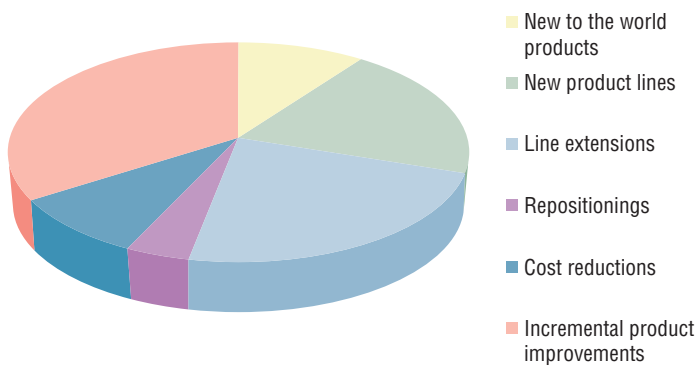

FIGURE 6.2 Types of new product

Source: Based on Griffin, A. (1997) PDMA research on new product development practices. *Journal of Product Innovation Management, 14*: 429. Reproduced by permission of John Wiley & Sons Ltd.

INNOVATION IN ACTION 6.2

Understanding user Needs in Hyundai Motor

One of the problems facing global manufacturers is how to tailor their products to suit the needs of local markets. For Hyundai this has meant paying considerable attention to getting deep insights into customer needs and aspirations, an approach which it used to good effect in developing the Santa Fe, reintroduced to the US market in 2007. The headline for its development programme was 'touch the market' and it deployed a number of tools and techniques to enable it. For example, its engineers visited an ice rink and watched an Olympic medallist skate around to help them gain an insight into the ideas of grace and speed which they wanted to embed in the car. This provided a metaphor – 'assertive grace' – which the development teams in Korea and the US were able to use.

Analysis of existing vehicles suggested some aspects of design were not being covered, for example many sport/utility vehicles (SUVs) were rather 'boxy' so there was scope to enhance the image of the car. Market research suggested a target segment of 'glamour mums' who would find this attractive and the teams then began an intensive study of how this group lived their lives. Ethnographic methods looked at their homes, their activities and their lifestyles, for example team members spent a day shopping with some target women to gain an understanding of their purchases and what motivated them. The list of key motivators which emerged from this shopping study included durability, versatility, uniqueness, child-friendly and good customer service from knowledgeable staff. Another approach was to make all members of the team experience driving routes around southern California, making journeys similar to those popular with the target segment and in the process getting first-hand experience of comfort, features and fixtures inside the car, etc.[1]

products, processes and services – a theme we'll explore in a later chapter. Whether it is social needs like provision of health care or clean water in developing countries or more effective education or social services in established industrial economies, the need for change is clear and provides an engine for increasing innovation.

Making Processes Better

Of course, needs aren't just about external markets for products and services. We can see the same phenomenon of need pull working inside the business, as a driver of *process* innovation. 'Squeaking wheels' and other sources of frustration provide rich signals for change, and this kind of innovation is often something which can engage a high proportion of the workforce who experiences these needs first hand.

Case Study of continuous improvement is available on the Innovation Portal at **www.innovation-portal.info**

Video Clips about Veeder-Root, a small company exploiting these ideas, and of an interview with Emma Taylor, of the giant Denso Systems, who talks about her experiences in establishing this kind of approach, are available on the Innovation Portal at **www.innovation-portal.info**

Case Studies of innovations in the health care sector where the drive has been to improve the provision of public services through process innovation are available on the Innovation Portal at **www.innovation-portal.info**

This approach provided the basic philosophy behind the 'total quality management' movement in the 1980s, the 'business process re-engineering' ideas of the 1990s and the current widespread application of concepts based on the idea of 'lean thinking' – essentially taking waste out of existing processes.

This kind of process improvement is of particular relevance in the public sector where the issue is not about creating wealth but of providing value for money in service delivery. Many applications of 'lean' and similar concepts can be found which apply this principle, for example in reducing waiting times or improving patient safety in hospitals, in speeding up delivery of services like car taxation and passport issuing and even in improving the collection of taxes!

INNOVATION IN ACTION 6.3

'Pretty in Pink'

Walking through the plant belonging to Ace Trucks (a major producer of forklift trucks) in Japan the first thing which strikes you is the colour scheme. In fact, you would need to be blind not to notice it. Amongst the usual rather dull greys and greens of machine tools and other equipment there are flashes of pink. Not just a quiet pastel tone but a full-blooded, shocking pink which would do credit to even the most image-conscious flamingo. Closer inspection shows these flashes and splashes of pink to be not random but associated with particular sections and parts of machines, and the eye-catching effect comes in part from the sheer number of pink-painted bits, distributed right across the factory floor and all over the different machines.

