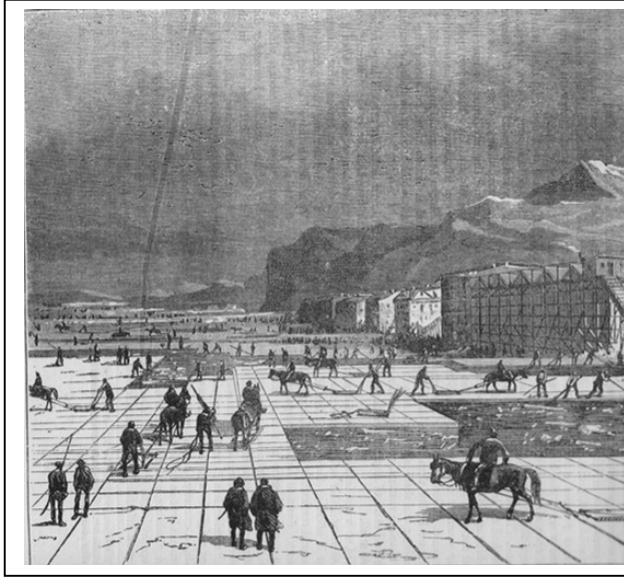


## ***Exploiting discontinuous innovation:***

### **1: The problem – and the opportunity – in discontinuous innovation**



Back in the 1880s there was a thriving industry in the north-eastern United States in the lucrative business of selling ice. The business model was deceptively simple – work hard to cut chunks of ice out of the frozen northern wastes, wrap the harvest quickly and ship it as quickly as possible to the warmer southern states – and increasingly overseas – where it could be used to preserve food. In its heyday this was a big industry – in 1886 the record harvest ran to 25 million

tons – and it employed thousands of people in cutting, storing and shipping the product. And it was an industry with strong commitment to innovation – developments in ice cutting, snow ploughs, insulation techniques and logistics underpinned the industry's strong growth.

Meanwhile in another part of the universe – or at least in laboratories around the globe - researchers like the young Carl von Linde were working on the emerging problems of refrigeration. It wasn't long before artificial ice-making became a reality and by 1873 a patented commercial refrigeration system was on the market. In the years which followed the industry grew – in 1879 there were 35 plants and ten years later 222 making artificial ice. Effectively this development signposted the end of the road for the ice harvesting industry – although for a while both industries grew alongside each other, learning and innovating and together expanding the overall market for ice. Eventually the ice harvesting industry was replaced by the new refrigeration industry dominated by new entrant firms.

### ***From freezers to servers – the pattern's the same***

This pattern of long periods of innovation under relatively steady conditions punctuated by dramatic shifts is a common one. Let's wind the film forwards to the last part of the 20<sup>th</sup> century and a very different industry – the computer disk drive business. Just like the ice industry it was a thriving sector in which the voracious demands of the growing mini-computer industry for powerful machines for engineering, banking, and others meant there was a booming market for disk drive storage units. Firms in the industry worked closely with their customers,

understanding the particular needs and demands for more storage capacity, faster access times, smaller footprints, etc. All fine – until a discontinuous change rocked the happily sailing boat of the industry.

In this case the dramatic shift wasn't due to technology but triggered by the emergence of a new market with very different expectations. Whilst the emphasis in the mini-computer world was on high performance and the requirement for storage units correspondingly technologically sophisticated, the emerging market for personal computers had a very different shape. These were much less clever machines, capable of running much simpler software and with massively inferior performance – but at a price which a very different set of people could afford. Importantly although simpler they were capable of doing most of the basic tasks which a much wider market was interested in – simple arithmetical calculations, word processing and basic graphics. As the market for these grew so the learning effects meant that these capabilities improved – but from a much lower cost base. This shift affected not only the makers of the new personal computers but also the new firms who supplied them with simpler and lower cost disk drives. In the end there was the same pattern as we saw in the ice industry– but from a different direction. Of the major manufacturers in the disk drive industry in the 1990s only a handful survived – and leadership in the new industry shifted to new entrant firms working with a very different model.(Christensen 1997)

These are not isolated examples but typical of a pattern in innovation. Think about the revolution in flying which the low cost carriers have brought about. Here the challenge came via a new business model rather than technology – based on the premise that if prices could be kept low a large new market could be opened up. In order to make low prices pay a number of problems needed solving – keeping load factors high, cutting administration costs, enabling rapid turnaround times at terminals – but once the model began to work it attracted not only new customers but increasingly established flyers who saw the advantages of lower prices.

What these – and many other examples – have in common is that they represent the challenge of *discontinuous* innovation. None of the industries were lacking in innovation or a commitment to further change. But the ice harvesters, mini-computer disk companies or the established airlines all carried on their innovation on a stage covered with a relatively predictable carpet. But shifts in technology, in new market emergence or in new business models pulled this carpet out from under the firms – and created a new set of conditions on which a new game would be played out. The trouble is that under such conditions, it is the new players who tend to do better because they don't have to wrestle with learning new tricks and letting go of their old ones. This is why discontinuous changes can often be *disruptive* to established players.

