

Organising Innovation: Design Intervention and Governance

MIKE BERRY

*lab.*3000
leading by design

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lab.3000 is a centre of excellence in digital design that is funded by the Victorian State Government and hosted at RMIT University. Over the past four years, *lab.3000* has focused on the brokerage of design and innovation through the integration of research, education and industry, building a clearly identified cluster of digital design based industries.

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lab.report 05

The *lab report* publication series continues to make a significant contribution to our understanding of the importance and impact of design intervention and governance.

Lab report 05 throws light on the evolutionary logic driving the virtuous circle and on the importance of networks, clusters and learning communities. Indeed, learning through collaboration and competition is at the heart of the innovation process. This research supports government initiatives that seek to build a region's learning environment, from pre-school to post-secondary and postgraduate levels. It is eminently sensible for universities like RMIT University to support and work with key brokerage organisations like *lab.3000*, supported by and in collaboration with relevant government, industry and professional agencies.

The seven case studies discussed in *lab report 05* Organising Innovation: Design Intervention and Governance – drawn from the United Kingdom, the Netherlands, Ireland and Australia – make up a typology, albeit incomplete, of concerted attempts to mediate and facilitate the innovation process in advanced technology fields, particularly those dependent on the application of the new information and communications technologies.

I commend *lab report 05* to you and encourage you to explore the findings raised by the case studies.

Professor Alan Cumming
Pro Vice Chancellor - Design and the Social Context
RMIT University



lab.report 05

I am delighted to release *lab report 05* Organising Innovation: Design Intervention and Governance.

The *lab report* series is made possible through the generous funding of the Victorian State Government and is a medium that disseminates the latest research across the diverse domains of design.

Lab.3000 has been commissioned to deliver the Victorian design agenda through strong association with the tertiary sector, design professional organisations, cultural institutions and diverse industries and in doing so achieves its goals through collaboration and innovation.

Lab Report 05 by Professor Mike Berry completes his journey that started with lab report 01 on the nature of innovation and the virtuous circle, continued in lab report 02 with a focus on the emergence of a digital design industry cluster in inner Melbourne and finishes with an account of how gatekeeper organisations like lab.3000 can facilitate and provoke innovation and growth in particular regions like Melbourne. Professor Berry's three lab reports should together be seen as an attempt to identify the drivers of successful economic performance, to situate design as a series of tools and strategies for creating new value, and to point to the complex interactions and policies directions that facilitate economic success.

Lab Report 05 has been co-ordinated by Dr Grace Lynch through lab.3000 and produced by the Design Centre at Swinburne University of Technology.

I commend this report and its findings to you. In an increasingly interconnected world, the prosperity of cities and regions rises and falls on the back of its creative citizens. Dynamic regional economies are driven by an 'innovation-productivity-competitive advantage-growth' virtuous circle. Innovation is the critical element and innovation is design in action.

Associate Professor Di Fleming
Director lab.3000 – leading by design
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www.lab.3000.com.au