What is going on here is not a bizarre attempt to redecorate the factory or a failed piece of interior design. The effect of catching the eye is quite deliberate: the colour is there to draw attention to the machines and other equipment which have been modified. Every pink splash is the result of a kaizen project to improve some aspect of the equipment, much of it in support of the drive towards 'total productive maintenance' (TPM), in which every item of plant is available and ready for use 100% of the time. This is a goal like 'zero defects' in total quality – certainly ambitious, possibly an impossibility in the statistical sense, but one which focuses the minds of everyone involved and leads to extensive and impressive problem-finding and -solving. TPM programmes have accounted for year-on-year cost savings of 10–15% in many Japanese firms, and these savings are being ground out of a system which is already renowned for its lean characteristics.

Painting the improvements pink plays an important role in drawing attention to the underlying activity in this factory, in which systematic problem-finding and -solving are part of 'the way we do things around here'. The visual cues remind everyone of the continuing search for new ideas and improvements, and often provide stimulus for other ideas or for places where the displayed pink idea can be transferred to. Closer inspection around the plant shows other forms of display – less visually striking but powerful nonetheless – charts and graphs of all shapes and sizes which focus attention on trends and problems as well as celebrating successful improvements. Photographs and graphics which pose problems or offer suggested improvements in methods or working practices. And flipcharts and whiteboards covered with symbols and shapes of fish bones and other tools being used to drive the improvement process forward.

INNOVATION IN ACTION 6.4

MindLab

MindLab is a Danish organization set up to promote and enable public sector innovation in Denmark. 'Owned' by the Ministries of Taxation, Employment and Economic Affairs, it has pioneered a series of initiatives engaging civil servants and members of the public in a wide range of social innovation which has raised productivity, improved service quality and cut costs across the public sector. Case studies of their activities can be found at their website:

Source: Derived from www.mind-lab.dk/en

Whose Needs? Working at the Edge

One very interesting source of innovation lies at the edges of existing markets. It poses a problem for existing players because the needs of such fringe groups are not seen as relevant to their 'mainstream' activities – and so they tend to ignore them or to dismiss them as not being important. But working with these users and their different needs creates different innovation options, and sometimes what has relevance for the fringe begins to be of interest to the mainstream. US professor Clayton Christensen in his many studies of such 'disruptive innovation' shows this has been the pattern across industries as diverse as computer disk drives, earth-moving equipment, steel making and low-cost air travel.[2]

For much of the time there is stability around markets where innovation of the 'do better' variety takes place and is well managed. Close relationships with existing customers are fostered and the system is configured to deliver a steady stream of what the market wants – and often a great deal more! (What Christensen calls 'technology overshoot' is often a characteristic of this,

where markets are offered more and more features which they may not ever use or place much value on but which come as part of the package.)

But somewhere else there is another group of potential users who have very different needs, usually for something much simpler and cheaper, which will help them get something done. Meeting these needs not only creates a new market but can also destabilize the existing one as customers there realize their needs can be met with a different approach. This phenomenon is known as 'disruptive innovation', and we'll explore it in more detail in a later chapter.

Disruptive innovation focuses our attention on the need to look for needs which are not being met, poorly met or sometimes where there is an overshoot. Each of these can provide a trigger for innovation – and often involves disruption because existing players don't see the different patterns of needs.

INNOVATION IN ACTION 6.5

Gaining a Competitive Edge Through Meeting Unserved Needs

The Nintendo Wii opened up radically new competitive space in the computer games industry and for a while enjoyed market leadership. The Wii console is not a particularly sophisticated piece of technology. Compared to the rivals Sony PS3 or the Microsoft Xbox it has less computing power, storage or other features and the games' graphics have a much lower resolution than major sellers like *Grand Theft Auto*. But the key to the phenomenal success of the Wii has been its appeal to an under-served market. Where computer games were traditionally targeted at boys, the Wii extends – by means of a simple interface wand – their interest to all members of the family. Add-ons to the platform like the Wii board for keep fit and other applications and the market reach extends, for example to include the elderly or patients suffering the after-effects of stroke.

Nintendo has performed a similar act of opening up the marketplace with its DS handheld device, again by targeting unmet needs across a different segment of the population. Many DS users are middle-aged or retired, and the bestselling games are for brain training and puzzles.

One powerful source of ideas at the edge comes from the developing world, where conditions are every different and radically new innovation options are beginning to emerge. Typically, the conditions in these markets are characterized by high volumes of demand – millions of people wanting goods and services – but limited financial resources. So the possibility for a low-cost airline type of approach – offering a simpler, cheaper version of the core product or service – is a very real opportunity. For example, think what a producer in China would do to an industry like pump manufacturing if it began to offer a simple, low-cost 'good enough' household pump for $10 (£6) instead of the high-tech, high-performance variants available from today's industry at prices 10 to 50 times higher?

