DEVELOPING PARALLEL ROUTINES FOR RADICAL PRODUCT INNOVATION

John Bessant
School of Management, Cranfield University, Bedford, U.K.
john.bessant@cranfield.ac.uk

David Francis
Centre for Research in Innovation Management (CENTRIM), University of Brighton, U.K.
David_L_Francis@compuserve.com

ABSTRACT

A paradox in innovation management is that firms deploying what is generally recognised 'good practice' can find themselves under threat through disruption caused by some form of discontinuity in their operating environment. Routines suited to dealing with 'steady state' innovation differ from and may even conflict with those needed to explore and exploit discontinuous shifts in technology or markets. This paper explores this 'innovator's dilemma' and reviews the experience of a case study firm working in the medical products field. It argues that firms need to learn to manage innovation but that two complementary learning approaches – adaptive and generative – are needed.

INTRODUCTION

All organizations face the challenge of innovation. Their survival and growth depends upon their capacity to renew what they offer the world (product/service innovation) and the ways in which they create and deliver that offering (process innovation) [1]. In different ways and through what is essentially a trial and error process they learn to organize and manage the activities needed to carry through this innovation task on a continuing basis. Over time particular behaviour patterns are rehearsed and reinforced until they become firm-specific *routines* and these give rise to structures, policies and procedures which embed them in the firm and define the way it approaches innovation. [2, 3]. This collection of behavioural routines takes on the form of what Schein and others call 'culture' – it becomes '*the way we do things around here'* and shapes the mental models and shared behavioural norms which people work with in the organization[4].

Although all organizations face the same basic challenge it becomes clear that some organizations develop routines which are more effective than others with dealing with the generic tasks of innovation – for example, how they search their environments for potential triggers to the process, how they allocate limited resources in strategic fashion, how they acquire and absorb new knowledge, etc. [5-7]. Although innovation remains an uncertain and inherently risky process, their ability to manage the process in more consistently successful fashion makes them targets for other firms to imitate [8-11]. An emerging model of 'good practice' emerges based on convergent patterns of behaviour which appear to be associated with successful management of innovation [1, 9, 12].

The innovation management problem thus has two core components, both linked to the question of organizational *learning.* The first is one of imitating and configuring generic routines which are associated with good practice but which need shaping and to suit a particular organizational environment. And the second is about adapting those routines to create firm specific advantage through a process of experimentation and consolidation. This pattern of continuous learning and sharpening up of innovation management capability conforms to what Senge calls 'adaptive learning' and Argyris and Schon term 'single loop learning' [13, 14].

Learning of this kind is essentially around learning to 'do what we do but better' and approximates to a kind of 'steady state' in innovation in which organizations push the boundaries of their current products and processes. This corresponds to the conditions termed 'mature phase' by Abernathy and Utterback in which there is a high degree of imitation and an essentially incremental pattern to innovation in product and process [15, 16]. Competitive advantage under such steady state conditions comes in large measure from being able to manage the innovation process more effectively than from direct product or process advantage. This condition arises because imitation is not easy – each competitor has to go through its own learning and absorption process [17].

Successful firms in mature industries have developed sophisticated suites of routines which they can constantly modify through an adaptive learning process to retain competitive edge [18, 19]. Even in relatively high velocity environments this pattern can provide a systematic mechanism to maintain continuous product innovation [20].

MEDPRODUCTS – A CASE EXAMPLE

An example of building and sustaining competitive advantage through innovation capability is Medproducts. One of the stars of Danish industry, it has built a highly profitable position as an increasingly global player in the medical products field within a comparatively short space of time. Founded in 1957 the company has grown through a series of innovations which combine a deep understanding of a specialist medical field with strong and focused technical competencies. Innovation is seen as a core value and expressed and embedded within their strategy. Their efforts at innovation have been regularly recognised and they have picked up an enviable set of awards over the years; most recently the daily newspaper Berlingske Tidende, Nordea A/S and the national Patent and Trademark Committee together awarded them the 2002 Innovation Prize.

