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Innovation in the Twenty-First Century

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1.1 Introduction

> *It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change*
>
> (Charles Darwin)

Darwin was right. His famous comment underlines one of the key challenges facing organizations – unless they are prepared to change what they offer the world and the ways they create and deliver those offerings they could be in trouble. The challenge is not whether or not to innovate, but *how?* This makes building the capability to deliver a steady stream of innovation a strategic imperative, not just for commercial organizations, but for any enterprise dealing with the turbulent conditions of the early twenty-first century. Public services struggling to balance rising demand and expectations of high quality delivery against the rising costs of provision need to seek new ways of meeting social needs. Third sector organizations concerned with improving social conditions recognize the importance of thinking and working in new directions if they are to gain attention and acquire the resources they need to carry through their agenda.

Innovation is about change and this can take place along a spectrum of increasing novelty, from simple incremental improvements – "doing what we do, but better" – through to radical, new to the world changes. The risks involved vary, as do the benefits,but it is clear that even sustaining growth through incremental innovation is not going to happen by accident. Any organization might get lucky once but in order to be

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able to repeat the trick there is a need for some kind of organized, structured approach to managing the process. This needs to find answers to two key questions:

- *Where* can we innovate?

and

- *How* can we innovate?

The trouble is that innovation involves trying to hit a moving target. Environments constantly shift and pose new threats – new technologies appear, new markets emerge, the regulatory framework changes – and unless organizations have the capacity to innovate their approaches to innovation they may not survive in the long term. History is clear about this – very few organizations are long-term survivors and those which have managed to stick around for over 100 years have made some major changes to what they do and how they do it (Francis *et al*., 2003).

Sometimes the changes are pretty dramatic, challenging the roots of where the company began and overturning a lot in the process. TUI, for example, is the largest European travel and tourism services company, owning (amongst others) Thomson Holidays, Britannia Airways, and Lunn Poly travel agents. Its origins, however, go back to 1917 where it began as the Prussian state-owned lead mining and smelting company! Nokia's key role as a leader in mobile telephony hides its origins as a diverse timber products conglomerate with interests as wide as rubber boots and toilet paper! One of the oldest companies in the world is the Stora company in Sweden, which was founded in the twelfth century as a timber cutting and processing operation. It is still thriving today – albeit in the very different areas of food processing and electronics.

A key dimension when exploring innovation lies in the concept of responsibility. Clearly, not all innovations are necessarily good things. Others may start out offering positive benefits, but later turn out to have unintended negative consequences. The famous example of DDT is a case in point – originally hailed as a breakthrough innovation in the field of pesticides it later turned out to have significant negative impacts. Other examples include the pharmaceutical thalidomide, nuclear power, and chlorofluorocarbons (CFCs) used as refrigerants and propellants.

The key issue is around how far we explore and consider innovation in its early stages in terms of the potential impacts it might have, and how far we are able and prepared to modify, ameliorate, or possibly abandon, projects which have the potential for negative effects – what Owen *et al*. (Chapter 2) describe as the dimension of responsiveness. It is this dimension and others (anticipation, reflection, and deliberation) which together underpin the concept of responsible innovation. The ways in which this can be conceptualized and operationalized in the face of uncertainty form the core theme of this book. Interestingly, much of the academic and policy-oriented innovation research tradition evolved around such concerns, riding on the back of the science and society movement in the 1970s. This led to key institutes (like the Science Policy Research unit at Sussex University) being established (Cole *et al*., 1973). While a sophisticated toolkit of approaches and resources emerged from much of this pioneering work, its use has often been limited and considerations of "responsible innovation" have often been marginalized in strategic management thinking (although there have been some high profile exceptions, such as the long-running debate around genetically modified food – see Von Schomberg (Chapter 3).

The key themes and content of responsible innovation will be explored in detail in later chapters in this book. The purpose of this chapter is to look at how the twenty-first century environment is changing and the challenges this poses for innovating organizations: important context for the discussions of responsible innovation that follow. In the face of some radical technological, market, social, and political shifts, how should they be thinking in terms of adapting and configuring their innovation processes? What are the strategic options open to them and how could they best explore the innovation space? Of the bundle of learned behavior patterns which they make use of, which ones should they be doing more of, reinforcing and strengthening? Which ones should they be doing less of, or even stopping – things which worked in the past but may no longer be suitable approaches? And which new behaviors are they going to need to learn and practice to take advantage of the newly – emerging context in which they are operating?

Before we move to the challenges it is worth spending a little time looking at two core questions around where and how organizations could innovate.

1.2 How Can We Innovate? – Innovation as a Process

Unlike the cartoon image, innovation requires a little more than just a light-bulb moment as an idea flashes above someone's head. In reality it involves a journey, growing and shaping the original trigger idea into something which can spread across a population and create value. As Figure 1.1 shows, traveling along this road means finding answers to some key questions:

No organization starts with a perfect model of the innovation process. Instead it is something they build up through a learning process, trying out new behaviors and hanging on to those which work. Eventually these patterns of repeated and learned behaviors – "routines" – become embedded in "the way we do things around here" and take shape in the form of policies, procedures, and rules (Nelson and Winter, 1982; Zollo and Winter, 2002). They will vary between organizations – everyone finds their

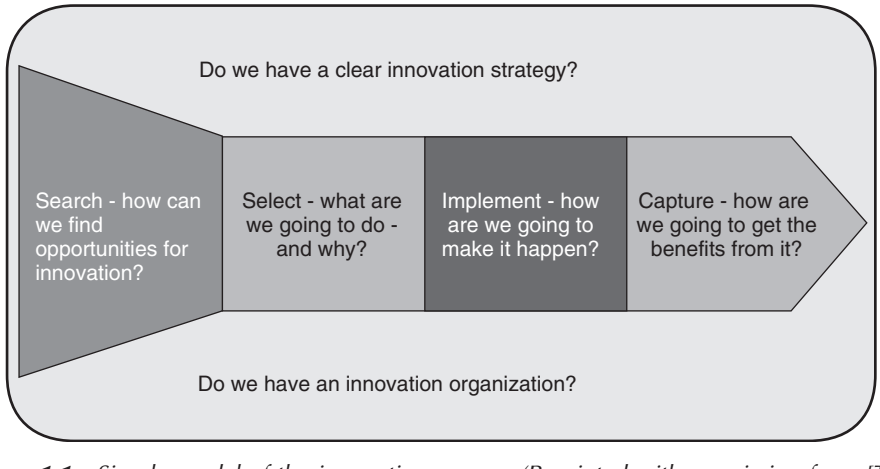

Figure 1.1 *Simple model of the innovation process (Reprinted with permission from [Tidd and Bessant, 2009] Copyright (2009) John Wiley & Sons Ltd)*

own particular way of answering the basic questions and some recipes work better than others. This is useful, since it allows us to learn not only through experience but also by watching how others manage the innovation task and grafting on useful new approaches and ideas.