INNOVATION IN ACTION 6.6

Low-Cost Innovation

India represents an interesting laboratory for the development of radically different products and services configured for a large but not particularly wealthy population. Examples include the Tata Nano car, developed and now on sale for around $3000 (£1850), and a mobile phone, which retails at $20 (£12). In 2010, the country's human resources development minister unveiled a $35 (£22) computer, targeted first at the school market (which is huge, around 110 million children in the first instance) and to be followed by higher education students. The minister commented that: 'The solutions for tomorrow will emerge from India. We have reached a stage that today, the motherboard, its chip, the processing, connectivity, all of them cumulatively cost around $35, including memory, display, everything.'

By way of comparison, this tablet-style computer will compete with Apple's iPad currently retailing in the United States for $450 (£275). It will be a simple but robust device, running on open-source Linux operating system, using Open Office software and will be powered by solar panel or batteries as well as mains electricity. It will have no hard drive but additional functionality can be provided via a USB port.

Importantly, it isn't just the case that fringe markets trigger simpler and cheaper innovations. Sometimes, the novel conditions spawn completely new trajectories. For example, the concept of 'mobile money' emerged from Africa, where the security risks of carrying cash round meant that people began to use the mobile phone system to provide an alternative way of moving money around. Systems like M-PESA have now grown in sophistication and widespread application in emerging markets like Africa and Latin America but are also offering a template for existing markets back in the industrialized world.

Case Study of M-PESA is available on the Innovation Portal at **www.innovation-portal.info**

Video Clip of an interview with Suzana Moreira, whose company, Mowoza, is a social innovator using the mobile money platform, is available on the Innovation Portal at **www.innovation-portal.info**

Case Study of the work of the Nokia Institute of Technology is available on the Innovation Portal at **www.innovation-portal.info**

Video Clip of an interview with Ana Sena, innovation manager at INdT, is available on the Innovation Portal at **www.innovation-portal.info**

Crisis Driven Innovation

Sometimes the urgency of a need can have a forcing effect on innovation – the example of wartime and other crises supports this view. For example, the demand for iron and iron products increased hugely during the Industrial Revolution and exposed the limitations of

INNOVATION IN ACTION 6.7

Living Labs

One approach being used by an increasing number of companies involves setting up 'Living Labs' which allow experimentation with and learning from users to generate ideas and perspectives on innovation. These could be amongst particular groups, for example in Denmark a network of such laboratories (http://www.openlivinglabs.eu/ourlabs/Denmark) is particularly concerned with the experience of ageing and the likely products and services which an increasingly elderly population will need. A description of the Lab and its operation can be found at http://www.edengene.co.uk/article/living-labs/.

In Brazil, the Nokia Institute of Technology (INdT) develops user-driven innovation platforms to support mobile products and services and as part of that process tries to enable the large-scale involvement of motivated communities. http://www.indt.org/. Its Mobile Work Spaces Living Lab is working in several technological fields and with communities across rural and urban environments.

the old methods of smelting with charcoal. It created the pull which led to developments like the Bessemer converter. In similar fashion the energy crisis has created a significant pull for innovation around alternative energy sources – and an investment boom for such work.

Case Studies of crisis driven innovations in the humanitarian sector are available on the Innovation Portal at **www.innovation-portal.info**

A powerful example of the impact crisis can have on driving innovation can be seen in the context of major humanitarian crises, for example after devastating earthquakes or hurricanes. The need to improvise solutions around logistics, shelter, health care, water and sanitation, and energy force a rapid pace of innovation.

INNOVATION IN ACTION 6.8

Humanitarian Innovation

ALNAP is a learning network of humanitarian agencies including organizations like the Red Cross, Save the Children and Christian Aid. It aims to share and build on experience gained through coping with humanitarian crises – whether natural or man-made – and has spent time reflecting on how many of the innovations developed as a response to urgent needs can be spread to others. Examples include high-energy biscuits which can be quickly distributed or building materials which can be deployed and assembled quickly into makeshift shelters. ALNAP's website gives a wide range of examples of such crisis driven innovations.