Growth has come through innovation but whilst the early phase involved significant product and process innovation, the marketplace has matured. There are a handful of major competing players, all of whom have broadly similar products and supporting processes. Emphasis has shifted to the ways in which each of these players manages what has become an innovation process based on 'doing what we do but better'. This does not imply any less commitment to innovation; on the contrary spending on R&D is high, investments in training and development are extensive, strong emphasis is given to exploration and joint venturing, etc. All this gives tangible support for the sentiments expressed in various public documents; for example, their mission statement: ' ….*Throughout the world we wish, within our selected business areas, to*

be the preferred source of medical devices and associated services, contributing to a better quality of life. By being close to customers we fulfill their needs with innovative, high quality solutions…..

In terms of our discussion of routines it is clear that this is a firm in which competitive advantage is increasingly built on the ability to manage the steady state innovation process effectively, fine tuning and extending a repertoire of established and proven routines. Two examples help clarify this position:

(a) Developing active user involvement in the product innovation process

One of the key lessons about successful innovation is the need to get close to the customer. At the limit the user can become a key part of the innovation process, feeding in ideas and improvements to help define and shape the innovation [21-23]. In the case of Medproducts this pattern had been established from the outset when a nurse developed a prototype bag and then found someone who could make it and gradually improve on it. Keeping close to users in a field like personal medical devices is crucial and Medproducts developed a novel way of building such insights in by making use of panels of users, specialist nurses and other healthcare professionals located in different countries. This had the advantage of getting an informed perspective from those involved in post-operative care and treatment but also able to articulate needs which might for the individual patient be difficult or embarrassing to express. By setting up panels in different countries the varying cultural attitudes and concerns could also be built into product design and development.

The concept for this approach to deepening understanding of user needs emerged in the early 1990s. It is essentially a series of product development activities carried out with a small group (10-15 people, called a Board) of key professionals experienced in post-operative care of ostomy patients. From an initial 5 Boards in Denmark, UK, Holland, France and Spain the concept now has 24 boards in 17 countries, involving around 350 Stoma Care Nurses. Each Board meets twice/year with a 1-2 day formal agenda set by the company but designed to promote extensive interaction and experience sharing.

The core objective within the Boards is to try and create a sense of partnership with key players, either as key customers or key influencers. Selection is based on an assessment of their technical experience and competence but also on the degree to which they will act as opinion leaders and gatekeepers – for example by influencing colleagues, authorities, hospitals and patients. They are also a key link in the clinical trials process. Over the years Medproducts has become quite skilled in identifying relevant people who would be good Board members – for example, by tracking people who author clinical articles or who have a wide range of experience across different operation types. Members of a Board are asked to sign a confidentiality agreement.

These people are expert in patient care and articulating user needs and their specific role is particularly to help with two elements in innovation:

- Identify, discuss and prioritize user needs

- Evaluate product development projects from idea generation right through to international marketing.

Importantly the Boards are seen as integrated with the main product development process and the views expressed by Board members provide valuable market and technical information into the stage gate decision process. This input is mainly associated with early stages around Concept formulation (where the input is helpful in testing and refining perceptions about real user needs and fit with new concepts). There is also significant involvement around Product Development where involvement is concerned with evaluating and responding to prototypes, suggesting detailed design improvements, design for usability, etc.

(b) The AIM strategic decision process for progressing ideas into products

Another area which represents good practice in innovation management is the use of some form of organized and accepted process for managing risk and progressing projects from initial selection through to strategic commitment of resources [24, 25]. Such portfolio management/stage gate models are essential in organisations with multiple product and process innovation projects. In the case of Medproducts the process developed was called AIM (Accelerating Ideas to Market) and provided a clear and widely accepted framework to take ideas and progress them through to successful products launched in the marketplace.

AIM's purpose can be expressed as being:

- To provide common rules of the game for product development within Medproducts

- To make clear decisions at the right moment

- To clarify responsibility

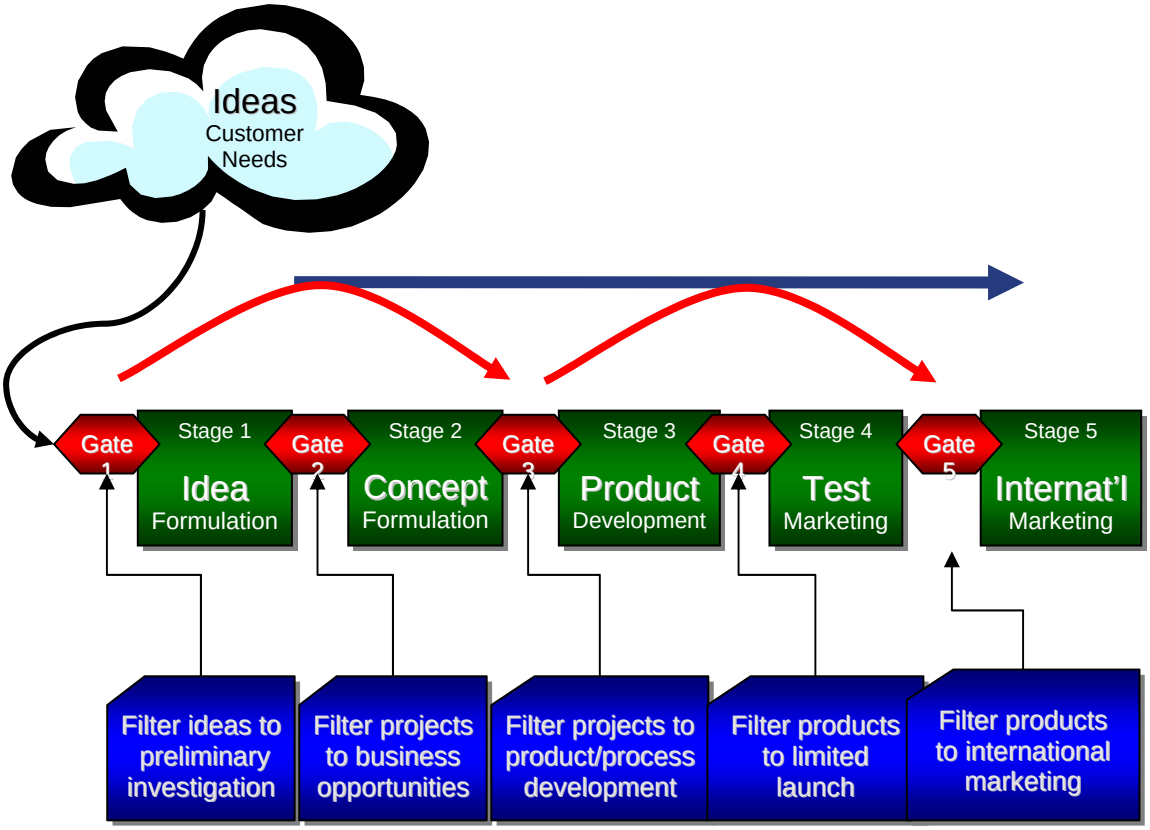
The objective of the AIM process is to ensure a high, uniform level of professionalism in product development yielding high quality products.
It is based on the view that Medproducts must increase the success rate and reduce the development time for new products in order to become a "world class innovator".

Much of the work in product development is carried out by project teams consisting of selected specialists from marketing (from both product divisions and subsidiaries), R & D, clinical affairs and manufacturing. Each project team will work under the leadership of a skilled and enthusiastic project manager, and the AIM process defines the rules to be followed by the project team.

The AIM process divides the development of new products into five manageable "stages". Each stage contains a number of parallel and coordinated activities designed to refine the definitions of customer needs and to develop technological solutions and capacity for efficient manufacturing.

Each stage is followed by a "gate", a decision point at which the project is reviewed by the "gatekeepers", senior managers with authority to keep worthy projects moving ahead quickly. The gates serve as the critical quality control checkpoints between the stages. A "go" decision is made when the gatekeepers decide that a project is likely, technically and economically, to meet the needs of the customers as well as to comply with Medproducts's high standards for Return on Investment, quality and environmental impact.

Figure 1 provides an overview.



THE CHALLENGE OF DISCONTINUITY

Such routines are demonstrably successful under 'steady state' conditions but they may be ineffective or inappropriate when the firm confronts situations outside of its 'normal' operating conditions. Discontinuities can take a number of forms – for example a step change in technological development, the emergence of a totally new market or a dramatic shift in the political/regulatory environment. (Table 1 gives some examples).