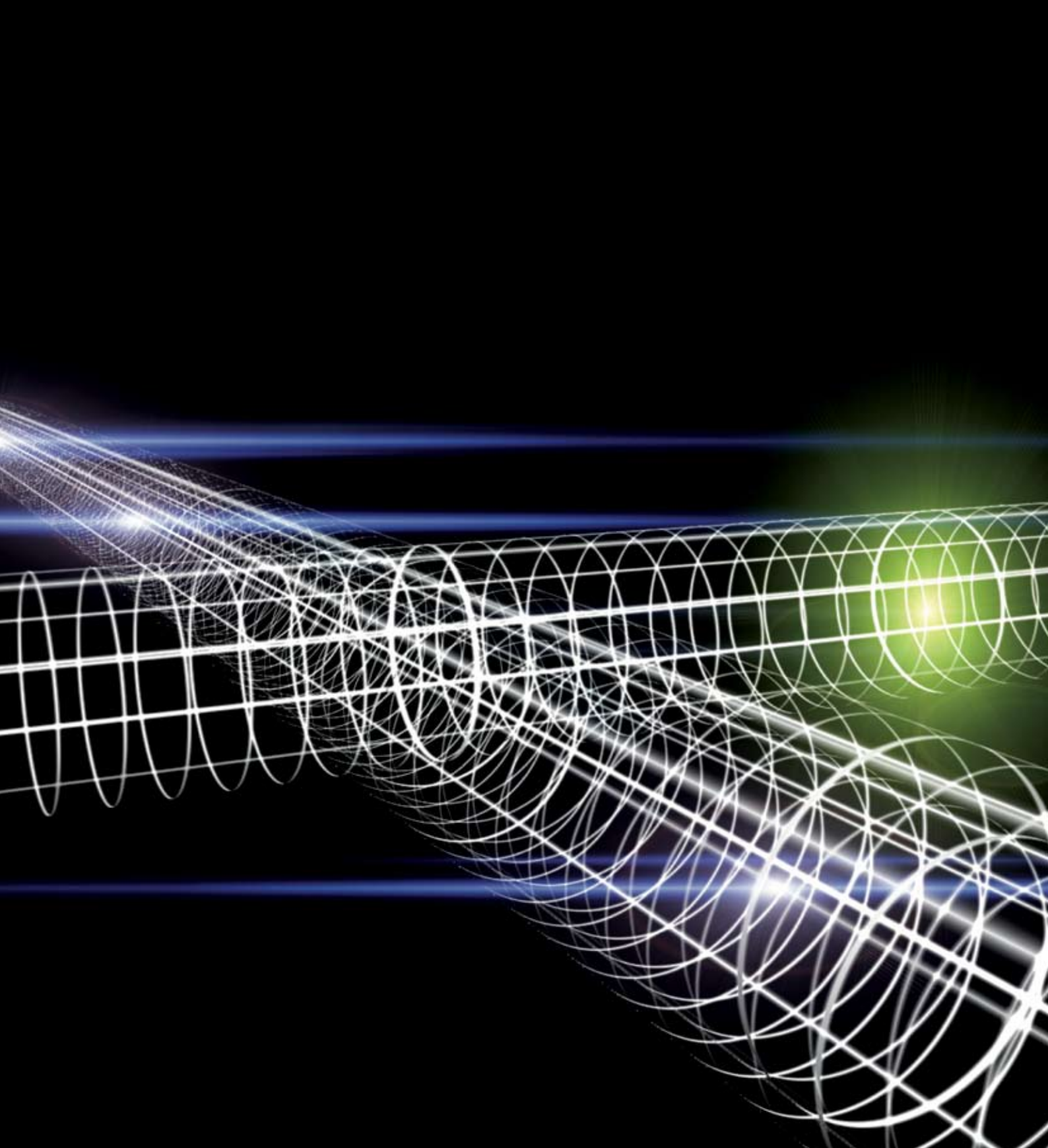


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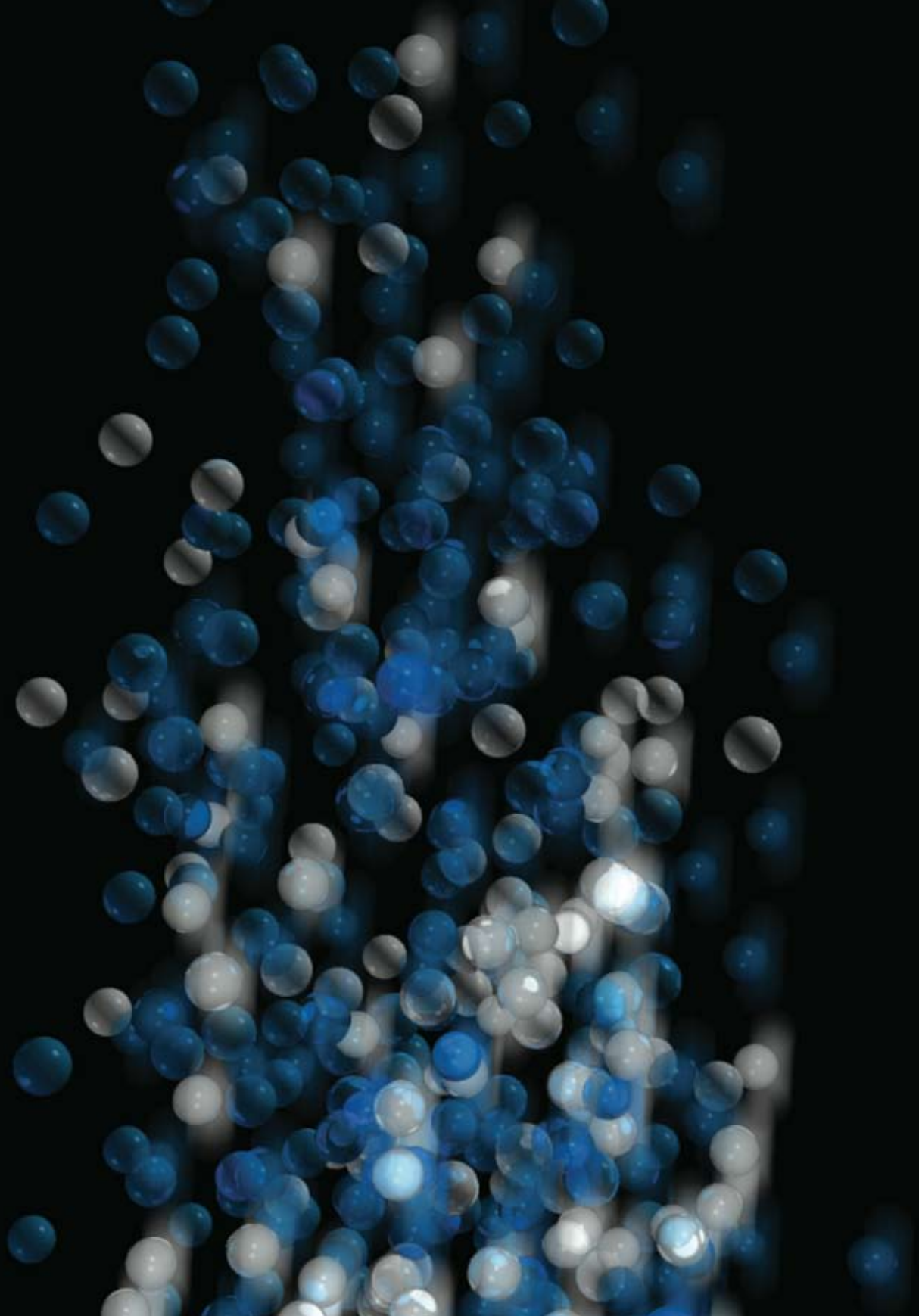
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Section One

The Nature of Innovation



01 Introduction

In earlier monographs in this series (Berry, 2003, 2004) I outlined and discussed, in some detail, the recent focus on innovation as the critical driver of economic growth in advanced economies and regions. The foundational idea is that innovation is *the* critical force for change, the creative agent underlying productivity growth in the ‘old’ as well as ‘new’ economies, generating competitive advantage for leading-edge firms located in favoured city-regions around the world.

A perfectly reasonable question to raise in this context is – how are the various processes that result in innovation activity and outcomes organised in practice? At an even more basic level we can ask – *can* innovation be organised? Are there practical examples of attempts to encourage and channel innovation in order to boost economic development in a region or nation? If so, does government have a role in directing, supporting or getting out of the way?

This report makes an attempt to frame and answer these questions. *Section One* addresses the innovation process directly. Drawing on the arguments and studies discussed in lab report 01 (Berry, 2003), I sketch the ways in which networks and industry clusters form and impact on innovation and growth outcomes. I argue that cluster formation unleashes a self-reinforcing ‘virtuous growth circle’ and provides an important institutional structure encouraging information flows, learning and knowledge creation. This analysis is presented in chapter 2.

Networks and clusters are essentially dynamic phenomena and form, merge, re-form and die in often unexpected and unpredictable ways. They impart an ‘evolutionary’ and ‘path dependent’ trajectory through time to the economic process. In this view, growth is a non-reversible, non-linear process, constrained by past investments and behavioural ‘routines’ but also influenced by current contingencies, particularly with respect to the unequal capacities of individual firms and other economic agents to learn from their experiences and collaborations. The self-transforming power of human learning through networks is addressed in chapter 3.