Source: Derived from www.alnap.org/resources/innovations.aspx

Towards Mass Customization

Another important source of innovation results from our desire for *customization*. Markets are not made up of people wanting the same thing – we all want variety and some degree of personalization. And as we move from a time where products are in short supply to one of mass production so the demand for differentiation increases. We can see this in the case of the motor car as one simple example. Arguably, Henry Ford's plant, based on principles of mass production, represented the most efficient response to the market environment of its time. But that environment changed rapidly during the 1920s, so that what had begun as a winning formula for manufacturing began gradually to represent a major obstacle to change. Production of the Model T began in 1909 and for fifteen years or so it was the market leader. Despite falling margins, the company managed to exploit its blueprint for factory technology and organization to ensure continuing profits. But growing competition (particularly from General Motors, with its strategy of product differentiation) was shifting away from trying to offer the customer low-cost personal transportation towards other design features – such as the closed body – and Ford was increasingly forced to add features to the Model T. Eventually, it was clear that a new model was needed and production of the Model T stopped in 1927.

Case Study of Model T Ford is available on the Innovation Portal at **www.innovation-portal.info**

There has always been a market for personalized custom-made goods (like tailored clothes) and services (e.g. personal shoppers, personal travel agents and personal physicians). But until recently there was an acceptance that this customization carried a high price tag and that mass markets could only be served with relatively standard product and service offerings.

However, a combination of enabling technologies and rising expectations has begun to shift this balance and resolve the trade-off between price and customization. 'Mass customization' (MC) is a widely used term which captures some elements of this. MC is the ability to offer highly configured bundles of non-price factors configured to suit different market segments (with the ideal target of total customization, i.e. a market size of one) but to do this without incurring cost penalties and the setting-up of a trade-off of agility vs. prices.

Of course, there are different levels of customizing – from simply putting a label 'specially made for . . . (insert your name here)' on a standard product right through to sitting down with a designer and co-creating something truly unique. Table 6.1 gives some examples of this range of options.

Understanding what it is that customers value and need is critical in pursuing a customization strategy – and it leads, inevitably, to the next source of innovation in which the users themselves become the source of ideas.

Users as Innovators

It is easy to fall into the trap of thinking about need pull innovation as involving a process in which user needs are identified and then something is created to meet those needs. This assumes that users are passive recipients, but this is often not the case. In many cases users

TABLE 6.1 Options in Customization

Type of customization	Characteristics	Examples
Distribution customization	Customers may customize product/service packaging, delivery schedule and delivery location but the actual product/service is standardized	Sending a book to a friend from Amazon.com. They will receive an individually wrapped gift with a personalized message from you – but it's actually all been done online and in its distribution warehouses. iTunes appears to offer personalization of a music experience but in fact it does so right at the end of the production and distribution chain
Assembly customization	Customers are offered a number of pre-defined options. Products/services are made to order using standardized components	Buying a computer from Dell or another online retailer. Customers choose and configure to suit their exact requirements from a rich menu of options – but Dell only starts to assemble this (from standard modules and components) when the order is finalized. Banks offering tailor-made insurance and financial products are actually configuring these from a relatively standard set of options
Fabrication customization	Customers are offered a number of pre-defined designs. Products/services are manufactured to order	Buying a luxury car like a BMW, where the customer is involved in choosing ('designing') the configuration which best meets their needs and wishes – for engine size, trim levels, colour, fixtures and extras, etc. Only when they are satisfied with the virtual model they have chosen does the manufacturing process begin – and they can even visit the factory to watch their car being built Services allow a much higher level of such customization since there is less of an asset base needed to set up for 'manufacturing' the service – examples here would include made-to-measure tailoring, personal planning for holidays, pensions, etc.
Design customization	Customer input stretches to the start of the production process. Products do not exist until initiated by a customer order	Co-creation, where end-users may not even be sure what it is they want but where – sitting down with a designer – they co-create the concept and elaborate it. It's a little like having some clothes made but rather than choosing from a pattern book they actually have a designer with them and create the concept together. Only when it exists as a firm design idea does it get made. Co-creation of services can be found in fields

(*continued*)

TABLE 6.1 (*Continued*)

Type of customization	Characteristics	Examples
		like entertainment (where user-led models like YouTube are posing significant challenges to mainstream providers) and in health care, where experiments towards radical alternatives for health care delivery are being explored – see, for example, the Design Council RED project, which is discussed on the Innovation Portal

Source: Derived from Lampel and Mintzberg.[3]

are ahead of the game – their ideas plus their frustrations with existing solutions lead them to experiment and create something new. And sometimes these prototypes eventually become mainstream innovations.

Eric von Hippel of Massachusetts Institute of Technology has made a lifelong study of this phenomenon and gives the example of the pickup truck – a long-time staple of the world automobile industry.[4] This major category did not begin life on the drawing boards of Detroit but rather on the farms and homesteads of a wide range of users who wanted more than a family saloon. They adapted their cars by removing seats, welding new pieces on and cutting off the roof – in the process prototyping and developing the early model of the pickup. Only later did Detroit pick up on the idea and begin the incremental innovation process to refine and mass produce the vehicle. A host of other examples support the view that user-led innovation matters, for example petroleum refining, medical devices, semiconductor equipment, scientific instruments and a wide range of sports goods and the Polaroid camera. Importantly, active and interested users (lead users) are often well ahead of the market in terms of innovation needs.