However, we should also recognize that learning to manage innovation is not just a matter of building capability to deal with the questions of searching, selecting, implementing, and so on. Environments are unpredictable and complex, so we don't know what will emerge in the way of new threats or opportunities. So the key to long-term innovation management success is to build "dynamic capability" – to be able to step back and review our innovation process and reconfigure it on a continuing basis (Teece *et al*., 1997). This is as much about letting go of old routines as it is about developing new ones.

1.3 Where Could We Innovate? – Innovation Strategy

Innovation can take many different forms – as Figure 1.2 suggests, there is plenty of space to explore (Francis and Bessant, 2005). We can think of four core dimensions:

- "product innovation" – changes in the things (products/services) which an organization offers;

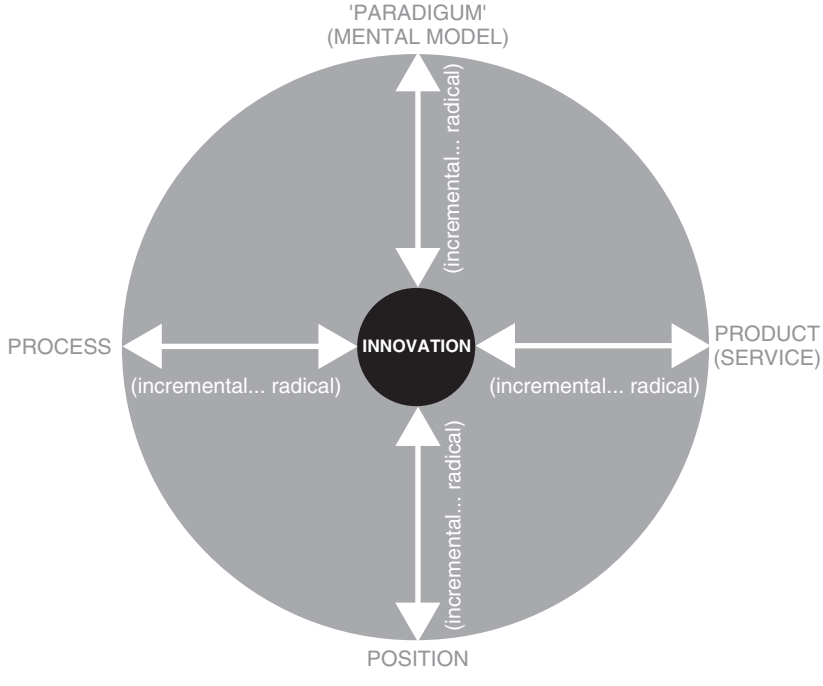

Figure 1.2 *Exploring the innovation space (Reprinted with permission from [Tidd and Bessant, 2009] Copyright (2009) John Wiley & Sons Ltd)*

- "process innovation" – changes in the ways in which products and services 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.

Table 1.1 gives some examples of these. In reality, of course, various combinations of incremental and radical innovation across these fields are possible. The key issue for any organization is to ensure that it explores its options thoroughly – it may choose not to pursue every idea but it is important to avoid being surprised!

1.4 Reframing Innovation

As I have discussed above, organizations create routines for managing the basic challenges of search (for innovation trigger signals), selection (resource allocation) and implementation. However, no organization can look at and respond to all the signals, and so it defines a search and selection space within which it innovates – and this selection environment shapes what it pays attention to and what it decides to do about it. It is of course not the only way of looking at the environment – reframing brings new challenges and opportunities to light and opens up new options for solving problems. This is what entrepreneurs do – seeing new or different elements within a different frame and exploiting innovation opportunities for this. This sets up the competitive dynamics which characterize innovation.

Established players are typically strong within their framed environment and have developed well-rehearsed and effective routines for dealing with it (March, 1991). But this can also mean that they lack the ability to search and explore in different ways or directions – often expressed as an inability to "think outside the box." At the limit – as Dorothy Leonard argues – their core competencies may become core rigidities, limiting the organization's ability to deal with changing conditions (Leonard, 1992).

We can map this challenge as in Figure 1.3, which provides a simple model of the innovation space. The vertical axis refers to the core activity of innovation – search, select, and implement – carried out in incremental steps or big leaps. The horizontal axis relates to environmental complexity – the number of different elements and the ways in which they interact. As we move to the right, new elements are brought into the frame and new challenges and opportunities emerge.

Using this space we can see four "zones" which have different implications for innovation management. Zones 1 and 2 are essentially the familiar territory of innovation, where established players dominate. They have well-developed routines for handling the search and selection problem and can not only exploit their well-defined space but also push its frontiers along key trajectories.

It is in zones 3 and 4 that the problems emerge for them since, by definition, these spaces involve bringing new elements into the frame and exploring new combinations. The old rules of the game don't apply here, and it is in this space that the entrepreneur's skills come to the fore. Being open and flexible and being able to reframe and reconfigure are key strengths and it is here that dynamic capability

Table 1.1 *Potential directions for innovation strategy*

Innovation type	Incremental – do what we do but better	Radical – do something different
Product – what we offer the world	Windows 7® and Windows 8® replacing Vista® and XP® – essentially improving on an existing software idea	New to the world software – for example, the first speech recognition program
	New versions of established car models – for example, the VW Golf essentially improving on established car design	Toyota Prius – bringing a new concept – hybrid engines. Tesla – high performance electric car.
	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 similar 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	Häagen-Daz® changing the target market for ice cream, from children to consenting adults	Addressing underserved markets – for example, the Tata Nano aimed at the emerging but relatively poor Indian market with cars priced around $2000
	Airlines segmenting service offering for different passenger groups – Virgin Upper Class, BA Premium Economy, and so on	Low cost airlines opening up air travel to those previously unable to afford it – create new markets and also disrupt existing ones
	Dell® and others segmenting and customizing computer configuration for individual users	Variations on the ''One laptop per child'' project – for example, Indian government $20 computer for schools