Clusters and the dynamic networks of which they are formed help generate what might be called ‘an environment of innovation’ that is particularly important for encouraging the emergence, participation and integration of small and medium sized enterprises (SMEs). The economic fate of SMEs is a useful indicator of the overall success of the regional economy. Economies in which smaller firms thrive are generally those in which innovation is rapid, deep and self-sustaining. This follows, in part, from the harnessing of new ideas and perspectives that would otherwise be lost if barriers to entry to established industries are too high. However, more importantly, some types of innovation, particularly those that widen the market, appear to be peculiarly tied to the activities of SMEs. These ‘disruptive innovations’ (Christensen, 1997; Christensen and Raynor, 2003) create major new market opportunities for the innovating firms and impose significant costs on lagging competitors and regions. The process of disruptive innovation appears to be one of the main causes of both the failure of market leaders and the highly uncertain and unpredictable nature of the economic environment in the current era of ‘Globalisation’. This analysis is presented in chapter 4.

Section Two switches to a discussion of attempts to influence or ‘steer’ the innovation process – to ‘organise innovation’, in some sense, in pursuit of improved regional or national economic performance. No attempt has been made to exhaustively sift the many possible cases here nor to analyse each selected case in detail. (The rationale for selection of the case studies is outlined in the Prologue to *Section Two*.) The cases covered are therefore not representative, in any sense, but provide interesting insights (to the author, at least) about the possibilities of and barriers to improving innovation outcomes. I have tried, in each case, to describe its main features, aims and mode of operation. I leave to *Section Three* the task of gleaning the implications of these cases for government policy.

The cases selected are:

- **Creative London.** In the words of the Mayor of London, Ken Livingstone, this program was established on the 2003 recommendation of the *Commission on the Creative Industries* and is administered through the *London Development Agency* to ‘... assist, guide and encourage creative businesses of every type in London. It will help to showcase the existing talent that London possesses and will work with local communities to try to unlock and galvanise the next generation of creative entrepreneurs’ (London Development Agency, 2004, p.1).
- **UK Design Council.** This agency was established 60 years ago to raise design awareness throughout industry and the broader community. Over the past decade it has moved to play a more strategic, focussed and interventionist role in coupling design thinking and technologies with industry development and the delivery of public services.

- **Zernike.** Established as a science park in the Netherlands in the early 1990s, and as a commercialisation route for researchers at the University of Groningen, Zernike has evolved into a vehicle for facilitating the growth of firms operating in advanced technology fields, in general. The principle task of this organisation is to 'accelerate' the development of client firms to the point of take off in the global economy. This task extends well beyond the traditional approach of 'incubation' and entails a number of strategies, including equity investment in the developing businesses.
- **Scottish Enterprise (SE).** This agency is the main industry and technology development arm of the Scottish Executive, the government body responsible for public welfare and order in Scotland under the move in the UK to 'Devolution'. SE has well-established business development and economic development divisions and has introduced a strong industry clusters strategy.
- **The Digital Hub.** This agency was established in 2003 with the strong support of the Irish Prime Minister. It operates on a partly re-developed 9-acre site in the run-down industrial area of Dublin and aims to create a viable, self-sustaining hub or cluster of growth in digital media. A supplementary aim is to assist in the urban regeneration of the surrounding area and to thereby contribute to greater 'social inclusion' of marginalised groups located there.
- **Nova UCD.** Nova is a technology development and transfer organisation established by University College Dublin. It fulfils the traditional role of a technology incubator (for both university spin-offs and outside start-ups) but utilises new strategies that bring together the research capacities of the university and the commercialisation capacity of external industry sponsors, each market leaders in their sectors.
- **lab.3000.** This agency was established by the Victorian government in 2001 as 'a centre of excellence in digital design', as part of the government's design strategy for growth in the state economy. Based at RMIT University in Melbourne, it aims to facilitate the formation and growth of overlapping clusters in the domain of digital design, encompassing the creative industries, new media, the design professions and design-intensive manufacturing.

Material describing the cases has been sourced from relevant publications, documents, web sites and by way of interviews with key people working in and near some of the organisations concerned (see the note in the Prologue to *Section Two*).

Finally, *Section Three* attempts to draw out from the earlier discussions of the nature of the innovation process in dynamic environments (*Section One*) and the experiences of efforts to organise innovation (*Section Two*), the implications for government policy. What are the lessons we can learn from such sources and experiences? Are there efficacious levers that government can identify and pull to achieve improved innovation – and therefore economic – outcomes for the local and national economies? Are there useful ways for traditional government agencies to interact with ‘broker’ agencies such as lab.3000? Just as critically, are there things that governments should avoid doing or becoming involved in if we are not to unintentionally erect or heighten barriers to growth? These questions are dealt with in *Section Three*.



02 Networks and Clusters

As hinted at in chapter 1, the analysis in this report is explicitly cast within the evolutionary economics paradigm. (See chapter 2 of Berry [2003] for a discussion of this paradigm as contrasted with the conventional approach of orthodox, neoclassical economics; this discussion is revisited in chapter 12.)

We are accustomed to thinking of evolution in a biological content, but modern evolutionary theory views evolution as something much more general. Evolution is an algorithm; it is an all-purpose formula for innovation, a formula that, through its special brand of trial and error, creates new designs and solves difficult problems (Beinhocker, 2006, p. 12).

The evolutionary approach to economics and especially to economic growth, was initially based on the analogy with Darwinian evolution in the biological sciences. As such, it suffered from both the strengths and weaknesses of argument by analogy. However, since it can also be argued that neoclassical economics, with its focus on the concept of equilibrium, relies implicitly on the analogy of nineteenth century mechanics, we would appear to be on a 'level playing field' here.

Witt (2002, p. 9) offers:

...a general definition of evolution as the self-transformation over time of a system under investigation. Such a system may be a population of living organisms, a collection of interacting individuals as in an economy or some of its parts, or even the set of ideas produced by the human mind....Self-transformation, it will be argued here, follows regularities, yet these regularities are too weak to allow for reliable prediction of the future results of evolution. Evolution is an 'open' process in which the capacity of a system to produce novelty is reflected, but, as the notion of novelty indicates, it is only the way in which this happens that can be anticipated as a regularity, not the outcome itself.