This phenomenon of user-led innovation is becoming increasingly significant, for example the Linux software which lies at the heart of mobile phones did not originate with a traditional corporation but rather a group of frustrated users who felt there were better ways to write and run operating systems and so built a community to create them. Studies of 'hidden

Video Clips made by Eric von Hippel with the 3M corporation exploring some of these ideas in greater detail are available on the Innovation Portal at **www.innovation-portal.info**

Case Studies of businesses – like Lego, Adidas and Threadless – which have made use of this approach are available on the Innovation Portal at **www.innovation-portal.info**

Video Clips of interviews with people like Catherina van Delden and Helle-Vibeke Pedersen who work actively in this space are available on the Innovation Portal at **www.innovation-portal.info**

innovation' suggest that a significant and growing number of people are involved in such innovation and it accounts for a surprising number of new ideas. And the idea doesn't stop with products: it is very relevant to services and the public sector. For example, the Danish government has had considerable success with engaging users in innovations around the tax system!

We'll explore this important theme in more detail in Chapter 16.

Watching Others – and Learning from Them

Another important source of innovation comes from watching others. Imitation is not only the sincerest form of flattery but also a viable and successful strategy for sourcing innovation. For example, the reverse engineering of products and processes and development of imitations – even around impregnable patents – is a well-known route to find ideas. Much of the rapid progress of Asian economies in the post-war years was based on a strategy of 'copy and develop', taking Western ideas and improving on them.

Tools such as competitiveness profiling, which provide structured ways for learning of this kind, are available on the Innovation Portal at **www.innovation-portal.info**

One powerful variation on this theme is the concept of 'benchmarking'. In this process enterprises make structured comparisons with others to try to identify new ways of carrying out particular processes or to explore new product or service concepts. The learning triggered by benchmarking may arise from comparing between similar organizations (same firm, same sector, etc.), or it may come from looking outside the sector but at similar products or processes.

For example, Southwest Airlines became the most successful carrier in the United States by dramatically reducing the turnaround times at airports— an innovation which it learnt from studying pit stop techniques in the Formula 1 Grand Prix events. Similarly, the Karolinska Hospital in Stockholm made significant improvements to its cost and time performance through studying inventory management techniques in advanced factories.

Benchmarking of this kind is increasingly being used to drive change across the public sector, via 'league tables' linked to performance metrics which aim to encourage the fast transfer of good practice between schools or hospitals and via secondment, visits and other mechanisms designed to facilitate learning from other sectors managing similar process issues such as logistics and distribution. One of the most successful applications of benchmarking has been in the development of the concept of 'lean' thinking, now widely applied to many public and private sector organizations. The origins were in a detailed benchmarking study of car manufacturing plants during the 1980s which identified significant performance differences and triggered a search for the underlying process innovations which were driving those differences.

Case Studies on organizations like Karolinska Hospital and sectors like the global automotive industry which have made use of benchmarking are available on the Innovation Portal at **www.innovation-portal.info**

Recombinant Innovation

Another wrong assumption which we often make about innovation is that it always has to involve something new to the world. The reality is that there is plenty of scope for crossover: ideas and applications which are commonplace in one world may be perceived as new and exciting in another. This is an important principle in sourcing innovation where transferring or combining old ideas in new contexts – a process called 'recombinant innovation' by US researcher Andrew Hargadon – can be a powerful resource.[5] The Reebok pump running shoe, for example, was a significant product innovation in the highly competitive world of sports equipment – yet, although this represented a breakthrough in that field, it drew on core ideas which were widely used in a different world. Design Works, the agency which came up with the design, brought together a team which included people with prior experience in fields like paramedic equipment (from which they took the idea of an inflatable splint providing support and minimizing shock to bones) and operating theatre equipment (from which they took the micro-bladder valve at the heart of the pump mechanisms.

Many businesses – as Hargadon points out – are able to offer rich innovation possibilities primarily because they have deliberately recruited teams with diverse industrial and professional backgrounds and thus bring very different perspectives to the problem in hand. His studies of the design company IDEO show the potential for such recombinant innovation work.

Nor is this a new idea. Thomas Edison's famous 'Invention Factory' in New Jersey was founded in 1876 with the grand promise of 'a minor invention every ten days and a big thing every six month or so'. It was able to deliver on that promise not because of the lone genius of Edison but rather from taking on board the recombinant lesson: Edison hired scientists and engineers from all the emerging new industries of early-twentieth-century USA. In doing so, he brought experience in technologies and applications like mass production and precision machining (gun industry) telegraphy and telecommunications, food processing and canning, automobile manufacture. Some of the early innovations which built the reputation of the business – for example the teleprinter for the New York Stock Exchange – were really simple crossover applications of well-known innovations in other sectors.