## **2: Innovation life cycles – from discontinuity to steady state**

In their pioneering work on this theme two US researchers (William Abernathy and James Utterback) developed a model describing the pattern in terms of three distinct phases. Initially, under discontinuous conditions, there is what they term a 'fluid phase' during which there is high uncertainty along two dimensions:

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

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

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

This can apply to products or processes; in both cases the key characteristics become stabilized and experimentation moves to getting the bugs out and refining the dominant design. For example, the 19<sup>th</sup> century chemical industry moved from making soda ash (an essential ingredient in making soap, glass and a host of other products) from the earliest days where it was produced by burning vegetable matter through to a sophisticated chemical reaction which was carried out on a batch process (the Leblanc process) which was one of the drivers of the Industrial Revolution. This process dominated for nearly a century but was in turn replaced by a new generation of continuous processes which used electrolytic techniques and which originated in Belgium where they were developed by the Solvay brothers. Moving to the Leblanc process or the Solvay process did not happen overnight; it took decades of work to refine and improve the process, and to fully understand the chemistry and engineering required to get consistent high quality and output.

The same pattern can be seen in products. For example, the original design for a camera is something which goes back to the early 19<sup>th</sup> century and - as a visit to any Science Museum will show - involved all sorts of ingenious solutions. The dominant design gradually emerged with an architecture which we would recognize - shutter and lens arrangement, focusing principles, back plate for film or plates, etc. But this design was then modified still further - for example, with different lenses, motorized drives, flash technology - and, in the case of George Eastman's work, to creating a simple and relatively 'idiot-proof' model camera (the Box Brownie) which opened up

photography to a mass market. More recent development has seen a similar fluid phase around digital imaging devices.

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

As the concept matures still further so incremental innovation becomes more significant and emphasis shifts to factors like cost - which means efforts within the industries which grow up around these product areas tend to focus increasingly on rationalization, on scale economies and on process innovation to drive out cost and improve productivity. Product innovation is increasingly about differentiation through customization to meet the particular needs of specific users. Abernathy and Utterback term this the 'specific phase'.<sup>1</sup>

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

Although originally developed for manufactured products the model also works for services – for example the early days of Internet banking were characterised by a typically fluid phase with many options and models being offered. This gradually moved to a transitional phase building a dominant design consensus on the package of services offered, the levels and nature of security and privacy support, the interactivity of website, etc. The field has now become mature with much of the competition shifting to marginal issues like relative interest rates

Table 1 sets out the main elements of this model.

**Table 1 Stages in the innovation life cycle**

---

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

### **3: Discontinuous can be *disruptive***

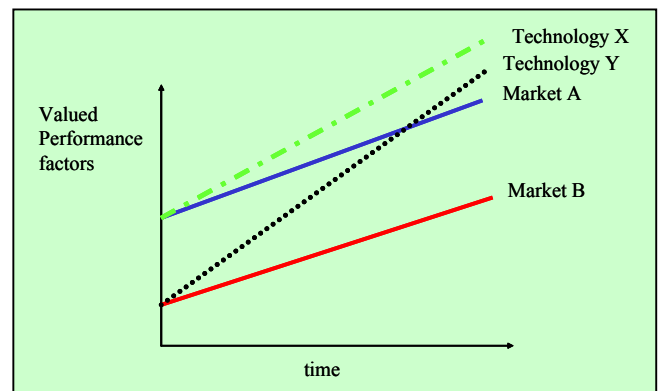
The term *disruptive* innovation is particularly associated with the work of Clayton Christensen, a US scholar who looked at the patterns of change in a number of industries including computer disk drives (outlined above), earthmoving equipment, and steelmaking. He noticed a pattern which seemed to run through all of these cases – and one which he has subsequently applied to over fifty industries. For much of the time there is a 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 usually a great deal more! What he terms ‘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 comes as part of the package. (Think about software like Microsoft Word and ask whether you really do make use of all the features or just a small but very useful subset? What some programmers call ‘bloatware’ is another way of thinking about technology overshoot).

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. For example the emergent home computer industry began amongst a small group of hobbyists who wanted simple computing capabilities at a much lower price than was available from the mini-computer suppliers. In turn the builders of those early PCs wanted disk drives which were much simpler technologically but – importantly – much cheaper and so were not really interested in what the existing disk drive industry had to offer. It was too high tech, massively over-engineered for their needs and, most important, much too expensive.

Although they approached the existing drive makers none of them was interested in making such a device – not surprisingly since they were doing very comfortably supplying expensive high performance equipment to an established mini-computer industry. Why should they worry about a fringe group of hobbyists as a market? Consequently the early PC makers had to look elsewhere – and found entrepreneurs willing to take the risks and experiment with trying to come up with a product which did meet their needs. It didn't happen overnight and there were plenty of failures on the way – and certainly the early drives were very poor performers in comparison with what was on offer in the mainstream industry. But gradually the PC market grew, moving from hobbyists to widespread home use and from there – helped by the emergence and standardisation of the IBM PC – to the office and business environment. And as it grew and matured so it learned and the performance of the machines became much more impressive and reliable – but coming from a much lower cost base than mini-computers. The same thing happened to the disk drives within them – the small entrepreneurial firms who began in the game grew and learned and became large suppliers of reliable products which did the job – but at a massively lower price.