Witt goes on to characterise an evolutionary theory as:

- **Dynamic** – so that at least some of its key variables can be dynamically specified – i.e. the variables or events are explicitly ‘dated’, in the sense that they change through time or can be located at points in time.
- **Historical** – the trajectory of a system through real time is ‘irrevocable’ – i.e. does not repeat itself identically – and ‘path dependent’ – i.e. once launched on a particular trajectory a system’s future development is partly constrained to moving in the same direction. This rules out the possibility of systems that continually converge on a unique equilibrium regardless of where and when they started. At any one time, it is not the case, in this approach, that all technological options are open to a firm. Path dependence in the economy follows from the twin, inter-linked processes of increasing returns to scale and the phenomenon of ‘lock-in’ (see Arthur, 1994, 1996; Berry, 2003, p. 18-19).
- **Self-transformative** – change is an incessant feature of evolving systems but change comes from within, rather than as the result of unpredictable external shocks. The sources and regularity of change differ between systems (e.g. a biological eco-system and a competitive environment of innovating firms) but in all cases:

...there seems to be a common, abstract causation of evolutionary change: the emergence of novelty within, and its dissemination throughout, the system under consideration. If this is true, endogenous change originates in the last resort, from the capacity of the system under investigation to produce novelty. The novelty is specific to each field of study (Witt, 2002, p. 11).

In short, evolution’s simple recipe of ‘differentiate, select and amplify’ is a type of computer program – a program for creating novelty, knowledge and growth. Because evolution is a form of information processing, it can do its order creating work in realms ranging from computer software to the mind, to human culture and to the economy (Beinhocker, 2006, p. 12)

The best-known evolutionary theory of economic development, focused on the centrality of the innovation process, is that presented by the Austro-American economist Joseph Schumpeter (1934, 1942). As Witt notes, Schumpeter's theory satisfies each of the three conditions noted above – it is dynamic, historical and locates the source and driver of change within the economic system of advanced capitalist societies.

For Schumpeter, innovations are introduced by highly motivated 'entrepreneurs' who are driven by a range of motivations, including not only greater profits but also a 'sense of achievement', the pursuit of power and status and the satisfaction gained from 'getting things done'. He also developed an explanation for why innovation in the economy is normally an uneven, cyclical process, coming in 'swarms' and imparting the particular dynamic rhythm to the economy as a whole that we call the business cycle. Later in his life he moved from a focus on the innovation role of individual entrepreneurs to the increasing capture and institutionalisation of innovation within the large corporation (Schumpeter, 1942; see also, Simmie, 2001).

Large firms, he argued, had sufficient resources to invest upfront in the necessary R&D to discover inventions that could be turned into innovations; moreover, they were financially strong enough to withstand the large number of failures that the search for new products, processes and organisational arrangements inevitably threw up. Finally and critically, the large corporation, he thought, was best placed to exert a degree of monopoly power in its core markets, thereby protecting the excess profits gained by successful innovation for a longer period; this prospect, in turn, provided a stronger motivation to innovate in the first place and generated more resources to devote to further innovation in the incessant race to stay ahead.

A major limitation with Schumpeter's particular evolutionary theory is that, in distinguishing between invention and innovation and focusing on the latter, he leaves unexplained the causes of the former. In other words, if leading entrepreneurs concentrate on applying existing inventions, what forces bring about the novel inventions to be selected from among? If the economy as an evolving system is internally transformed through the emergence of novel products, processes and organisational forms, what causes these novel features to arise? Put simply – if novelty drives change, what generates novelty? 'With the focus on entrepreneurial skills in promoting innovations, rather than conceiving them, attention is diverted from general human creativity and inventiveness and the motivations underlying it as crucial elements of evolutionary change' (Witt, op.cit., p. 15).

By shifting the focus to the issue of creativity, to what generates novel developments and, secondly, to how some novelties are 'selected for' or triumph over others, jerking the system onto new path dependent trajectories, light can be cast on the dynamic regularities actually driving economic development. This gets us away from a concern

with both the heroic individual entrepreneur and the large, monopoly-seeking corporation to a greater understanding of the complex, interacting forces that account for observable change. It also raises the possibility of identifying levers that would allow firms, industry associations, R&D organisations and government policy makers to remove barriers and stimulate faster and more effective innovation activity.

Rationality and creativity feed and shape the workings of the evolutionary algorithm in the economy, but do not replace it. (Beinhocker, 2006, p. 14)

More recently, the application of an evolutionary paradigm to the economy has been characterised as more than a metaphorical statement. Evolution is characterised as a general set of processes – an algorithm – that give a law-like rhythm to complex systems, whether organic or social.

From a scientific standpoint, the distinction between a metaphorical versus a literal understanding of the global economy as an evolutionary system is critical. Saying that economic systems are like biological systems does not tell us much that is scientifically useful. But saying that both economic and biological systems are sub-classes of a more general and universal class of evolutionary systems tells us quite a lot. This is because researchers believe that there are general laws of evolutionary systems (Beinhocker, 2006, p. 12).

Networks – Conduits of Collaboration

It is clear that actual industry and economic development in advanced economies is driven by both competitive and collaborative factors. The outcome, in any place and period, has much to do with the overall institutional or ‘environmental’ frame within which firms and other economic actors interact. Increasingly, patterns of collaboration and cooperation are implicated in commercially successful innovation activity. In an economic environment characterised by instantaneous communications competitive advantage arises not just from being ‘first to market’ but in quickly creating cooperative ventures to identify relevant market opportunities and tailor products best suited to exploiting them.

There are two senses in which we believe an organisation can compete by collaborating. One is through the internal collaboration between the organisation's managers and employees. The other is external, through collaboration with other organisations beginning with customers, suppliers and business partners, but even including competitors if the circumstances are right. The second form of collaboration is known as collaborative commerce or c-commerce (Logan and Stokes, 2004, p. 13)

"Collaborate or die – the writing is on the wall. Collaboration is the key to profitability in the New Economy" – J. D. Edwards (quoted in Logan and Stokes, op. cit. p. 10)

Networks are loose collections of actors linked in various ways – by flows of information, exchanges of resources, agreements to cooperate or reciprocal commitments. 'Thus the nature of some aspects of firms' environments may be negotiated through networks of social interaction between agents and their counterparts in other relevant organisations' (Clark and Tracey, 2004, p. 75).