Table 1.1 *(continued)*

Innovation type	Incremental – do what we do but better	Radical – do something different
	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, and so on	''Bottom of the pyramid'' (Prahalad, 2006) approaches using a similar principle but tapping into huge and very different high volume/low margin markets – Aravind eye care, Cemex® construction products
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 into artificial eyesight	Grameen Bank and other microfinance models – rethinking the assumptions about credit and the poor iTunes® platform – a complete system of personalized entertainment Cirque du Soleil – redefining the circus experience
	Dyson® redefining the home appliance market in terms of high performance engineered products	Amazon, Google, Skype – redefining industries like retailing, advertizing, and telecoms through online models
	Rolls Royce – from high quality aero engines to becoming a service company offering ''power by the hour''	Linux®, Mozilla®, Apache® – moving from passive users to active communities of users co-creating new products and services
	IBM®, from being a machine maker to a service and solution company – selling off its computer-making operations and building up its consultancy and service side.	

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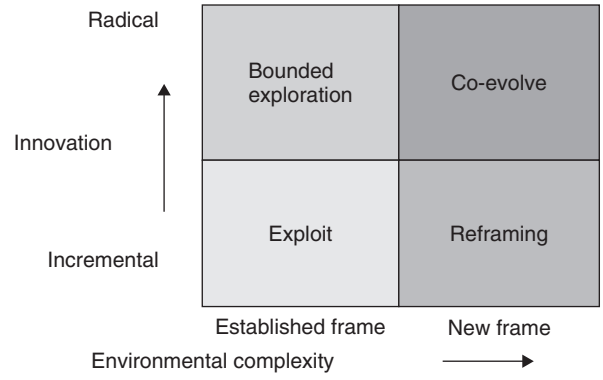

Figure 1.3 *Framing innovation space*

is an essential requirement. The problem for established players is that they cannot simply abandon their old approaches and adopt new ones – they face the challenge of overcoming well-established mindsets which see the world in particular ways – and they often have significant investments in the old spaces which they are unable or unwilling to relinquish. For them the challenge is exploring new spaces whilst simultaneously maintaining a "mainstream" approach to innovation; many writers talk about the problem of "ambidexterity" in this connection (Tushman and O'Reilly, 1996; Benner and Tushman, 2003; Birkinshaw and Gibson, 2004).

In particular, the reframing problem is difficult because it requires *rewiring* the knowledge systems which organizations use. As long as they stay within the frame, knowledge flows support a virtuous circle of *sustaining* innovation (Christensen, 1997). Smart firms are often radical innovators, pushing the frontiers of knowledge through extensive exploration, and they become adept at working closely with customers, suppliers, and other players to help them run a successful innovation system in which regular and well-managed searching leads to the kinds of innovations which that group of players value. Building strong ties generates a healthy flow of innovation and everyone wins.

However, when there is a need to look through a different frame, this set of assets becomes a liability. Knowledge flows along different channels and between different points, and new and different connections must be made. For a newcomer firm that is not a problem – its knowledge networks are laid down from scratch and the new opportunities offered by the emerging new model can start to be exploited. The trouble is that for established players there is a natural tendency to reinforce the existing systems since they used to work so well. This risks compounding the problem – the old networks can get in the way, overriding or clashing with the emerging new ones (Henderson and Clark, 1990).

This is at the heart of Christensen's observations about disruptive innovation. For example, when the computer disk drive industry began to change with the emergence of new players, the response of the incumbent players was not to sit still and do nothing. The problem was not that they did not listen to customers – they listened really well – but they were listening to the *wrong* customers and the organizational systems for reward

and reinforcement supported the old wiring and made the emergence of new connections very difficult (Christensen, 1997).

1.5 Reframing Challenges for Twenty-First Century Innovation

It follows from the above model that moving into new innovation space involves being able to reframe in order to see and exploit new opportunities. Standing still may not be an option – staying on the left-hand side of the model risks something emerging on the right-hand side which disrupts the game – a pattern we have increasingly seen across sectors and even whole industries. For example, the role of the internet in opening up innovation space to new elements and players has radically transformed industries as diverse as bookselling, music creation and distribution, share dealing, banking, insurance, and travel.

In the following section we will look at three megatrends which are opening up the frame of innovation management, pushing us into the right-hand zones. They offer significant opportunity to those able to reframe, but may also pose threats to existing players unless they are able to deploy dynamic capability in reconfiguring their approaches. These challenges – which I call "spaghetti," "Sappho," and "sustainability" – are examples of a much broader range of issues which are emerging along the innovation frontier and which require us to rethink our approaches to innovation management.

1.5.1 The Spaghetti Challenge

At the heart of the innovation process is an engine which runs on knowledge. The fuel for innovation is different kinds of knowledge – about technological possibilities, market needs, legal options, financial issues, political enablers and constraints, and a host of other diverse knowledge sets. The innovation process works by weaving the various strands of this "knowledge spaghetti" into something which creates value (Bessant and Venables, 2008).

As I have noted earlier, we have learned a lot about effective ways to manage this knowledge spaghetti, bringing different knowledge sets together in various forms to build organizations which can deliver a steady stream of innovation. We recognize that innovation is a multi-player game; successful innovators work with a network of knowledge sources to create value. They understand and work with customers, drawing their knowledge into the process. They collaborate with key suppliers, bringing their expertise to bear. They may link to specialist institutions – universities, banks, technical centers – to pull in external knowledge, and they recruit new staff to bring knowledge into the organization. Within the organization they configure for knowledge flows between functions, units, and departments to allow for optimum combination, and they invest in creating their own knowledge – through R&D, market research, forecasting the future, and so on (Griffin *et al*., 1996; Dodgson *et al*., 2008; Goffin and Mitchell, 2010).

The idea of innovation as a knowledge-based, multi-player game is, of course, not new. Carter and Williams, for example, carried out a pioneering study in 1957 of "technically progressive" firms in the UK and found that the degree of "cosmopolitan" orientation

(as opposed to "parochial") was a significant determinant of innovation success (Carter and Williams, 1957). In other words, those organizations with rich networks of connections were more likely to be successful innovators. This theme emerged in the many major studies of innovation throughout the 1960s and 1970s, – for example, Project SAPPHO stressed linkages as a critical factor while the Manchester "Wealth from knowledge" research provided extensive case examples of award-winning innovators who shared a common external orientation (Langrish *et al*., 1972; Rothwell, 1992).