Case Study of the DOME (Designing out medical error) project looking at lessons which could be transferred between a variety of different worlds with the same basic problems of safety is available on the Innovation Portal at **www.innovation-portal.info**

Regulation

Photographs of the industrial towns around the Midlands in the United Kingdom taken in the early part of the twentieth century would not be much use in tracing landmarks or spotting key geographical features. The images, in fact, would reveal very little at all – not because of a limitation in the photographic equipment or processing but because the subject

matter itself – the urban landscape – was rendered largely invisible by the thick smog which regularly enveloped the area. Yet sixty years later the same images would show up crystal clear – not because the factories had closed (although there are fewer of them) but because of the continuing effects of the Clean Air Act and other legislation. They provide a clear reminder of another important source of innovation – the stimulus given by changes in the rules and regulations which define the various 'games' for business and society. The Clean Air Act didn't specify how but only what had to change. Achieving the reduction in pollutants emitted to the atmosphere involved extensive innovation in materials, processes and even in product design made by the factories.

Regulation in this way provides a two-edged sword: it both closes off avenues along which innovation had been taking place (and so restricts certain things) and opens up new ones along which change is mandated to happen.

One of the powerful drivers for moving into environmentally sustainable 'clean' technologies is the increasingly tough legislation in areas like carbon emissions and pollution.

And it works the other way: deregulation (the slackening-off of controls) may open up new innovation space. The liberalization and then privatization of telecommunications in many countries led to rapid growth in competition and high rates of innovation, for example.

Given the pervasiveness of legal frameworks in our lives, we shouldn't be surprised to see this source of innovation. From the moment we get up and turn the radio on (regulation of broadcasting shaping the range and availability of the programmes we listen to) to eating our breakfast (food and drink is highly regulated in terms of what can and can't be included in ingredients, how foods are tested before being allowed for sale, etc.) to climbing into our cars and buckling on our seatbelt while switching on our hands-free phone devices (both the result of safety legislation) the role of regulation in shaping innovation can be seen.

Regulation can also trigger counter-innovation – solutions designed to get round existing rules or at least bend them to one's advantage. The rapid growth in speed cameras as a means of enforcing safety legislation on roads throughout Europe has led to the healthy growth of an industry providing products or services for detecting and avoiding them. And at the limit, changes in the regulatory environment can create radical new space and opportunity. Although Enron ended its days as a corporation in disgrace because of financial impropriety, it is worth asking how a small gas pipeline services company rose to become such a powerful beast in the first place. The answer was its rapid and entrepreneurial take-up of the opportunities opened up by the deregulation of markets for utilities like gas and electricity.

Futures and Forecasting

Another way we can identify innovation possibilities is to imagine and explore into the future. What may be the key trends, where may the threats and opportunities lie? For example, Shell has a long history of exploring future options and driving innovations, most recently through its GameChanger programme. Various tools and techniques for forecasting and imagining

alternative futures have been developed to help work with these rich sources of innovation and we'll look at them in detail in the next chapter.

Video Clip of a podcast interview with Helen King of Bord Bia, the government body in Ireland responsible for supporting the food industry, exploring the ways in which futures can be used to drive an innovation agenda is available on the Innovation Portal at **www.innovation-portal.info**

Design-driven Innovation

One increasingly significant source of innovation is what researcher Roberto Verganti calls 'design-driven innovation'.[6] Examples include many of the recent successful Apple products where the user experience is one of surprise and pleasure at the look and feel, the intuitive beauty of the product. This emerges not as a result of analysis of user needs but rather through a design process which seeks to give meaning to the shape and form of products – features and characteristics which they didn't know they wanted. But it is also not another version of knowledge or technology push in which powerful new functions are installed. In many ways design-led products are deceptively simple in their usability. Apple's iPod was a comparative latecomer to the mp3 player market yet it created the standard for the others to follow because of the uniqueness of the look and feel – the design attributes. Its subsequent success with its iPad and iPhone owes a great deal to the design ideas of Jonathan Ive, which bring a philosophy to the whole product range and provide one of the key competitiveness factors to the company.

As Verganti points out, people do not buy things only to meet their needs; there are important psychological and cultural factors at work as well. In essence, we need to ask about the 'meaning' of products in people's lives – and then develop ways of bringing this into the innovation process. This is the role of design: to use tools and skills to articulate and create meaning in products – and to increase services as well. He suggests a map in which both knowledge/technology push and market pull can be positioned – and where design-driven innovation represents a third space around creating radical new concepts which have meaning in people's lives (Figure 6.3).