Table 1: Examples of discontinuities and their triggers

Example	***Trigger***
Transition from valve-based to solid state electronics (Braun and Macdonald 1980)	Technological change, particularly the development of the transistor and subsequently integrated circuits. Many of the major player in the glass valve industry did not make a successful transition to the new era of solid state, whilst other new players - for example, Texas Instrument, emerged at this time
Deregulation of utilities markets	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 [26]. Although Enron failed to capitalise on their innovative business model (financial concerns became apparent in 2001 and the company became insolvent) their re-conceptualisation of business opportunities remains an example of significant innovation in paradigm. The Enron case demonstrates the risks inherent in radical change where bold moves are called for. Without a track record is difficult for prudent decisions to be made - unquantifiable chances may be need to be taken.
Dismantling of political systems	The post-Cold War experience in Eastern Europe or the transition from apartheid in South Africa led to conditions in which new rules of the competitive game applied [27]. Incumbent firms in those regions were ill-equipped to jump trajectories and many failed as a consequence.
Emergence of new market constituencies	Christenson's work on disk drives suggests that new markets that later become mainstream and set trajectories/define the innovation envelope begin at the fringes and are often not detected by established players [28]. Under these conditions 'good practice' recipes like staying close to existing customers, whilst effective for 'do better' types of innovation may not be sufficient to help with the transition to new markets and product platforms.
Diminishing innovation space within mature industries	Firms in mature industries may seek 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 [18]. For example, Preussag's move from primary production (lead and other ore smelting) into a broad based conglomerate and from there into a focused tourism business.

The problem lies less in the absolute scale of novelty or dislocation but rather in the firm's experience of these conditions as something which takes it beyond its normal operating envelope. Since such conditions do not emerge every day – they are

essentially discontinuous - established firms are often unable to deal with them effectively. As a number of writers have shown it is usually new entrant firms who are able to exploit the 'fluid phase' in terms of developing innovations to take advantage of these conditions whilst existing incumbents do badly [28-30].

Significantly the threat is posed most to those well-managed firms which have developed effective steady state routines for innovation. They work closely with customers and suppliers, they make use of sophisticated resource allocation mechanisms to select a strategically relevant portfolio of projects, they use advanced project and risk management approaches in developing new products and processes and so on. These routines are the product of well-developed adaptive learning processes which give the firm a strong position in managing innovation under steady-state conditions – but they also act as a set of barriers to picking up signals about, and effectively responding to, innovation threats and opportunities associated with discontinuous shifts. Christensen's work on 'the innovator's dilemma' highlights this problem of a virtuous circle which operates in a successful firm and its surrounding value network, and describes in detail the ways in which their markets become disrupted by new entrants [28].

This is not simply a matter of being surprised by a single unexpected event such as being caught out by a new technology which a new entrant has brought to market. Anyone can get unlucky once just as they can get lucky once in the innovation game. Nor is it the case that each new discontinuity brings with it a wave of new players with the old falling away. As Tushman and Anderson point out, radical technological shifts do not necessarily disrupt the existing order and in many cases can be competence enhancing rather than competence destroying. Similarly not all existing incumbents failed in picking up on newly emerging markets in Christensen's studies.

The real challenge is in building the capability within the firm so that it is prepared for, able to pick up on and proactively deal with innovation opportunities and threats created by emerging discontinuous conditions. In other words, to develop alternative routines for discontinuous innovation '(do different' routines) which can sit alongside those for steady state ' do better' innovation [31].

Working 'out of the box' requires 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. Established and well-proven routines for 'steady state' conditions may break down here – for example, an effective 'stage gate' system such as the AIM process described earlier would find it difficult to deal with high risk project proposals which lie at the fringes of the firm's envelope of experience. Developing new behaviours more appropriate to these conditions – and then embedding them into routines – requires a different kind of learning – 'generative learning' [13]or 'double loop' [14].

In part this explains the observation that new entrants do better under discontinuous conditions than exiting incumbents in an industry; put simply the new players do not face the problem of having to 'unlearn' well-established behavioural routines but can put in place a new set from a zero base. Equally it also explains why those same new

entrants are themselves often upstaged by subsequent generations of change when they have become the existing incumbents [30].