But we are working at a moving frontier, along which an increasing number of people are brought into the innovation game through a growing number of channels. Powerful technological shifts around information and communication, coupled with major social changes (in particular the rise of social networking) means that *the context in which innovation takes place is significantly different to even a decade ago*. A problem emerges when the amount of knowledge and its distribution outstrips the models we have been using to weave knowledge spaghetti to create value.

In his pioneering work on innovation management, Roy Rothwell drew attention to models of innovation which policy agents and practitioners make use of – how they think the innovation process works – and the limitations of these (Dodgson and Rothwell, 1995). Such mental models are important because they shape what decision-makers pay attention to, what they commit resources to, and how they manage the process. He suggested five generations of thinking about innovation management, moving from the simplistic linear push or pull models of the 1960s, through increasingly sophisticated coupling models which recognize the need for intra- and inter-organizational links. His 1992 paper predicted a fifth generation which would involve extensive use of ICT(information and communications technology), rich and diverse networking, which was globally-distributed (Rothwell, 1992). Within such a highly networked, multi-actor environment he foresaw that the emergent properties of the innovation system would be likely to require different approaches.

Table 1.2 gives some examples of the massive acceleration of change along several knowledge-linked trajectories which has changed the global landscape, and with it the innovation agenda. The issue for new and established organizations is increasingly one of finding new models to work in this "fifth generation" innovation world.

Under these conditions – an explosion of knowledge – the innovation emphasis moves from knowledge creation to knowledge *flow*. It is a much more fluid, open game with a constant swirl of knowledge around organizations, moving into and out from them. The term open innovation was coined by US professor Henry Chesbrough in 2003 and it neatly encapsulates the challenge. In a world which is so rich in knowledge, the message for even the largest, most research-active organization is clear – "*not all the smart guys work for us*."

This has huge implications for the ways in which organizations work on innovation – as we can see in the well-documented case of the giant Procter and Gamble corporation (Huston and Sakkab, 2006). In the late 1990s they faced a number of innovation challenges; as CEO Alan Lafley explained: "*Our R&D productivity had levelled off, and our innovation success rate – the percentage of new products that met financial objectives – had stagnated at about 35%*." Their response was to implement Connect + Develop$^{(SM)}$ – an innovation process based on open innovation principles (Lafley and Charan, 2008). The original target was to get 50% of innovations coming from outside the company. At the time only 35% of new products had elements which originated from outside. R&D productivity has since increased by nearly 60% and the innovation

Table 1.2 *Changing context for innovation*

Context change	Indicative examples
Acceleration of knowledge production	OECD estimates that around $750 billion 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, and China) nations – so there is 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® third largest R&D Centre employing thousands of scientists and engineers is now in Shanghai, China.
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 (Prahalad, 2006) 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 poses 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,'' while 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 (Von Hippel, 2005). In sectors like media, the line between consumers and creators is increasingly blurred – for example, You Tube® has around 100 million videos viewed each day but also has over 70 000 new videos uploaded every day from its user base.
Development 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 has reduced the separation between users and producers (Schrage, 2000; Gann, 2004).

success rate more than doubled – yet their R&D spend reduced from 4.8% of turnover in 2000 to 3.4% in 2007.

Successful open innovation strategies require new ways of accessing a wide and diverse set of ideas (NESTA, 2010) and connecting these to sites within the organization which can make effective use of them. In turn, this raises questions of networking and knowledge management, issues identified by Allen back in the 1970s but which are now coming to the fore in an era of social networking and enabling technologies (Allen, 1977; Dahlander and Gann, 2008). Much of the new challenge is about combining and creating communities of practice around key themes which transcend traditional organizational boundaries (Wenger, 1999; Brown and Duguid, 2000; Lafley and Charan, 2008).

Many organizations are using open innovation approaches – organizations such as the BBC®, LEGO®, and Ordnance Survey® are, for example, increasingly extending their networks to engage communities of software developers, sharing source code and inviting them to "*use our stuff to build your stuff*." This is the highly successful open model behind the Apple® Developer® Connection, an online community allowing thousands of developers to create applications which make the core product more attractive.

"Crowdsourcing" is another variant of open innovation, whereby companies open up their innovation challenges to the outside world, often in the form of a web-enabled competition. Swarovski®, the crystal company, has, for example, deployed crowdsourcing approaches to expand its design capacity, while Audi and BMW use it to prototype and explore new features. Other examples include:

- OSRAM, a leading lighting manufacturer which initiated a user idea generation platform. Designers and interested persons worldwide were invited to join the "LED-Emotionalize your light" community to create innovative light solutions with the latest LED (light emitting diode) technology. The goal of the contest was to involve interested users, developers, designers, and engineers in the innovation process in a new and exciting manner. Within only 11 weeks, 909 participants from nearly 100 countries joined the lighting community to showcase their talent and submit their ideas, including designs, technical solutions, and application scenarios of LED solutions. In total, they created 568 LED ideas and concepts in different segments, such as furniture, bathroom, outdoor locations, toys and children's play locations.
- The business model of Netflix®, the online and mail-order film rental business, depends on having a good understanding of what people want and tailoring advertising and offers to their preferences. In 2006, in an effort to improve the algorithm it used to develop these recommendations, it offered a $1 million reward – the Netflix Prize – to anyone who could improve the performance of its algorithm by 10% or better. Over 18 000 contestants from 125 countries registered within three months; within three years, there were 51 000 contestants from 186 countries, with 44 000 valid entries. Netflix's huge, global, if temporary, R&D laboratory that it created from the competition, produced over 7000 better algorithms.
- As the year 2000 approached, the mining company Goldcorp® was wrestling with the challenge of finding new sources of gold. In a radical departure from conventional surveying approaches the firm opened up its geological database and asked for ideas

about where it should prospect. Tapping into the combined insights of 1200 people from 50 countries helped the company locate 110 new sites, 80% of which produced gold. The business has grown from $100 million in 1999 to over $4 billion today.

The crowdsourcing model has also been applied in a variety of settings, including public sector and social enterprise. For example, the Bavarian government runs an innovation contest, encouraging its citizens to suggest ideas for new public services and how to improve the existing ones. In 2006 the Seoul Metropolitan Government launched an "ideas bank," inviting citizens to suggest ways of improving public services; by 2007 it was receiving around 140 ideas per day (74 000 over the year) and 1300 were implemented.