Eventually the fringe market which the original disk drive makers had ignored because it didn't seem relevant or important enough to worry about grew to dominate – and by the time they realised this it was too late for many of them. The best they could hope for would be to be late entrant imitators, coming from behind and hoping to catch up.



This pattern is essentially one of *disruption* – the rules of the game changed dramatically in the marketplace with some new winners and losers. Figure 1 shows the transition where the new market and suppliers gradually take over from the existing players. It can be seen in many industries – think about the low cost airlines, for example. Here the original low cost players didn't go head to head with the national flag carriers who offered the best routes, high levels of service and prime airport slots – all for a high price. Instead they sought new markets at the fringe – users who would accept a much lower level of service (no food, no seat allocation, no lounges, no frills at all) but for a basic safe flight would pay a much lower price. As these new users began to use the service and talk about it, so the industry grew

and came to the attention of existing private and business travellers who were interested in lower cost flights at least for short-haul because it met their needs for a 'good enough' solution to their travel problem. Eventually the challenge hit the major airlines who found it difficult to respond because of their inherently much higher cost structure – even those – like BA and KLM which set up low cost subsidiaries found themselves unable to manage with the very different business model low cost flying involved.

Importantly this is only one way to upset the market apple-cart. Low end market disruption is a potent threat – think what a producer in China might do to an industry like pump manufacturing if they began to offer a simple, low cost 'good enough' household pump for \$10 instead of the high tech high performance variants available from today's industry at prices ten to fifty times as high? Or medical devices like asthma inhalers once they have come off-patent?

But disruption can also come when technology shifts – like in the ice industry – and opens up new possibilities. It can come through shifts in thinking around the dominant business model. It can come when external agencies like government change the regulatory rules of the game. The end effect is the same – the carpet is pulled out from beneath the market and a new set of rules comes into play. How new and established players handle the disruption is the challenge – but they should begin by recognising that there is an increasing likelihood of disruption happening. Table 2 gives some examples.

**Table 2: Sources of discontinuity**

<i>Triggers/ sources of discontinuity</i>	<i>Explanation</i>	<i>Problems posed</i>	<i>Examples (of good and bad experiences)</i>
<b><i>New market emerges</i></b>	Most markets evolve through a process of growth, segmentation, etc. But at certain times completely new markets emerge which can not be analysed or predicted in advance or explored through using conventional market research/ analytical techniques	Established players don't see it because they are focused on their existing markets May discount it as being too small or not representing their preferred target market – fringe/brands dismissal Originators of new product may not see	Disk drives, excavators, mini-mills Mobile phone/SMS where market which actually emerged was not the one expected or predicted by originators

		potential in new markets and may ignore them, - e.g. text messaging	
<b><i>New technology emerges</i></b>	Step change takes place in product or process technology – may result from convergence and maturing of several streams (e.g. industrial automation, mobile phones) or as a result of a single breakthrough (e.g. LED as new white light source)	Don't see it because beyond the periphery of technology search environment. Not an extension of current areas but completely new field or approach Tipping point may not be a single breakthrough but convergence and maturing of established technological streams, whose combined effect is underestimated Not invented here effect – new technology represents a different basis for delivering value – e.g. telephone vs. telegraphy	Ice harvesting to cold storage Valves to solid state electronics Photos to digital images Voice over internet protocol telephony Filament light bulbs to LED sources
<b><i>New political rules emerge</i></b>	Political conditions which shape the economic and social rules may shift dramatically – for example, the collapse of communism meant	Old mindset about how business is done, rules of the game, etc. are challenged and established firms fail to	Centrally planned to market economy e.g. former Soviet Union Apartheid to post-apartheid South Africa Free trade/ globalisation results in dismantling protective



	an alternative model – capitalist, competition – as opposed to central planning – and many ex-state firms couldn't adapt their ways of thinking	understand or learn new rules	tariff and other barriers and new competition basis emerges
<b><i>Running out of road</i></b>	Firms in mature industries may need to escape the constraints of diminishing space for product and process innovation and the increasing competition of industry structures by either exit or by radical reorientation of their business	Current system is built around a particular trajectory and embedded in a steady-state set of innovation routines which militate against widespread search or risk taking experiments	Encyclopaedia Britannica finally running out of road as it is displaced by first CD-based, then online and now open source encyclopaedias like Wikipedia Sometimes the firms manages to break out and establish a new trajectory – e.g. Nokia from timber products to mobile phones or Preussag, from metals and commodities to tourism.
<b><i>Sea change in market sentiment or behaviour</i></b>	Public opinion or behaviour shifts slowly and then tips over into a new model – for example, the music industry is in the midst of a (technology-enabled) revolution in delivery systems from buying records, tapes and CDs to direct download of tracks in MP3 and related formats.  Long-standing issues of concern to a	Don't pick up on it or persist in alternative explanations – cognitive dissonance – until it may be too late  Rules of the game suddenly shift and then new pattern gathers rapid momentum wrong-footing existing players working with old	Apple, Napster, Dell, Microsoft vs. traditional music industry  McDonalds, Burger King and obesity concerns Tobacco companies and smoking bans Oil/energy and others and global warming Opportunity for new energy sources like wind-power where Danish firms have come to dominate