DEALING WITH THE CHALLENGE OF DISCONTINUITY

Why do established players find discontinuous innovation problematic? It is clearly not simply a case of firms getting old and sluggish in their willingness to look at new things – but it does have something to do with the ways in which they see the world and the salience they attach to signals about particular new developments. The famous 'not-invented-here' pattern of behaviour is not the response of a stupid firm but rather that of one which does not – or chooses not to – see the significance and relevance of a new idea being offered to it. The issue is analogous to the problem of 'cognitive dissonance' in individual psychology, which refers to the ways in which people selectively perceive the world in order to maintain stability. Organizations find considerable difficulties in adjusting their mental models [26].

The issue is not simply cognitive; there are also political and operational problems. Portfolio management and resource allocation techniques which may operate well for ensuring good fit with the strategic directions and competencies of the firm may not be appropriate for reviewing apparently wild and unexpected ideas which might establish completely new directions. Risk management systems operating with stage gate reviews over the development life of a new project may not deal well with apparently high-risk projects with a high level of market and technological uncertainty.

The problem is further compounded by the networks of relationships the firm has with other firms. Typically, much of the basis of innovation lies at a system level involving networks of suppliers and partners configuring knowledge and other resources to create a new offering. Discontinuous innovation is often problematic because it may involve building and working with a significantly different set of partners than those the firm is accustomed to working with. Whereas 'strong ties' – close and consistent relationships with regular partners in a network - may be important in enabling a steady stream of continuous improvement innovations, evidence suggests that where firms are seeking to do something different they need to exploit much weaker ties across a very different population in order to gain access to new ideas and different sources of knowledge and expertise [32-34].

Faced with this need to build alternative routines to enable them to cope with discontinuous conditions, what strategies do firms adopt? The problem is that existing 'steady state' routines may not only be inappropriate for discontinuous innovation, they may actively militate against its successful management. One option is to split off the organisation concerned with 'do different' routines; examples include setting up 'skunk works', corporate venture units, spin-off ventures and establishing new companies [10, 35-37]. Whilst this makes the management task simpler because it effectively creates a new entrant set of conditions it carries the disadvantage of losing links with the established resource and competence base – for example, access to technological or market know-how, distribution channels, key individual knowledge sets, etc.

An alternative is to try and develop an 'ambidextrous capability in which the same organisation is simultaneously capable of working in 'do better' and ' do different'

mode [38]. Here the advantages of resource complementarity and synergy are available but the risk is that the default behaviour patterns will be those concerned with maintaining steady state rather than opening up new directions. In practice these represent two poles of a spectrum along which firms are experimenting with possible mechanisms through which they can deal with the challenge of developing and embedding routines suited to the challenge [39].

DEVELOPING PARALLEL ROUTINES WITHIN MEDPRODUCTS

As we saw earlier, Medproducts is a successful business which creates much of its competitive advantage through a steady stream of market-focused innovations. Yet despite the apparent strength of its innovation capabilities it recognises their limitations in the face of what will be discontinuous events – technological, market, political/regulatory – at some point in its future. It is concerned with building complementary routines of the kind outlined above – but it also recognises the difficulties in fitting these alongside its existing set of approaches.

For example, the close links with their users via the Boards is an excellent mechanism for identifying and testing new concepts - provided these fall within the general 'envelope' of current operations. These are the very best people to ask for input to maintain a development trajectory – but, as Christensen found with his studies of disc drive companies, they represent a problem in terms of exploring completely new concepts [28]. The 'virtuous circle' becomes a 'vicious circle' which does not support the entry or active evaluation of alternative concepts but is primarily about reinforcing the existing ones.

In similar fashion, the AIM process which functions well as a widely-accepted stage-gate mechanism for risk management and resource allocation is not well-suited to dealing with risky new concepts about which information is limited. Yet it is precisely these 'weak signals' which represent the early warning of what may form the basis for a major new opportunity or, if introduced early by a competitor, a significant threat to the business.

Some example statements (see table 2) from a recent 'innovation audit' of the company suggest that despite the strength of the current routines in dealing with the steady state challenge, there is a concern that something different will be needed for discontinuous conditions. The case of Medproducts is typical of successful firms which are having to confront a major organizational development challenge. How can they build, alongside existing and proven successful routines for innovation a new and complementary set which help them deal with the challenges outlined above? Although there is an accepted model of 'good practice' based on research across many different kinds of enterprise, this has effectively evolved through studies of 'steady state' innovation. Far less is known about the ways in which organisations can – or should – deal with the parallel challenge of discontinuous change – although there is growing research interest. For this reason firms like Medproducts are now engaged in a 'learning-by-doing process of experimentation with new structures (such as a joint discovery/business development team acting as 'scouts' for new options), new processes (such as a revised more open-ended version of the AIM approach) and new underlying beliefs (like the need to accept high levels of failure in risky ventures but to balance this by failing early and learning fast from mistakes). There is clearly considerable scope for learning between firms and across sectors under these

conditions and one part of their strategy is to build such learning networks with a variety of different organisations.