Networks increasingly stand between individual firms and the market. They can be powerful instruments for mutual learning, once relations of trust have been established between network members. As such, networks figure as both the organisational form through which creativity and innovation are engendered and the means of rapid dissemination of innovations that are selected for in the wider competitive environment.

In many ways the contemporary economic environment might be described as *alliance capitalism* (Clark and Tracey, 2004, p. 15; ital. in original)

Alliances may involve a variety of different partners. They can occur between functional departments and/or subsidiaries within the same firm, between firms and their competitors, between complementary firms such as suppliers, customers, subcontractors and distributors, between private firms and public institutions such as universities and regional and national governments, between kinds of public institutions, or between firms and other stakeholders and interest groups which operate within market-based systems of accumulation such as consumers, trades unions and environmentalists...In practice, networks of interaction often involve a combination of two or more of the above alliances (ibid., p. 75-76).

Clark and Tracey, following Hotz-Hart (2000), summarise the advantages flowing to network members as:

- Better access to information, knowledge, skills and experience
- Greater opportunities to form useful alliances or collaborations
- Improved response capacity to new market opportunities (including opportunities opened up by new forms of technology) and changed environmental conditions
- Reduced risk, moral hazard and information and transaction costs – due to greater trust between and closer monitoring among network members
- Improved trust and social cohesion achieved through the shared experience of successful collaboration and reinforcement of shared values

...networks are thought to encourage interactive learning between participating organisations through the sharing of knowledge and information, which is itself facilitated through trust, shared values and ways of working (Clark and Tracey, 2004, p. 77)

Networks, then, are the critical vehicles or conduits for innovation negotiated through complex combinations of competition and collaboration. Network structure varies across industry sectors and regions and through time. They can establish simple, asymmetric ‘first-order’ relationships between individual agents or evolve into complex, ‘higher order’ sets of inter-relationships characterised by ‘dense’ overlapping ties, spread over long distances, negotiated through both face-to-face and virtual communication. (For a discussion of network forms, see Berry, 2003, p. 33-36)

Staber (2001) notes that successful networks that enable rather than constrain innovation have to balance two opposing structural forces. On the one hand, they need to be relatively decentralised, open and ‘permeable’, not ‘closed shops’ nor governed by strong centralising powers, if they are to attract new members with new skills, resources and knowledge and respond flexibly to changing external competitive conditions. On the other hand, inter-relationships need to be stable enough for mutual knowledge and trust to build up and for the benefits of innovations sparked by some network members to filter through to other members.

From an evolutionary economic viewpoint, successful networks are those that last! There are likely to be a variety of network forms and structures emerging in the competitive environment. External pressures from technological change, increasing Globalisation, changing government policies and the like impact differently on different networks, selecting or favouring some structures over others. The favoured network types tend



to proliferate in those environments for which they are well-fitted, for the period that this fit lasts. This suggests that, over time, as external environmental changes occur, the nature of networks – their size, density, geographical reach and complexity – are likely to change as new forms better suited to the changed circumstances prosper at the expense of existing forms, the latter tending to disappear (i.e. face extinction) or transform towards the new structure(s).

However, it is clearly the case that internal forces for change also act on network structure and functioning. The source of change here is the capacity of networks to throw up genuine novelty from within, via innovation by network members. This is a dual process. Innovation is facilitated and, to a degree, shaped by existing network structures; innovation also changes those structures and favourable changes may be ‘selected for’ (reinforced) through the external competitive process. Existing networks facilitate innovation by bringing members into cooperative contact with each other; ‘(s)uccessful networks and the regions supporting them are “collective learning systems”’ (Berry, 2003, p. 38). Conversely, existing networks can constrain or block innovation from within, especially where they are inadequately flexible and open to new ideas and members. In such circumstances it is far from certain that evolutionary change will consign these unsuccessful networks to ‘the dustbin of history’ and automatically generate new productive interactions. All that will tend to happen is the industries and regions affected fall further and further behind more dynamic economies elsewhere. Successful networks and regions may be selected for and experience rapid growth, while the unsuccessful just fade away. This is a typical trajectory expressing path dependent ‘divergence’, ‘cumulative causation’ or uneven development, rather than market-led ‘convergence’ to a common equilibrium (as neoclassical economics would have it).

A key question therefore becomes – what network structures and rules would have the best chance of generally facilitating innovation, reinforcing supportive networks for continuing innovation in a highly competitive global economy? Summarising the discussion in my earlier monograph (Berry, 2003, 38-40), Staber (2001) has offered a tentative hypothesis that such networks would display three defining characteristics:

a) Loose coupling. In loosely coupled networks members interact with each other:

suddenly – rather than continuously

occasionally – rather than constantly

negligibly – rather than significantly

indirectly – rather than directly, and

eventually – rather than immediately

In other words, loosely coupled networks are contingent and porous enough to link members when and where they can generate useful synergies, without requiring a large investment of time and other resources that would deflect their attentions from more important activities and may lock them into relationships that prove fruitless.

This analysis echoes earlier work by Granovetter (1973) on 'the strength of weak ties'.

The argument is essentially very simple: weak ties provide a link to other firms and networks with different ways of viewing the world, and are therefore important bridges across which alternate information flows can travel and are crucial for innovative behaviour. By way of contrast, strong, well established networks are effective at transmitting information between participating firms, but tend to be poor sources of new ideas and ways of working. This propensity increases over time –as firms learn more about one another, they come to view situations from increasingly similar perspectives (Clark and Tracey, 2004, p. 78).