	<p>minority accumulate momentum (sometimes through the action of pressure groups) and suddenly the system switches/ tips over – for example, social attitudes to smoking or health concerns about obesity levels and fast-foods</p>	<p>assumptions</p>	
<p><b><i>Deregulation/ shifts in regulatory regime</i></b></p>	<p>Political and market pressures lead to shifts in the regulatory framework and enable the emergence of a new set of rules – e.g. liberalization, privatization or deregulation</p>	<p>New rules of the game but old mindsets persist and existing player unable to move fast enough or see new opportunities opened up</p>	<p>Old monopoly positions in fields like telecommunications and energy were dismantled and new players/combinations of enterprises emerged. In particular, energy and bandwidth become increasingly viewed as commodities. Innovations include skills in trading and distribution - a factor behind the considerable success of Enron in the late 1990s as it emerged from a small gas pipeline business to becoming a major energy trade</p>
<p><b><i>Business model innovation</i></b></p>	<p>Established business models are challenged by a reframing, usually by a new entrant who redefines/reframes the problem and the consequent 'rules of the game'</p>	<p>New entrants see opportunity to deliver product/service via new business model and rewrite rules – existing players have at best to be fast followers</p>	<p>Aamazon.com in retailing Charles Schwab in share trading Southwest and other low cost airlines Direct Line insurance</p>
<p><b><i>Unthinkable</i></b></p>	<p>Unimagined and</p>	<p>New rules may</p>	<p>9/11</p>

<b>events</b>	therefore not prepared for events which – sometimes literally – change the world and set up new rules of the game.	disempower existing players or render competencies unnecessary	
<b>Shifts in 'techno-economic paradigm' – systemic changes which impact whole sectors or even whole societies</b>	Change takes place at system level, involving technology and market shifts. This involves the convergence of a number of trends which result in a 'paradigm shift' where the old order is replaced.	Hard to see where new paradigm begins until rules become established. Existing players tend to reinforce their commitment to old model, reinforced by 'sailing ship' effects	Industrial Revolution Mass production

**4: Managing discontinuous innovation**

Discontinuous innovation offers threats and opportunities for both new and established players. By changing the rules of the game it puts a premium on entrepreneurial behaviour – being able to spot an emerging opportunity and exploit it. For new entrants it is the 'classic' entrepreneurs challenge of being able to manage the growth of a business from a bright but often high risk idea – and doing it from a weak asset base. For established players the challenge is one of reinventing themselves to allow at least a part of the business to behave as if it were an entrepreneurial start-up – and of holding back the conservative forces of the mainstream organization to let this happen.

The problem is not that discontinuity happens – it is a near-certainty that disruption will come from somewhere at some time, as we saw in. What do we do about it – and can we do it early enough to exploit the opportunities rather than be threatened by the disruptive changes? And – for existing players – this raises the existing question of whether what we have already learned to do about managing innovation is still the right thing to do under these new circumstances?

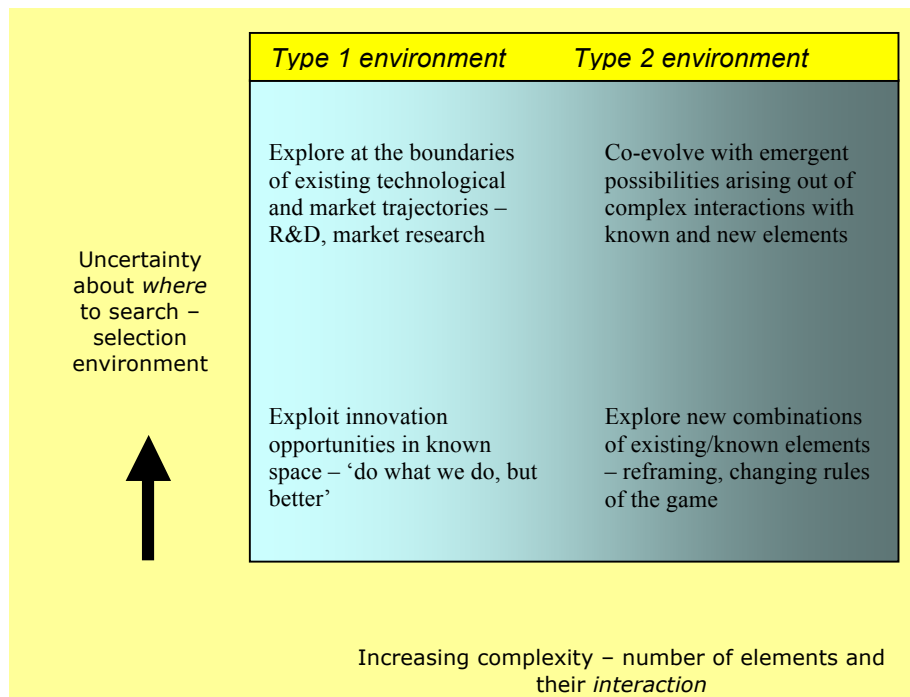
For example, the problem for the firms in the disk drive industry wasn't that they didn't listen to customers but rather that they listened too well. They build a virtuous circle of demanding customers in their existing market place with whom