Table 2: Example problem statements from Medproducts innovation audit

- *'…AIM is successful but slow!'*
- *'…the machine (AIM) in itself is very good at optimising. there is a motivation to do even better…'*
- *'sometimes it is a too heavy process - because you have ideas they stop on the way because you have to fill in all these forms - so it kills initiative and maybe innovation from time to time'*
- *'…you will end up with frustration - people get all these good ideas but there's nowhere to take them ...'*
- *'on some things we're starting to be very good… but because it's so structured there's no real room for radical ideas'*
- *'…the machine (AIM) for optimising works well but not for radical new products or market redefinition…'*
- *'I don't think we have the DD side well covered today… we have one project which might… but the pipeline is 4-5 years from now'*
- *'I think we do too little for the radical side - but Medproducts is too busy…'*
- *'we like to think we're the best in the world but we're not!'*
- *'after you've banged the wall 4 or 5 times you give up!'*
- *'…sometimes what you need is radical, out of the box - you need a separate kind of structure for that because it can't fit the optimising one…'*
- *'…(needs a structure) well-protected from the planning process, budgets, the normal resource drain, so to speak!'*
- *'…if we don't get outside the box, then somebody outside the box will step in and do it .. that will ruin our business in the long term.'*
- *'because it's all focused on this well-oiled machine there are no resources for the radical ideas…'*
- *'…there should be a forum where it's allowed to have new ideas and it should be supported where there is money to run with these good new ideas..'*
- *'this is the resource we put into that (radical front end) because we want it... we must protect this, though, and not cut back when things get difficult or allow it to be taken away…'*
- *'need to allocate significant target resource and build up to it - not just a few %'.*
- *'... if you just have the task to say 'new machine this year, new machine next year, etc.' you'll never be innovative, because you're ordinary tasks will fill up your whole programme…'*
- *'we should allow people to go to conferences and exhibitions without having a specific target - just to see what's around'*
- *'people aren't taken enough out of their daily work to think differently'*
- *'… most of the time we are too focused on a particular problem…'*
- *'… you have to change the attitude, send people out on a more loose basis…'*
- *'the risk of taking only one risk and that's it!'*
- *'…we need a 'safe haven' for ideas… but there have to be checkpoints - if anything interesting comes up then we put it into the (AIM) machine'.*
- *'it's (DD) not integrated in the AIM procedure'*
- *'…if it's interesting then you can take it into the 'real world' - budgets, plans, etc. - but when it lives there it has its own life'*
- *'AIM too constraining'*
- *'because it is so structured there's no real room for radical ideas, no 'let's try this', no way to run with it outside the structures'*
- *'…failure is not an option! (in AIM)…'*
- *'Today's DD needs to become tomorrow's DB innovation!'*
- *'…the new ideas, the organizational framework has to be fitted to the size of them.'*

CONCLUSIONS

The challenge of discontinuous change is not new. History is filled with examples where dislocations take place across industries and sometimes whole civilisations as a result of discontinuous shifts in technologies, markets or political conditions. It is also clear that discontinuous change offers considerable new growth opportunities for both new entrants and established players, but the latter often find difficulty exploiting these. Arguably the problem arises because the set of routines for managing innovation under steady state conditions is not suited to more turbulent situations and a new, complementary set needs to be deployed. Importantly we are talking here about a general capability to manage innovation to exploit discontinuous conditions – not the threats or opportunities posed by a single specific example.

Firms develop routines through a process of trial and error accumulation – essentially a learning process which can be managed to create advantage. In this paper we have suggested that the learning process associated with embedding and refining 'steady state' routines is one of 'adaptive' learning whilst that needed for discontinuous innovation requires a more 'generative' learning approach. These complementary learning themes are a key part of the dynamic capability critical to innovation success.

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