Researchers at the University of Erlangen-Nuremberg and the Center for Leading Innovation and Cooperation (CLIC) have identified and classified more than 360 innovation contests (www.innovation-contest.org). This database shows how widely the approach is being used and also the different forms in which such an open model can be deployed.

Another development has been the rise of innovation markets – essentially using the e-Bay® principle to link communities around innovation themes. A good example is InnoCentive® (www.innocentive.com) – an online marketplace where innovation seekers and solution providers meet. The company was launched in 2001 by former employees of Eli Lilly & Co and offers a broad range of open innovation services to companies to leverage their internal R&D with external innovators. R&D problems are framed as challenges and offered on the online marketplace to a large community of more than 200 000 innovators (so-called solvers) worldwide. Successful solvers are offered a cash award for their submissions. From an organizational perspective, InnoCentive acts as an intermediary between companies seeking solutions to innovation challenges and innovators worldwide interested in proposing solutions to these challenges.

Recombinant innovation is another variant of open innovation, using ideas developed in one world to good effect in another. Cross-sector learning throws some unlikely partners together and opens up new ways of looking at old problems. For example, low cost airlines like Ryanair® and Easyjet® learned about rapid turnaround in airports by watching pit stop teams in Formula1®, while the UK National Health Service is learning powerful lessons about patient safety from oil rigs, chemical plants, and aircraft cockpits.

Open innovation is not simply about casting a wide net. It may also involve a more intimate exchange of ideas, requiring a high degree of trust, between new partners who may be able to share ideas and intellectual property but who would not normally have made such a connection. Third party agencies, innovation brokers, often act as intermediaries that bring parties together and enable the sharing of ideas in a controlled and high trust environment. Models used range from online dating agencies through to more people-based approaches, such as the trusted intermediary model used by the Innovation Exchange®, which places skilled individuals within companies and then enables those individuals to regularly share information under high trust conditions.

Opening up the innovation search activity and reframing from closed to open models is clearly a rich source of new opportunity but exploiting it will depend on building

new innovation management capabilities – and letting go of some well-established ones. Amongst the challenges which moving to open innovation poses are:

- **Intellectual property management** – in an open innovation world how do creators of knowledge appropriate the gains from their investments in creating knowledge?
- **Connectivity** – how are the rich new linkages which social and technological change make possible enabled? Who/what are the mechanisms for broking and bridging between different knowledge worlds, and how can the skills for doing this be developed?
- **Network-building** – research has shown that an effective team is not simply a collection of individuals but the result of complex dynamics around "*forming, storming, norming, and performing*" (Tuckman and Jensen, 1977). In the same way, new knowledge networks need to be constructed but this raises challenges of "finding, forming, and performing" (Birkinshaw *et al*., 2007).

1.5.2 The Sappho Challenge – Bringing Stakeholders into the Frame

A significant strand of research concerns the concept of user-led innovation (Von Hippel, 1988, 2005; Herstatt and von Hippel, 1992). We know that users are rarely passive in the innovation process – they are often frustrated with the available solutions and sometimes that frustration drives them to create their own alternative solutions. They may do this on their own, producing sketches and prototypes, or they may work with others to help them realize their ideas. Without doubt user-led innovation is a powerful force – especially when it engages a community of such frustrated innovators. That, of course, is the story behind Linux – now a vibrant community of software developers and users supporting and continuously extending a powerful operating system in widespread use. But there is no Linux Corporation with formal R&D, marketing, and other facilities – instead it is a community which grew out of the dissatisfaction with proprietary systems felt by Linus Torvald and other early users who began to develop and share their ideas about an alternative.

While already a well-documented and important source of innovation, the emergence of powerful communication technologies which enable active co-operation of user communities in co-creation and diffusion has accelerated the trend toward more active engagement of users (Von Hippel, 2005; Dahlander and Gann, 2008, 2010).

A good illustration comes from Daimler-Benz who initiated the "*style your Smart*" design contest as a user-linked crowdsourcing project (www.smart-design-contest.com/). The aim was not just to attract interesting design ideas but also to try to establish a relationship with a community of active users. Participants from all over the world were invited online to style the skin of the Smart car, vote for the designs of others and comment on them. The online platform combined an innovation contest with the full functionality of a state-of-the art community platform, including a Facebook-connect® feature and a Twitter® channel. Besides the highly interactive and attractive community-based innovation contest, several prizes for the best designs, as well as the most active members, were offered as additional incentives to fuel motivation and the level of engagement of the participants. A five-star community evaluation and a smart internal expert round helped to pre-select the most attractive designs and the

best designs were selected by an expert jury. Within a period of only six weeks, the contest attracted 8864 participants from 110 nations worldwide. In total, the participants contributed 52 170 designs and spent 12 723 hours on the platform.

Increasingly companies like LEGO®, Threadless®, Adidas®, and Muji are engaging with users as front-end co-creators of new products and services.[1] In the public sector too there is growing use of these approaches to create innovative and more successful public services. Hospitals increasingly focus on patients as a source of experience-based design input, while innovative partnerships, like Nokia's Living Lab, work closely with users, co-developing services for long-term care.

Innovation of this form often takes place entirely within the user community as a co-operative enterprise – the examples of Linux®, Mozilla®, and Apache® software projects underline the potential of such emergent properties as an alternative to R&D centered on the firm. At its limit, this involves communities creating innovation amongst and for themselves, with the resulting innovations only then being appropriated by the traditional corporate agents in public and private sectors – a significant reversal of the traditional innovation model. Much public sector innovation is driven by the needs of particular groups in society and finding ways of engaging their creativity and entrepreneurial drive to co-create new approaches to delivering those services offers a powerful alternative innovation model (Murray *et al*., 2010; Bason, 2011).

As Eric von Hippel points out, there is a class of user whose needs require particular solutions which lie far ahead of the mainstream. Examining the ways in which they approach the problem may identify very different solution pathways which could have much wider relevance if they could be scaled and developed. He gives the example of anti-lock braking systems, which were originally developed for the extreme conditions of stopping aircraft safely and without skidding. The learning from such extreme conditions eventually transferred to the much bigger market for general automobiles.