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

Not all technological revolutions do upset the established players. If they see the new developments early enough and pick up on their significance they can often strengthen their position. Two US researchers studied discontinuous technological shifts across a wide range of industries over an extended time period and noted that under some conditions major technological shifts could be ‘competence destroying’ – at which point new entrants would dominate the new industries enabled by radical technology. (Tushman and Anderson 1987) But under other conditions the radical technologies were ‘competence enhancing’ and strengthened the hand of existing incumbents. This suggests that disruption is not always a ‘changing of the guard’ between existing incumbents and new entrants.

Figure 2 shows two kinds of innovation space which organizations have to operate in. Type 1 is essentially one where the challenge is innovating within a relatively stable framework – the rules of the game are clear, the identity and nature of competitors is known, the sources of ideas and the relationships along which they flow (for example with customers or suppliers, universities and others) are well-established and the underlying requirement is essentially around ‘doing what we do, but better’. This may not be easy but it clearly is something which established players have much more experience in – so we’d expect them to have learned how best to structure and operate the innovation process for this relatively steady state.

Figure 2: Mapping innovation space



By contrast Type 2 is a volatile, unpredictable and essentially fluid state – on the edge of chaos. New games emerge here– triggered by discontinuous shifts in markets, technologies or external regulations – but quite what the rules are, or even the precise nature of the game are not clear.

Table 3 contrasts the innovation management challenges posed by these two very different environments. Type 1 organizations are – not surprisingly – something which established players are good at creating and operating – geared to ‘doing what we do better’ and to repeating the innovation trick – structures and procedures to enable a steady stream of product, process and service innovations. But type 2 organizations are much more like new entrants – agile and flexible, able to switch directions, to experiment around the emergent new rules of the game.

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

Type 1 Innovation organization	Type 2
<b>Operates within mental framework based on clear and accepted set of rules of the game</b>	No clear rules – these emerge over time High tolerance for ambiguity
<b>Strategies path dependent</b>	Path independent, emergent, probe and learn
<b>Clear selection environment</b>	Fuzzy, emergent selection environment

***Selection and resource allocation linked to clear trajectories and criteria for fit***

*Risk taking, multiple parallel bets, tolerance of (fast) failure*

***Operating routines refined and stable***

*Operating patterns emergent and 'fuzzy'*

***Strong ties and knowledge flows along clear channels***

*Weak ties and peripheral vision important*

## **5. Dealing with discontinuity**

Working in Type 2 mode means a new set of approaches to organising and managing innovation – for example how the firm searches for weak signals about potential discontinuities, how it makes strategic choices in the face of high uncertainty, how it resources projects which lie far outside the mainstream of its innovation operations, etc. And it's a problem which extends beyond the firm - discontinuous innovation is often problematic because it may involve building and working with a significantly different set of partners. 'Strong ties' – close and consistent relationships with regular partners in a network - may be important in enabling a steady stream of continuous improvement innovations, but where firms are seeking to do something different they may need links across a very different population in order to gain access to new ideas and different sources of knowledge and expertise.

For new entrants this isn't an issue – they can set their organization and networks up from scratch. But what does an established player do? One option is to set up their own version of new entrant firms, simply spinning off entities which they hope will be able to colonise and settle the new world of a type 2 environment. This is a low risk option but also means that there may be little synergy or leverage across to and from the core business. Another option is to try and develop a parallel innovation management capability within the mainstream business – but in order to do this a number of new approaches will be needed.

In practice there are many options between these two poles, including setting up special units within an established business or managing more 'open innovation' operations which leverage the entrepreneurial strengths of smaller players. A number of large firms – for example, Microsoft, Intel Cisco Siemens and GSK – have developed sophisticated 'fishing' strategies looking around for smaller smart players to buy or at least link up with to help them keep an edge.

The question facing organizations trying to deal with discontinuity can be summarised as:

- What do we need to more of and extend?
- What do we need to do less of, or stop?

- What new approaches do we need to add?