Video Clips of several media interviews looking at the role of design in enhancing services, for example Lynne Maher on patient-centred health care and the RED and Open Door cases, are available on the Innovation Portal at **www.innovation-portal.info**

Design features increasingly in the area of services and design methods and tools are being used to identify and work with user needs in a variety of contexts.

Related to the design idea is that of 'experience innovation', a concept first explored by Joseph Pine.[7] In an increasingly competitive world, differentiation comes increasingly from creating 'experience innovation', especially in services where fulfilling needs takes second place to the meaning and psychological importance of the experience. For example, the restaurant business moves from an emphasis on food as an essential human need towards increasingly significant experience innovation around restaurants as systems of consumption involving the product, its delivery, the physical and cultural context, etc. Increasingly, service providers such as airlines, hotels or entertainment businesses are differentiating themselves along such 'experience innovation' lines.

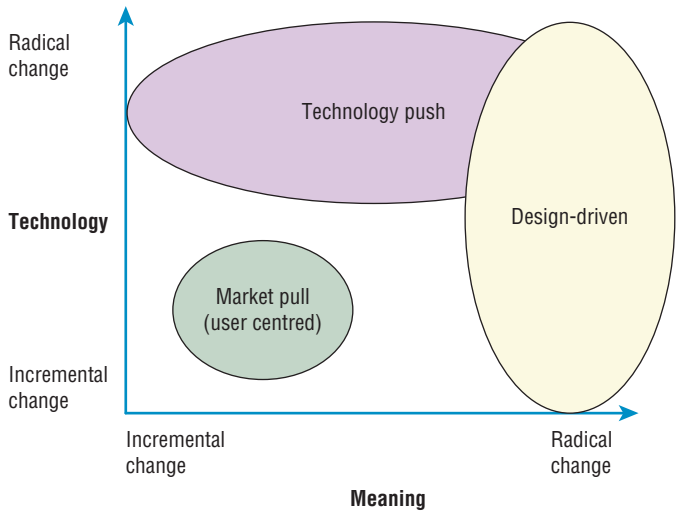

FIGURE 6.3 The role of design driven innovation

Source: Derived from R. Verganti (2009) *Design-Driven Innovation*. Boston: Harvard Business School Press

Accidents

Accidents and unexpected events happen – and in the course of a carefully planned R&D project they could be seen as annoying disruptions. But on occasions accidents can also trigger innovation, opening up surprisingly new lines of attack. The famous example of Fleming's discovery of penicillin is but one of many stories in which mistakes and accidents turned out to trigger important innovation directions. 3M's 'Post-it' notes began when a polymer chemist mixed an experimental batch of what should have been a good adhesive but which turned out to have rather weak properties – sticky but not very sticky. This failure in terms of the original project provided the impetus for what has become a billion-dollar product platform for the company.

In another example from the late 1980s, scientists working for Pfizer began testing what was then known as 'compound UK-92,480' for the treatment of angina. Although promising in the lab and in animal tests, the compound showed little benefit in clinical trials in humans. Despite these initial negative results the team pursued what was an interesting side effect which eventually led to UK-92,480 becoming sildenafil, and sold as the blockbuster drug Viagra.

The secret is not so much recognizing that such stimuli are available but rather creating the conditions under which they can be noticed and acted upon. As Pasteur is reputed to have said, 'Chance favours the prepared mind!' Using mistakes as a source of ideas only happens if the conditions exist to help them emerge. A study by Chesbrough of Xerox highlighted the fact that the company developed many technologies in its laboratories in Palo Alto which did not easily fit its image of itself as 'the document company'. These included Ethernet

(later successfully commercialized by 3Com and others and PostScript language and taken forward by Adobe Systems). In fact, 11 of 35 rejected projects from Xerox's labs were later commercialized with the resulting businesses having a market capitalization of twice that of Xerox itself.

In similar fashion shocks to the system which fundamentally change the rules provide not only a threat to the existing status quo but also a powerful stimulus to find and develop something new. The tragedy of the 9/11 bombing of the Twin Towers served to change fundamentally the public's sense of security – but it has also provided a huge stimulus to innovate in areas like security, alternative transportation, fire safety and evacuation, etc.

INNOVATION IN ACTION 6.9

Cleaning up by Accident

Audley Williamson is not a household name of the Thomas Edison variety but he was a successful innovator whose UK business sold for £135 million in 2004. The core product which he invented was called Swarfega and offered a widely used and dermatologically safe cleaner for skin. It is a greenish gel which has achieved widespread use in households as a simple and robust aid with the advertising slogan 'Clean hands in a flash!' But the original product was not designed for this market at all. It was developed in 1941 as a mild detergent to wash silk stockings. Unfortunately, the invention of Nylon and its rapid application in stockings meant that the market quickly disappeared and so Williamson was forced to find an alternative. Watching workers in a factory trying to clean their hands with an abrasive mixture of petrol, paraffin and sand which left their hands cracked and sore led him to rethink the use of his gel as a safer alternative.