In fact, as Clark and Tracey go on to stress, the situation is more complex, since '... innovative firms rely on a dynamic combination of strong and weak ties' (ibid, p. 80). A firm may be a member of several networks and, in a given period, find it advantageous to build ties of varying strength and commitment with a range of allies. 'The key point is that flexibility in terms of the construction and reformulation of appropriate network forms constitutes a crucial component of competitiveness' (ibid., p. 81).

b) Diversity. A major advantage of networks held together by weak ties is, as already noted, that it encourages recruitment of agents with new and novel perspectives, experiences and differing skills or capacities. Networks that can call on complementary capacities and resources are more likely to survive and thrive in changeable economic environments than highly specialised networks made up of members with similar or identical resources. In the former, the likelihood is high that at least some members will have the ability to exploit the new opportunities thrown up by unpredictable environmental change. Other members are also in a position to learn through formal and informal information exchanges with their well-placed network allies.

c) Redundancy. Some degree of duplication of relationships between network members can be very useful, especially in relation to channels of formal and informal (tacit) information. Highly specialised 'efficient' networks are vulnerable to information breakdowns and the loss of strategically placed members. 'The evolutionary advantage of redundant relationships is that they minimise the negative impact of the loss of a particular relationship on the maintenance of the network as a whole....Structural redundancy makes the network more 'error friendly' (Staber, 2001, p.547; quoted in Berry, 2003, p. 39).

Arguably, there is a fourth feature of networks that facilitates innovation – size. The larger the number of members participating in various ways and with varying investments of resources, the greater the number of potential synergies and productive alliances resulting. Moreover, the number of potential linkages increases faster than the number of members.

In the two-member network or simple cluster the potential number of possible ‘collaborations’ is precisely one – AB. In the three-member case the number of direct collaborations rises to three: AB, AC and BC. In addition, there now arises the possibility of a three-agent collaboration – ABC – making four collaborations in all. The addition of one cluster member quadruples the potential collaborations. Adding a fourth member increases the direct collaborative potential of the whole to six – AB, AC, AD, BC, DC and BD – and the number of larger collaborations to five – ABC, ADC, BDC, ABD and ABCD. And so on.

This is illustrated in the Figure 1 as follows:

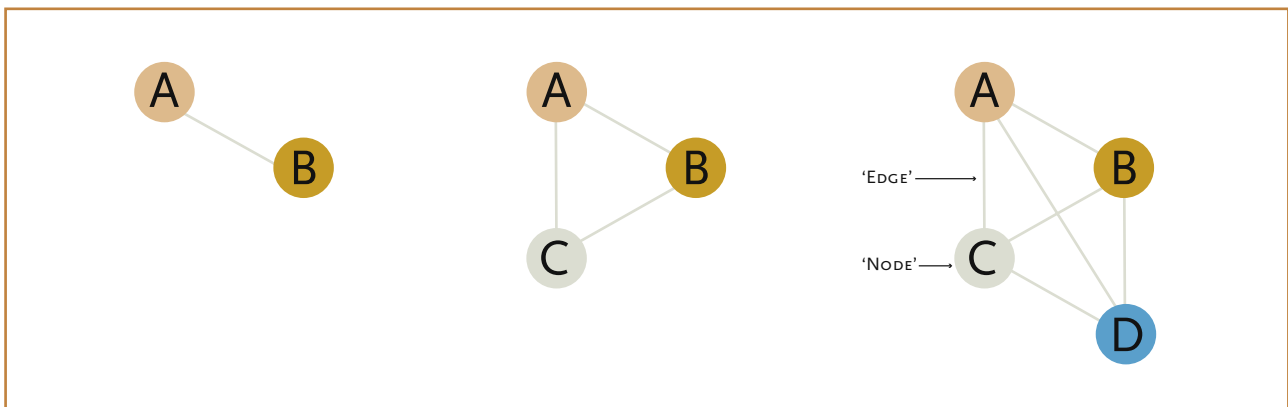


FIGURE 1

A particular type of network – a Boolean network – comprises nodes that are in either one of two states – ‘on’ or ‘off’ (e.g. communicating or not communicating).

As the size of a Boolean network grows, the potential for novelty increases exponentially... The space of possible states for a 100-node network is not merely ten times greater than that for a 10-node network; it is thirty orders of magnitude (10^{30}) greater (Beinhocker, 2006, p.149)

However, it is also the case that as the number of participants in a network increases, so too do the costs – in money, time and information processing – of tracking, choosing between and monitoring the rapidly growing phalanx of possible connections ('edges') or collaborations. Some networks may reach an unsustainable size and collapse under their own weight.

This tendency for *diseconomies* of scale to radically disrupt functioning networks has been exhaustively studied (e.g. Kaufman, 1993; Watts, 2003). The key finding is that as the number and strength of connections grow denser, the more likely it is that small changes in one part of the network will ripple through causing changes throughout, some of which will be negative. The network overall becomes more unstable, liable to sudden large changes, not necessarily suited to the more slowly changing environments in which network members operate. This outcome has been called – 'a complexity catastrophe'.

This [catastrophic] effect occurs because as the network grows, the probability that a positive change in one part of the network will lead to a cascade resulting in a negative change somewhere else grows exponentially with the number of nodes. This in turn means that densely connected networks become less adaptable as they grow (Beinhocker, 2006, p.152)

Kaufman has calculated that (highly stylised) networks operate effectively – i.e. display a capacity for self-organising order – where each node has between two and four connections but that once over four, the system becomes chaotically unstable and prone to complexity catastrophes. Other researchers have demonstrated that if 'bias' is built in to the network – by assuming that some nodes behave with a degree of predictably – the number of connections per node can be increased to between six and nine without reaching the 'tipping point' into catastrophe, increasing the workable density of networks considerably.

Other network characteristics operate in the same way to limit the density problem. In particular, the characteristic outlined above – loose coupling - imparts a degree of resilience and flexibility to networks that enables nodes to 'switch' on and off, move in and out, as particular environmental opportunities arise and constraints bite. Similarly, the tendency for networks to segment (see diagram below) or evolve internal hierarchical arrangements or nest within other networks all reduces the danger of over-densification.