## 6: How to search for the unexpected?

This isn't as easy as it looks – think about the 'search' challenge, for example. Rather like the drunk who has lost his keys on the way home and is desperately searching for them under the nearest lamp-post '*because there is more light there*', firms have a natural tendency to search in spaces which they already know and understand. But we know that the weak early warning signals of the emergence of totally new possibilities – radically different technologies, new markets with radically different needs, changing public opinion or political context – won't happen under our particular lamp-post. Instead they are out there in the darkness – so we have to find new ways of searching in space we aren't familiar with. To make it even worse we have no real idea what we are looking for – it will only become clear as it emerges and the best we can hope for is to spot it early in its emergence and develop our response alongside it.

So what we need to develop is three sets of skills:

- a. the capability to be in the space where emergence of something new is likely to happen
- b. the capability to 'hear' or sense the emergence of something new against the background noise, in a position to pick up on emerging trends early
- c. the capability to act – to mobilise enough around them to capture and shape the innovation opportunities before others become aware of the new 'rules of the game'.

How can this be done? By luck, sometimes – except that simply being in the right place at the right time doesn't always help. History suggests that even when the new possibility is presented to the firm on a plate its internal capacity to see and act on the possibilities is often lacking. For example, the famous 'not invented here' effect has been observed on many occasions where an otherwise well-established and successful innovative firm rejects a new opportunity which turns out to be of major significance

The problem of framing is a big one – it takes insight and courage to see a mistake or failure as an opportunity – although when this does happen it can have spectacular results. Viagra, for example, began life as a failure in terms of its original indication as a vasoconstrictor whilst 3M's Post It notes are based on an adhesive with decidedly non-sticky properties! What emerges from stories like these is that firms need more than luck – they need to be prepared and equipped – as Pasteur put it, *chance favours the prepared mind*.

So if it's not just luck but some more purposive action, how might we do it? One answer is to try and match the variety which is out there, cover all the bases— so firms should put lots of resource into building rich intelligence networks to detect and give early warning about possible shifts in their environment. At first sight this would seem a non-starter on the grounds of prohibitive cost – but increasingly firms are experimenting with tools like the internet to help provide some kind of wide-scanning early warning system. The Internet has become a powerful amplifier for making such connections and an increasing number of organizations are developing search strategies (and accompanying 'gatekeeper' skills) to work with it. IBM, for example, uses an approach called 'Web fountain' to help it monitor a wide range of potential triggers. Even the CIA makes use of an internal group called In-Q-Tel to act as a 'venture catalyst' to facilitate trend spotting in key technology areas!

Processing the data from such an array is another big issue but again we are seeing some creative responses – such as IBM's use of pattern recognition tools to make sense out of large data sets or Procter and Gambles use of retired employees (in the 'Encore' programme who have not only the time to act as internet scanners but also the experience and insight into the firms needs and means to act as highly relevant gatekeepers).

Another problem to be addressed is that of escaping the dominant frame of reference in the business – what C K Prahalad calls '*the blinders of dominant logic*'. If you have traditionally worked with one set of users, chances are you'll develop better ways of listening to them and people like them. But emergence is often driven by people with different needs or wants – as Christensen's work showed. For example, much of the development of the mobile phone industry has been on the back of the different uses to which schoolchildren put their phones and delivering innovations which support this. Examples include text messaging, image/video exchange and downloadable personal ring tones where the clues to the emergence of these innovation trajectories were picked up by monitoring what such children were doing or aspiring towards. Yet school playgrounds isn't where most market research would normally get done

The concept of 'communities of practice' stresses not only the power of formal and informal networking as a source of knowledge but also the importance of bringing unconnected elements together – most new knowledge emerges at such interfaces. In Xerox, for example, 23,000 technical reps from around the world are linked into a network of communities of practice to share knowledge about unusual machine faults and heuristics for finding and fixing them. In industries like computer games the role of user groups and online communities becomes central – as an executive of Westwood Studios (producers of successful games like Command and Conquer and Red Alert) commented '*the online communities are the way to get the feedback we need ....and these guys, they help us ultimately to better our product*'

Another strategy is what might be termed 'total immersion' in a potentially interesting new context. Researcher Peter Koen calls this approach a 'deep dive' as part of the 'fuzzy front end' of new product/service development, a chance to tune



in to emerging needs and match them to potential means to create radical innovations. The challenge here is to ensure sufficient openness to new and emerging stimuli rather than focusing too quickly on a particular target. The Danish medical devices producer, Coloplast, is employing this approach, exploring not only new medical needs in their home country markets but also in a number of developing countries in which the starting and operating context is radically different.

The difficulty of such strategies is that it depends still on some form of targeting – of knowing where to start looking. In an earlier era of the music business skilled A&R staff knew which smoky clubs to go and sit in to pick up on new artists and musical trends and sign them to the record label. But ‘cool hunting’ of this kind is a lot more tricky in the Internet era where mp3, peer-to-peer networking and a host of other technological enablers mean that the emergence of new musical directions comes from many different sources and along many different channels.