Source: Derived from *The Independent*, 28/2/2006, p. 7.

Summary

- Innovations don't just appear perfectly formed – and the process is not simply a spark of imagination giving rise to changing the world. Instead, innovations come from a number of sources and these interact over time.
- Sources of innovation can be resolved into two broad classes: knowledge push and need pull – although they almost always act in tandem. Innovation arises from the interplay between them.
- There are many variations on this theme (e.g. 'need pull' can include social needs, market needs, latent needs 'squeaking wheels', crisis needs).
- While the basic forces pushing and pulling have been a feature of the innovation landscape for a long time, it involves a moving frontier in which new sources of push and pull come into play. Examples include the emerging demand pull from the 'bottom of the pyramid' and the opportunities opened up by an acceleration in knowledge production in R&D systems around the world.
- Regulation is also an important element in shaping and directing innovative activity: by restricting what can and can't be done for legal reasons, new trajectories for change are established which entrepreneurs can take advantage of.

Further Resources

The long-running debate about which sources – demand pull or knowledge push – are most important is well covered in Freeman and Soete's book *The Economics of Industrial Innovation* (MIT Press, 3rd edition, 1997). Particular discussion of fringe markets and unmet or poorly met needs as sources of innovation is covered by Christensen, Anthony and Roth in *Seeing What's Next* (Harvard Business School Press, 2007), Utterback in 'High End Disruption' (*International Journal of Innovation Management*, 2007) and Ulnwick in *What Customers Want: Using outcome-driven innovation to create breakthrough products and services* (McGraw-Hill, 2005), while the 'bottom of the pyramid' and extreme user potential is explored by Prahalad in *The Fortune at the Bottom of the Pyramid* (Wharton School Publishing, 2006). User-led innovation has been researched extensively by Eric von Hippel (http://web.mit.edu/evhippel/www/). Frank Piller, a professor at Aachen University in Germany, has a rich website around the theme of mass customization with extensive case examples and other resources (http://www.mass-customization.de/); the original work on the topic is covered by Pine in *Mass Customisation: The new frontier in business competition* (Harvard University Press, 1993). High involvement innovation is covered by Bessant in *High Involvement Innovation* (John Wiley & Son, Ltd., 2003) and lean thinking ideas and tools by

Jones and Womack in *Lean Solutions* (Free Press, 2005). Andrew Hargadon has done extensive work on 'recombinant innovation' in *How Breakthroughs Happen* (Harvard Business School Press, 2003) and Mohammed Zairi provides a good overview of benchmarking in *Effective Benchmarking: Learning from the best* (Chapman & Hall, 1996).

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4. Von Hippel, E. (2005) *The Democratization of Innovation*. Cambridge, MA: MIT Press.
5. Hargadon, A. (2003) *How Breakthroughs Happen*. Boston: Harvard Business School Press.
6. Verganti, R. (2009) *Design-driven Innovation*. Boston: Harvard Business School Press.
7. Pine, J. and J. Gilmore (1999) *The Experience Economy*. Boston: Harvard Business School Press.

Deeper Dive explanations of innovation concepts and ideas are available on the Innovation Portal at **www.innovation-portal.info**

Quizzes to test yourself further are available online via the Innovation Portal at **www.innovation-portal.info**

Summary of online resources for Chapter 6 – all material is available via the Innovation Portal at www.innovation-portal.info

Cases

- 3M
- Philips
- Corning
- Spirit
- Torbay Hospital
- Karolinska Hospital
- Aravind Eye Clinics
- Lifespring Hospitals
- NHL hospitals
- M-PESA
- Nokia Institute of Technology
- Crisis driven innovation in humanitarian sector
- Model T Ford
- Lego
- Adidas
- Threadless
- DOME project
- Global automobile industry
- RED
- Open Door

Media

- Veeder Root
- Emma Taylor, Denso
- Torbay Hospital
- No delays
- Lynne Maher
- Suzana Moreira
- Ana Sena
- Eric von Hippel
- Frank Piller
- Helle-Vibeke Pedersen, Danish Ministry of Taxation
- Catherina van Delden, Innosabi
- Helen King, Bord Bia

Tools

- Continuous improvement toolkit
- Competitiveness profiling
- Value curves
- Benchmarking

Activities

- Innovation family trees
- Competitiveness profiling

Deeper Dive

- Policy deployment
- Crisis driven innovation