The significant point about learning from extreme conditions is that the starting point may be different and the class of solutions and their direction of development may open up alternative trajectories along which innovation can take place. For example, in the development of medical devices to assist in infection control, ideas from extreme conditions far from the mainstream of general hospital use might be captured. Studying battlefield operating theaters, veterinary practices, and even advanced clean room technology in semiconductor manufacture offers new insights which can lead to the development of new approaches within the medical world. The principle is that today's extreme users may provide clues for tomorrow's mainstream innovations.

An example of this comes from the "bottom of the pyramid" identified by Prahalad – the 5 billion or so members of the world population with very limited resources (Prahalad, 2006). Opening up to the challenges posed by this market is leading to radical innovation in the field of healthcare, which offers significant new insights into how established economies can deal with the rising costs and demands for "good enough" quality healthcare. For example, the Aravind eye clinics in India originally targeted the 9 million cataract sufferers in India, but the resulting model has profound implications for low cost surgical care across a much broader frontier.

[1] Example case studies of these and other organizations can be found on the web site www.managing-innovation.com

While cataract treatment itself – diagnosis, operation, and after-care – is well-developed in the eye hospitals of the world, it comes at a price. In the USA, for example, treating cataracts costs around $3000 and even in an Indian hospital it is $300. The innovation challenge was to reduce this cost to the point where care became accessible to the bottom of the pyramid market and this required a reduction in average cost to closer to $30 per operation. The Aravind® Eye Care System is now the largest and most productive eye care facility in the world – for example, in the year 2007–2008, about 2.4 million persons received outpatient eye care and over 285 000 underwent eye surgeries.[2] The extreme conditions posed by this market forced the search for new approaches and involved the transfer of concepts originating in the fast food industry, which in turn came from the mass production ideas of Henry Ford (Tidd and Bessant, 2009).

Extreme conditions are also found in crisis situations where humanitarian agencies are forced to solve problems quickly and creatively. Increasingly such experience is being seen not only as something to be shared across the community, but also as a source of radical new insights into key problems like logistics and communications (Ramalingam *et al*., 2010).

Another aspect of *opening up the involvement space* is the considerable untapped potential of employees within the organization. It is not a new concept – attempts to utilize this approach in a formal way can be traced back to the eighteenth century, when the 8th shogun Yoshimune Tokugawa introduced the suggestion box in Japan. In 1871, Denny's shipyard in Dumbarton, Scotland, employed a program of incentives to encourage suggestions about productivity-improving techniques; they sought to draw out "*any change by which work is rendered either superior in quality or more economical in cost*." In 1894, the National Cash Register (NCR®) company made considerable efforts to mobilize the "hundred–headed brain" which their staff represented. Eastman Kodak introduced one of the first documented systems of employee involvement in 1909, while the Lincoln Electric Company started implementing an incentive management system in 1915. NCR®'s ideas, especially around suggestion schemes, found their way to Japan, where the textile firm of Kanebuchi Boseki introduced them in 1905.

But it was particularly in the post-war period that these ideas were exploited on a large scale; much of the momentum came from Japanese experience, taking forward ideas about employee involvement in innovation which were originally introduced as part of the US "Training within industry" (TWI) initiative (Schroeder and Robinson, 2004). Over the next 60 years, the system – largely involving incremental innovation or *kaizen* – has evolved and developed and represents a potent force for improving various aspects of organizational performance. For example, much early innovation was in the domain of quality, where a reputation for poor and shoddy products was turned into one in which world standards, measured in defective parts of one per million or less, were set. *Kaizen* has been applied with equal effect in other areas, such as increasing flexibility (through set-up time reduction), increasing plant availability (through total productive maintenance), and cost reduction (in particular, keeping pace with a highly valued Yen) (Bessant, 2003).

[2] Example case studies of these and other organizations can be found on the web site www.managing-innovation.com

These days, employee involvement is widely recognized as a key source of innovation. For example, an Ideas UK (www.ideasuk.com) survey of around 160 organizations highlighted cost savings of over £100 million, with the average implemented idea being worth £1400, giving a return on investment of around 5 to 1. Participation rates across the workforce were around 28%. Similar data can be found in other countries – for example, a study conducted by the Employee Involvement Association in the USA suggested that companies can expect to save close to £200 annually per employee by implementing a suggestion system. Ideas America reports around 6000 schemes operating. In Germany, specific company savings reported by Zentrums Ideenmanagement include (2010 figures) Deutsche Post DHL €220 million, Siemens €189 million, Volkswagen €94 million. Importantly, the benefits are not confined to large firms – amongst small and medium enterprises were Takata Petri (€6.3 million), Herbier Antriebstechnik (€3.1 million), and Mitsubishi Polyester Film (€1.8 million). In a survey of 164 German and Austrian firms, representing 1.5 million workers, they found around 20% (326 000) workers were involved, contributing just under 1 million ideas (955 701). Of these, two thirds (621 109) were implemented, producing savings of €1.086 billion. The investment needed to generate these was of the order of €109 million, giving an impressive rate of return.

But in many ways this is just scratching the surface; the real potential of high involvement innovation comes when employees can begin to act as internal entrepreneurs, not just contributing to "do better" incremental innovation but also suggesting ways of moving in more radical directions. Considerable acceleration of this trend has happened, with an increasing number of on-line schemes which allow high levels of participation. For example, France Telecom have been running a program called "Idee Cliq" for the past three years, generating savings of close to €1 billion across its workforce, and also creating a parallel innovation system with employees commenting and building upon suggested ideas, voting for the best and committing themselves to implementing the emerging ideas.

Opening up innovation to users, employees, and other stakeholders is then an important and established theme. This is explored in far more detail in the context of responsible innovation in the chapter by Sykes and Macnaghten in Chapter 5 and should not be perceived as something that is alien to, or indeed unwelcome in, innovative organizations.