Getting in early is another strategy which is becoming increasingly important. As US professor Eric von Hippel has noted over many years, users can be active innovators, playing a key role in developing and shaping early stage innovations. His recent work in fields as diverse as sports equipment and open source software underlines the power of building such networks and working with them in the co-evolution of novel and influential innovations.

## Advice for future managers

All of this experimental experience suggests some principles around which innovation strategies for picking up on discontinuities might be built. They are:

<b>Strategic principle</b>	<b>Why it matters</b>	<b>Why it's hard to do</b>
<b>Being there</b>	New things don't arrive fully-formed – they emerge but you won't be able to play a part unless you're in the space where they are likely to develop. For many firms this means recognising that this emergence space may well be a long way from their existing turf.	But being in there means making investments in exploring spaces which may be far from the core business and may not offer any short-term prospects. And no firm can be everywhere at once – so how to target your presence?
<b>Get in early</b>	Discontinuous shifts do not emerge fully-formed but emerge over time. So the earlier an organization can pick up key signals about threats, opportunities and potential actions to climb the learning curve, the better.	Where and when do you start committing resources? Maintaining an early warning system is expensive and most of it may be redundant most of the time
<b>Diversity – enabling odd conversations</b>	Discontinuity is often the result of unexpected conjunctions – not necessarily radical shifts at the technological or market frontier. Recombinant innovation – packaging existing things up by making new connections between elements, or linking users needs to technological means – can often be the trigger.	Maintaining existing networks is expensive but returns justify this. Building speculative linkages is less easy to justify. But the limitation is that whilst strong ties support exploitation innovation, 'the ties that bind can become the ties that blind' when it comes to discontinuous.
<b>Try things out – probe and learn</b>	Discontinuous innovation doesn't involve a binary switch from one dominant design to another but rather a transitional process of multiple experiments most of which fail. But there is learning and each experiment helps clarify the emerging trajectory	Risk aversion and difficulty of justifying radical experiments – no organizational slack. Low tolerance for failure – mistakes are not welcome, organisational systems try to avoid or cover them up rather than use them to learn
<b>Make early bets</b>	Active co-evolution rather than passive waiting for the trend to develop	Risk aversion and project selection systems which favour the safe bets
<b>Work with the 'fuzzy front end'</b>	Emergence is a process which is high on ambiguity – multiple views and approaches need to be held simultaneously	Low tolerance of ambiguity.
<b>Think along different tracks</b>	Need to reframe to see the relevance of emerging phenomena – and may need to do this from several different reference points.	Linear thinking, inability to view with alternative perspectives, dominant logic blinders.

## **7: Developing alternative strategic frames**

Another significant problem is a reluctance to reframe the underlying models of the business. The example of Polaroid is a good illustration – their inability to see the move to digital imaging as a completely new game rather than just a technological shift led to the company's downfall. They aren't alone – as writers like Foster and Kaplan point out in many examples of firms which lose by being too heavily committed to defending a status quo. The problem is compounded by the presence of many aspects of organizational life which reinforce old models –for example reward systems which favour working with established customers or knowledge flows which underpin established product architectures.

In order to escape this trap organizations seek to develop alternative ways of framing their activities. One route for this is to explore alternative scenarios for the future and to look at ways in which the current resource base could be reconfigured to provide an alternative but viable business model. For example, Shell has developed its long-established capabilities in scenario planning into an approach called 'Gamechanger' in which detailed alternative future scenarios are developed and used to provide challenging reframing possibilities. In turn these help identify relevant domains within which 'targeted hunting', for new opportunities can take place. Such exploration provides a mechanism for pursuing several 'parallel future' development projects without compromising mainstream activities and helps maintain a tolerance for ambiguity suited to discontinuous conditions.

## **8: Extending resource allocation approaches**

A significant problem around discontinuous innovation occurs when well-developed strategic resource allocation and review systems are confronted with radical challenges. Whilst such systems evolve as a robust way of managing a stream of projects under steady state innovation conditions they may not be suited to discontinuities. For this reason a number of organizations decentralise the funding process for high risk/radical venturing and make use of various forms of corporate venturing approach. These arrangements range from completely separate venture units to internal venture capital sources for which project owners can make bids. The intention – although not always the outcome – is to provide an alternative and parallel channel for exploring radical options and allocating at least early stage funding.

## Advice for future managers

### An emergent 'good practice' model outline for discontinuous innovation

#### **Element in innovation model**

#### **Type 2 characteristics**

***Search – firms need to scan and search their environments (internal and external) to pick up and process signals about potential innovation. These could be needs of various kinds, or opportunities arising from research activities somewhere, or pressures to conform to legislation, or the behaviour of competitors - but they represent the bundle of stimuli to which the organisation must respond***

***Strategic selection - from this set of potential triggers for innovation firms need to choose what they will commit resources to doing. Even the best-resourced organisation can't do everything, so the challenge lies in selecting those things which offer the best chance of developing a competitive edge.***