Finally, as implied above, it should be stressed that some members are 'more equal than others'. That is, due to their size, function, particular combination of resources or strategic location, they exert a considerable degree of influence over the survival and growth prospects of the whole network. For example, so-called 'gatekeepers' play a vital

role in linking different parts of large networks together and facilitating information exchanges between different networks¹. Gatekeepers also help insulate different parts of the network from the problems of over-connectivity discussed above. In a study of exchanges and collaboration between inventors, Fleming and Juda (2004) identified a small number who had developed links with large numbers of other inventors. 'Gatekeepers...have two defining characteristics: They are prolific technical contributors (usually with advanced degrees), and they work and communicate with many people, both within and across discipline and organisational boundaries' (ibid., p. 222; quoted in Berry, 2004, p. 55). Gatekeepers are the glue holding together disparate parts of or links between different networks. As such, their loss or non-functioning can have adverse consequences for the network(s) as a whole. This point is made schematically in the figure below. If either gatekeeper linking the two network segments ceases its role, then the two parts of the network (or two different networks) turn their backs on each other and the potential numbers of alliances and exchanges fall sharply. This underscores the evolutionary value of built-in redundancy, as well as the strategically important role of gatekeepers in the success of dynamic networks.

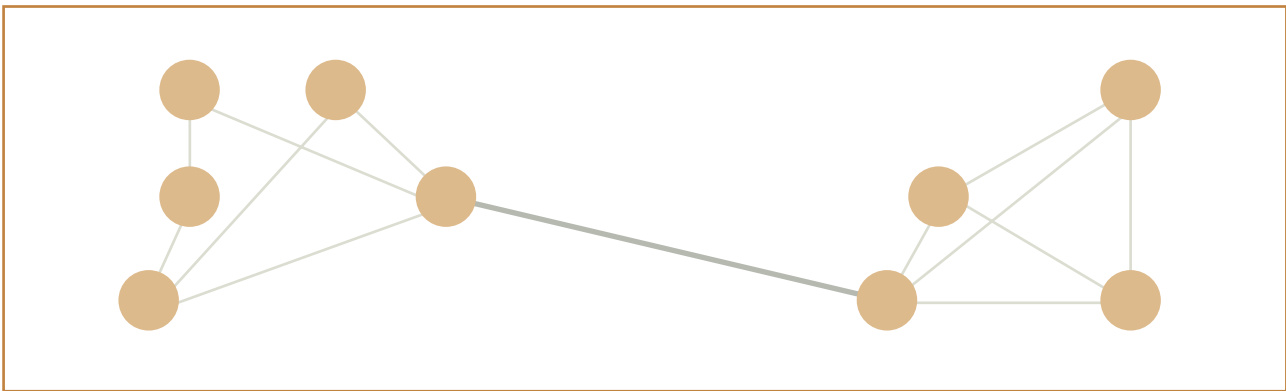


FIGURE 2

Understanding network dynamics is important, because of their critical role in the innovation process and as the building blocks of what have been called 'industry clusters'.

¹ The uneven flows of information through a network can be described by what statisticians call 'a power law' (see Omerod, 2005, chapter 10)

Industry clusters are loose knit collections of agents held together by overlapping networks and concentrated in particular regions or places. They are major engines of innovation and growth in successful metropolitan regional economies around the world. (For a discussion of clusters, see Berry, 2003, p. 23-27; see also, Saxenian, 1994; Porter, 2000; Athreye, 2004).

“Clusters are geographic concentrations of interconnected companies, specialist suppliers, service suppliers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate” (Porter, 1998, p. 197)

Clusters drive regional and economic growth because they directly and indirectly improve productivity and create competitive advantage for member firms. Successful clusters grow in a self-reinforcing way, attracting new members and creating ever-more complex patterns of network interaction. Increasingly, successful clusters are developing international dimensions, based on networks that stretch across the globe (Clark and Tracey, 2004). This suggests that clusters are, at the same time, institutional complexes focused on growth in the local regional economy and vehicles for overcoming the constraints of space by ranging across the global economy. They are key means of organising innovation in the current era of Globalisation.

Clusters have assumed importance in policy circles over the past ten years because they are seen as a potent lever for inducing improved regional economic development performance (Department of Trade and Industry, 2001). We will return to this theme in chapter 12 in the discussion of what governments can do to facilitate innovation and growth.



03 Learning to Innovate

The essence of the information and knowledge economy, and what makes it a very real phenomenon which has profoundly affected rates of labour productivity, innovation and economic growth, are the distinctive ways in which knowledge is created and disseminated between constituent actors, and the accompanying changes to the organisation of firms, industries and regions (Clark and Tracey, 2004, p. 92).

Innovation in the globally pervasive knowledge economy is increasingly mediated through evolving patterns of networks that form clusters concentrated in leading regional centres. Networks and clusters, then, form an important part of the overall institutional structure within which endogenous growth processes unwind over space and through time. Individual agents or actors within a given innovation system collectively create, operate through and transform networks. Network membership and participation both empowers individual agents, by for example, facilitating exchanges of market-relevant information, and limits or constrains their behaviours by filtering information and locking activities into established routines based on shared values and norms. Most critical of all, networks are powerful vehicles for learning. The capacity of firms and other agents to learn as they interact with each other and their broader economic environment is the vital spur to the unpredictable generation of novelty – of new ways of doing and organising things – that is then selected for in the competitive world that all find themselves. As agents learn, so too do they change or transform the larger organisational and institutional structures of which they are a part – though often in unexpected and unintended ways.

Any theory of learning and innovation must be able to accommodate the interaction between individual, group, organisational and regional or societal levels that this implies (ibid., p. 93)



In the Frame

In orthodox, mainstream economics the role of information is distinctly marginal. All firms and consumers are assumed to be well (if not ‘perfectly’) informed about all alternative productive activities, all the consequences of each activity and all possible technological approaches to each activity. Learning occurs through adaptive responses – basically, trial and error – to changing market conditions. Firms and consumers are ‘price takers’ not ‘market makers’. Economic agents are assumed to be utility or profit maximising rationalists.

The ‘expected utility’ (EU) model dominates orthodox economics. Each agent faces a fully specified, well-behaved (usually linear) utility function and is able to continuously value and place probabilities on each alternative outcome of every possible action. The agent will choose that action that has the highest expected utility – i.e. the greatest sum of outcomes weighted by their probabilities. The massive information and information-processing requirements implied by this super-rationalist model of individual decision making are simply ignored.