1.5.3 The Sustainability Challenge – Innovation for Sustainable Development

The evidence underpinning concern about sustainability is extensive and there is a sense of urgency about much of the discussion it provokes (MEA, 2005; UNEP, 2007; Rockstrom, 2009). The World Wildlife Fund (WWF), for example, suggests that lifestyles in the developed world at present require the resources of around two planets, and that if emerging economies follow the same trajectory this will rise to 2.5 by 2050 (WWF, 2010). Others draw attention to the implications of reaching "peak" availability of key strategic energy and physical resources (Heinberg, 2007; Adams and Jeanrenaud, 2008; Brown, 2011). However, it is also important to reflect a more optimistic view, which sees significant *opportunities* emerging. The provision of alternative goods and services, more efficient approaches to resource and energy management, new partnerships and ways of working can help unleash a new era of economic development. A recent Pricewaterhouse Coopers (PWC) report suggests significant market potential in

the provision of green goods and services; their estimate was as high as 3% of global GDP (gross domestic product). UNEP's (2011) report illustrates how "greening the economy" is already becoming a powerful new engine of growth in the twenty-first century (UNEP, 2011). The World Business Council for Sustainable Development's (WBCSD) Vision 2050 sets out new opportunities for businesses in responding to sustainability challenges, promoting whole system perspectives (WBCSD, 2010).

The scale on which change is required is also leading some commentators to talk about a systems level shift and to argue that what is emerging – as a consequence of socio-economic pressures and enabling technologies – is another "long wave" of innovation (Freeman and Perez, 1989; Perez, 2002).

Growing concern of the kind described above is driving a combination of increasingly strong legislation, international environmental management standards, new sustainability metrics, and reporting standards that will force business to adopt greener approaches if they are to retain a social license to operate. At the same time the opportunities opened up for "doing what we do better" (through lean, green investments in improving efficiencies around resources, energy, logistics, etc.) and "doing different" (radical new moves toward systems change) make it an increasingly significant item in strategic planning amongst progressive organizations of all sizes. Evidence for this can be seen in their participation and active engagement with United Nations and NGO business initiatives (such as the UN Global Compact and The Climate Group) and in networks like the Global Sustainability Forum.

Innovation for sustainable development (ISD) highlights the problem of dynamic capability in that it forces firms to learn new approaches and let go of old ones around the core search, select and implement questions. By its nature, ISD involves working with different knowledge components – new technologies, new markets, new environmental or regulatory conditions, and so on, – and firms need to develop enhanced absorptive capacity for handling this (Zahra and George, 2002). In particular they need capability (and enabling tools and methods) to acquire, assimilate, and exploit new knowledge and to work at a systems level.

Reconfiguration can take place at an incremental level (zone 3) – essentially finding new ways of doing what we already do. The case of "lean" thinking provides an example; the extreme conditions of post-war Japan brought new elements into the frame as far as manufacturing was concerned. Faced with shortages of skilled labor, reliable energy sources, or key raw materials, firms like Toyota were unable to follow the established mass production trajectories which dominated innovation thinking at the time. Instead, they developed an alternative approach to process innovation based around minimizing waste. This led to radically different performance in terms of key productivity indicators. It also involved a suite of new innovation management routines (for example, the development of effective employee involvement, concurrent engineering, *kaizen* tools and methods, and so on, some of which I have discussed above).

Similarly the "eco-efficiency" concept (WBCSD, 2000) involves finding new and more efficient ways of "doing more with less"; its famous 3Rs – reduce, re-use, and recycle – has its roots in early industrialization, but is now being widely adopted by companies. Reducing carbon footprint through supply chain improvements or switching to less energy or resource intensive products and services which deliver equivalent value can generate significant savings. 3M, for example, saved nearly $1.4 billion over a

34 year period and prevented billions of pounds of pollutants entering the environment through their Pollution-Prevention-Pays (3P) programs (3M, 2011). GE Industrial saved $12.8 million per year by using high-efficiency lights in their plants. One of Alcoa's facilities in France achieved an 85% reduction in water consumption, leading to a $40 000 per year reduction in operating costs (Senge *et al*., 2008).

Significantly, some of the approaches around crowdsourcing mentioned in Section 1.5.1 are also being deployed. For example, the energy company EON is sponsoring a TV series in the UK in which people are asked to contribute ideas for energy saving and management innovations. As well as showcasing user ideas in the program itself, the company has set up an innovation platform where the watching public will be invited to contribute and further develop their ideas.

Sony launched an "Ideas challenge" in 2010 in partnership with WWF aimed at drawing in ideas for sustainability solutions which might take advantage of Sony technologies. As their web site explained: "*Sony and WWF want to hear your smart ideas about using technology to make the most of our planet's resources. And to get you started, we've pulled together a showcase of technologies that are ripe for re-purposing. Now it's up to you to put them together in radical new ways . . . and shape a cleaner, more sustainable future for our planet. How can we make better use of our scarce natural resources? How can we actively change people's behaviour and encourage more sustainable lifestyles?*"

Zone 4 ISD will involve significant *systems* level thinking, representing a shift from eco-efficiency to eco-effectiveness (McDonough and Braungart, 2002). According to Porter and Kramer the focus on creating shared value, which builds connections between social, environmental, and economic progress, has the power to unleash the next wave of global growth (Porter and Kramer, 2011).

One aspect of this is the involvement of multiple players, who have traditionally not worked together, in co-creating system level change. For instance, Grameen Shakti, a rural renewable energy initiative in Bangladesh, fosters collaboration between the microfinance sector, suppliers of solar energy equipment, and consumers, enabling millions of poor households to leapfrog to new energy systems. It is generating new employment opportunities, increasing rural incomes, empowering women, and reducing the use of environmentally polluting kerosene. Grameen Shakti is the world's largest and fastest growing rural renewable energy company in the world (Shakti, 2011).

Reconfiguring an established organization's innovation approaches and portfolio on this scale is a major strategic undertaking and requires a combination of clear and stretching vision linked to a coherent roadmap for delivering it. A number of models for such frameworks are emerging around the sustainability challenge – for example, the World Business Council for Sustainable Development involved 29 major multi-national companies and many NGOs, academics and other partners in elaborating a vision in which "*by 2050 some 9 billion people live well, and with the limits of the planet*."

Applying such long-term models for business planning is beginning to deliver business as well as social benefits; for example, one of the success stories has been the growth of floorings business InterfaceFLOR which has made radical changes to its business and operating model and secured significant business growth. It has cut greenhouse gas emissions by 82%, fossil fuel consumption by 60%, waste by 66%, water use by 75%, and increased sales by 66%, doubling earnings and raising profit margins. Significantly,

the process has involved a complete repositioning of the business model from product supply to service delivery – a major change in direction which necessitated a great deal of unlearning as well as the acquisition of new competencies. To quote Ray Anderson, founder and chairman; "*As we climb Mount Sustainability with the four sustainability principles on top, we are doing better than ever on bottom-line business. This is not at the cost of social or ecological systems, but at the cost of our competitors who still haven't got it*."