Search at the periphery – pick up and amplify weak signals  
Use multiple and alternative perspectives  
Manage the idea generation process inside the firm – enable systematic and high involvement in innovation  
Develop an external scanning capability – scouts and hunters  
Use technological antennae to seek out potential new technologies  
Tune in to weak market signals – e.g. working with fringe users, early trend locations (such as chat rooms on Internet)  
Develop future exploring capability – scenario and alternatives  
Explore at periphery of firm – subsidiaries, joint ventures, distributors as sources of innovation.  
Bring in outside perspectives

Build pluralism into decision-making processes  
Create 'markets for judgment' Decentralize seed funding for new ideas- for example via internal venture funds or development budgets  
Build dual structures for

**Implementation- having chosen an option, organisations need to grow it from an idea through various stages of development to final launch - as a new product or service in the external market place or a new process or method within the organisation. On the way they have to solve a host of problems (like where to get hold of the knowledge they need, how to find and integrate different groups of people with key skills, how to get the bugs and wrinkles out of the emerging innovation, how to steer the project against tight budgets of time and cost, etc.) and they have to do all this against a background of high uncertainty!**

**Innovation strategy - innovation is about taking risks, about going into new and sometimes completely unexplored spaces. We don't want to gamble – simply changing things for their own sake or because the fancy takes us. No organization has resources to waste in that scattergun fashion – innovation needs a strategy. But equally we need to have a degree of courage and leadership, steering the organization away from what everyone else is doing or what we've always done and into new spaces.**

**Innovative organization – firms need a structure and climate which enables people to deploy their creativity and share their knowledge to bring about change. It's easy to find prescriptions for innovative organizations which highlight the need to eliminate stifling bureaucracy, unhelpful structures, brick walls blocking communication and other factors stopping good ideas getting through. But we must be careful not to fall into the chaos trap—not all innovation works in organic, loose, informal environments or 'skunk works'—and these types of organization can sometimes act against the interests of successful innovation. Too little order and structure may be as bad as too much.**

**Pro-active linkages – firms need to build bridges**

innovation development and decision making  
Develop 'fuzzy front end' approaches

Build flexible project development organisations – emphasise probe and learn rather than predictive project planning  
Work actively with users on co-evolution of innovation  
Build parallel resource networks

Explore alternative future scenarios and consider parallel possibilities  
Identify strategic domains within which targeted hunting can take place  
Build capacity for ambiguity/multiple parallel strategies  
Actively explore 'how to destroy the business' to enable reframing

Build a culture which supports and encourages diversity and curiosity-driven behaviour.  
Set up appropriate incentive structures  
Enable complex knowledge flows

Develop non-committal

***across boundaries inside the organisation and to the many external agencies who can play a part in the innovation process – suppliers, customers, sources of finance, skilled resources and of knowledge, etc.***

exploratory supply relationships in addition to longer-term strategic alliances - 'strategic dalliances'  
Explore and develop parallel 'weak ties'

### **9: Managing discontinuous innovation**

One thing is inevitable – all organizations will confront discontinuities in their worlds from time to time. Sometimes these will be separated by long periods of calm where innovation is just a case of 'doing what we do but better' – as was the case for nearly three hundred years of banking before the storms of the Internet forced radical change on the sector. At other times it's as if there is a new model every day – as is the case in the turbulent waters of the telecommunications ocean. Discontinuities come from all sorts of causes – technological shifts, emergence of new markets, political pressures or just unforeseen dramatic events. Their result, however, is the same – a rewriting of the rules of the game.

Under these conditions all the old recipes for organizing and managing an efficient innovation process come into question. What we really need is the ability to deal with a 'fluid' state in which as the new rules emerge so there are rich opportunities in the game. But in order to exploit them we need to harness the basic entrepreneurial spirit – risk-taking, agile, quick to spot and follow through on opportunities – and to reshape what they do as they learn fast about the new situation. This kind of behaviour is second nature to a start-up or new entrant – it's what they are in the game for. But for existing organizations there is a real challenge – how can they – or at least a part of their organization – get back to their roots and rediscover how to be an entrepreneurial player?

### **References**

- Abernathy, W. and J. Utterback (1975). "A dynamic model of product and process innovation." *Omega* **3**(6): 639-656.
- Abernathy, W. and J. Utterback (1978). "Patterns of industrial innovation." *Technology Review* **80**: 40-47.
- Christensen, C. (1997). *The innovator's dilemma*. Cambridge, Mass., Harvard Business School Press.

- Dosi, G. (1982). "Technological paradigms and technological trajectories." Research Policy **11**: 147-162.
- Henderson, R. and K. Clark (1990). "Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms." Administrative Science Quarterly **35**: 9-30.
- Prahalad, C. (2004). "The blinders of dominant logic." Long Range Planning **37**(2): 171-179.
- Tushman, M. and P. Anderson (1987). "Technological discontinuities and organizational environments." Administrative Science Quarterly **31**(3): 439-465.
- Utterback, J. (1994). Mastering the dynamics of innovation. Boston, MA., Harvard Business School Press.
- Von Hippel, E. (2005). The democratization of innovation. Cambridge, Mass., MIT Press.