Moving into the space characterized by zones 3 and 4 requires more than exploring possible options; the new approaches need to become embedded within the innovation management processes of the organization. An example of this long-term transition can be found in the case of the giant Philips Corporation, which has been exploring innovation space since the early 1990s. Its EcoVision programs were first launched in 1998, setting corporate sustainability-related targets and the first green innovation targets were introduced in 2007. In 2003, the Philips Environmental Report (first published in 1999) was extended into a Sustainability Report, and in 2009 this was integrated into the Philips Annual Report, signaling the full embedding of sustainability in Philips' business practices.

In its ambitious five year plan launched in 2010 (Vision 2015) the company articulates a clear commitment to becoming "*a global leader in health and well-being . . . to simply make a difference to people's lives with meaningful, sustainable innovations*."

This vision is backed by specific targets for sustainable innovation which include extending the range of people in its market space, improving the energy efficiency of their overall product portfolio by 50%, doubling the amount of recycled materials in their products, and doubling the collection and recycling of their products.

To achieve this, the innovation system within the company has adapted, bringing these criteria to the center of selection and resource allocation decisions while simultaneously spreading much more widely the search net to create new knowledge networks outside the organization. One area in which this can be seen is the development of "Green Products" – those offering significant environmental improvements in one or more key areas of energy efficiency, packaging, hazardous substances, weight, recycling, disposal, and lifetime reliability.

Examples include the Performer EnergyCare vacuum cleaner, 50% made from post-industrial plastics and 25% from bio-based plastics. It is extremely energy-efficient, but it earns its designation as a Green Product primarily because it scores so highly in the focal area of recycling. Another example is the award-winning Econova LED TV. This high-performance LED TV consumes 60% less power than its predecessor. Even the remote control is efficient – powered by solar energy. In addition, the TV is completely free of PVC and brominated flame retardants, and 60% of the aluminum used in the set is recycled. Overall some €1 billion has already been invested to support this development; in 2010 Green Products accounted for 37.5% of Philips sales and the 2015 target is 50%.

We saw earlier the challenges posed to innovation management in moving into the zone 3 and 4 innovation space posed by sustainability-led innovation (SLI). In particular, there is a need for clear strategic frameworks to guide and shape project level activities over a sustained period of time. In the Philips example, we can see this pattern emerging – with a long-term commitment to sustainability taking a more concrete form in the past decade

with an explicit vision providing the context for specific and targeted initiatives. As a recent report suggests, SLI is becoming a mainstream approach characterized by early adopters – termed embracers – who have an explicit strategy and roadmap to shape their activities (Boston Consulting Group, 2011).

But SLI involves challenges to their innovation management systems. For example, search strategies based on conventional R&D or market research may need to shift to take account of new signals giving early warning of newly emerging innovation trajectories (Bessant and Von Stamm, 2007). An indicator here is the growth of new functions within established organizations associated with searching and building links into the emerging sustainability communities.

Similarly, resource allocation systems will need to shift to embed SLI values and criteria into established frameworks, such as stage gate systems (Bessant *et al*., 2011). Developing explicit criteria, and measuring performance against these, will become an important driver of behavior change within innovation systems.

1.6 Emergent Properties of the New Innovation Environment

None of the above strands are new, they all have deep historical roots, but the combination of technology and shifting social patterns has accelerated progress along each of them, and their growing convergence. The result is an explosion of new innovation opportunities and an opening up of the innovation game. Shifts to more open innovation approaches lower the entry barriers – increasingly innovation need not require the resources of a giant corporation but instead will depend on knowing where and how to access knowledge.

For example, the idea of an innovation contest is not new, but in the past it required significant resources to be able to put up a prize, publicize the challenge, filter and judge the submissions, and eventually arrive at a solution. John Harrison's chronometer, which changed the face of naval navigation by allowing accurate determination of longitude, was a result of a challenge offered by the UK government (with a prize worth the equivalent of $4 million!) while Emperor Louis Napoleon's sponsorship of a competition to find a substitute for butter led to the development of margarine. But while innovation contests were once the province of kings and emperors they are now open to anyone who wishes to organize or participate in them.

The process also works in reverse – whereas the problem for small enterprises has often been their isolation, we are now in a situation where getting connected becomes increasingly possible. Open innovation has led many large players to expand their search, and in the process discover rich potential among small enterprises which would previously not have featured on their radar screens. Tiny businesses are now able to access global markets from anywhere and to build links and partnerships which give them access to the resources they need to growwithout necessarily owning all those resources.

Shifts in the innovation landscape open new options for public services. For example, GemeinsamSelten (www.gemeinsamselten.de) is an ambitious initiative that aims to mobilize innovators across German-speaking countries to help identify and solve problems related to rare diseases. Rare diseases are a real challenge for today's national healthcare systems, as they represent an example of what Anderson calls the long tail

(Anderson, 2004). Just as traditional bookstores (with restricted shelf space) have a hard time dealing with rare books, national healthcare systems cannot cope with the enormous number of rare diseases. However, while a traditional bookstore might cover 40 000–100 000 books, Amazon is able to offer about 3 million books in its online bookstore and even offers the most specialized ones. Similarly, rare diseases and the huge number of specialized problems linked to them could profit from open collective innovation and an online co-creation platform.

Another powerful consequence of opening up access to mobile communications and computing is the liberating of creativity across previously disadvantaged groups. So fishermen in Kerula, India, no longer have to work hard to catch fish and then sell them at prices fixed by local merchants – now they can use their mobile internet access to work out where to fish, what to fish for, and where to sail in order to sell at the most advantageous price. Mobile banking has emerged bottom-up in dispersed population areas like the islands of the Philippines, or across rural Africa, and the co-creation of new applications for mobile communications is opening up other rich and socially valuable possibilities.

However, while these are examples of the significant new opportunities associated with shifts in the innovation landscape, it is worth concluding with the reflection made at the start of this chapter: that innovation is not necessarily always a good thing. Even if it appears to be so in the initial stages, there may be unanticipated negative consequences which emerge downstream – examples from nuclear power to a wide range of "miracle" drugs. For this reason, we need to think carefully about innovation choices at our selection stage in the model and ensure that the approaches we take allow for "responsible innovation." That is the focus of the rest of the book.

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