Evolutionary and institutionalist approaches to economics, on the other hand, pay serious attention to learning as a dynamic *process*, as the means by which information is sought and new ideas are created, disseminated and applied to qualitatively new situations. Individual agents are *not* assumed to be human calculating machines. They *are* held to be bound by available information and the cognitive limits and emotional factors that influence how real people in real situations actually make (and avoid making) decisions. Individual agents can change their decisions or behaviours as they learn more about their opportunities, resource availability, personal and institutional constraints and what other agents are or could be doing.

The growing body of theory that underpins these approaches and provides a devastating critique of the EU model is called ‘behavioural economics’ (see Cammerer et al, 2004, for a summary of this rapidly growing field). One of the earliest contributions was by Simon (1955, 1956) who introduced the concept of ‘bounded rationality’. He argued that the capacity of an agent to act rationally in the context of the EU model is heavily constrained by limited information, limited knowledge about how to use the information they do have, limited cognitive capacities to process that information and a less than fully accurate picture of the external environment in which they make their decisions. Economic agents can’t possibly know all about all the possible alternatives for action, including their impacts, costs and probabilities of occurrence. As such, Simon argued, they do the best they can – they ‘satisfice’ rather than maximise utility.

In Simon’s world, agents decide (under conditions of imperfect and incomplete knowledge) how many resources, including time, to devote to ‘searching’ for relevant information. The search process is a critical determinant of actual behaviour because

what agents find out confines their decision making activity to a finite set of choices; more to the point, what they do *not* find out effectively rules out of consideration the choices they *could* have made *if* they had known of their existence. Because of the confusingly large number of choices facing an agent at any point in time, the manifold possibilities of new information sources, the uncertainties attaching to the outcomes of most courses of action and the cognitive and emotional difficulties of setting priorities, agents tend to fall back on rules of thumb or 'heuristics' to help them decide what to do (Shefrin, 2002). 'Considered in this way, heuristics are essentially strategies to simplify, systemise and economise on decision-making' (Clark and Tracey, 2004, p. 95).

Rules of thumb tend to be developed within organisations and disseminated to agents within and across organisations. In short, heuristics are learned 'on the job' and reinforced through both formal and informal means. Hence, formal organisational rules can guide individual behaviour within the organisation along known paths, confining attention to a particular range of factors and actions. Conversely, some heuristics are developed, reinforced and spread through informal or tacit channels – in casual workplace conversations, by repeated observation of work colleagues, as the unintended outcome of core tasks. Through time heuristics may be 'routinised' – i.e. turned into widely recognised and accepted routines or ways of acting – within the organisational and institutional environment. Individual agents, by sticking to the relevant routines, make sense of the otherwise bewilderingly complex environment and are empowered to act; of course, by drawing on established organisational routines, agents collectively reinforce them.

Established organisational routines are important factors in 'framing' the decision-making environment for agents. In one of the classic texts of behavioural economics, Kahneman and Tversy (1979; see also Kahneman and Tversy, 1984) argue, in opposition to the EU model, that *the way in which* opportunities for gains and losses are posed to actors materially influences the decisions they make. Through repeated and robust experimentation these authors (and others) have found that actors tend to be *both* risk averse for potential gains *and* risk seeking in the case of potential losses. Moreover, they consistently find evidence of a pervasive *loss aversion* among actors; people value avoiding a loss more than receiving a gain of the same size. This suggests that only some connections and collaborations brokered through networks will throw up novel innovations that are selected for in driving growth. Whether or not they do will depend critically on how the potential gains and losses from actions associated with the novel opportunity appear to the collaborating actors. In some cases, then, the routines established and the information shared among network members will lock the latter into current patterns of action, screening out the novel opportunities that would shift the system onto a new development path. In other cases, where potential gains more than outweigh potential losses to a significant degree, opportunities will be avidly taken up, resulting in unpredictable novel changes and (eventually) new

routines. What this does suggest is that there is an in-built 'psychophysical' barrier to innovation at the level of the individual decision maker and that this barrier can be either reinforced or overcome through network participation. This 'either-or' condition is, as noted in the preceding chapter, characteristic of the open, unpredictable nature of evolving systems in general.

This view of decision-making in uncertain environments sits well with recent developments in organisational theory on the nature of 'the modern firm'. Roberts (2004, p. 12) argues that: '(a)chieving high performance in a business results from establishing and maintaining a fit between three elements: the strategy of the firm, its organisational design, and the environment in which it operates'.

Learning Loops

Clark and Tracey (2004, p. 84) stress that networks both constrain innovation and provide the potential for network members to overcome these constraints through active learning. Learning involves the dissemination of information and knowledge through formal and tacit mechanisms and they present, following Argyris and Schon (1978), a tripartite theory of how this occurs within and between organisations forming functioning networks and clusters. Their typology can be summarised as follows.

1. Single-loop learning covers behaviour aimed at achieving perceived organisational goals within the existing environmental conditions or frame of action. It depends on a simple 'signal-response' mode of behaviour. Actors are reactive. They do not question or seek to change existing organisational values and norms; '...the purpose of single-loop learning is to achieve existing goals and objectives while ensuring that organisational performance does not move beyond current values and norms' (ibid., p. 100). They do seek, process and act on information that they expect, on the basis of past experience, will assist them to achieve the unquestioned goals of their organisations and, in particular, maintain their competitive positions. For the most part this means responding to price and related signals generated in the market – e.g. the prices charged by competitors and suppliers, movements in interest rates and share markets, and so on.

2. Double-loop learning involves not only responding to outside signals but also seeking to improve existing performance by questioning current assumptions on which the organisation's goals and values are based. This entails moving beyond experiential modes of acting with the aim of making the organisation better able to recognise and seize opportunities in a highly competitive and unpredictable environment. It may result in significant changes to operating procedures, routines and structures within the organisation, creating new or modified norms, values and channels of information. Tacit or informal flows of information within the organisation are important in this process

of organisational reform, both to reinforce formal top-down instructions and to enable actors at different positions within the organisation to negotiate conflicting views about – and resolve conflicting interests in – the particular direction reform takes.

3. Triple-loop learning moves an important step further and entails agents developing an understanding of the learning process itself, enabling them to influence and change the processes and outcomes of learning, in spite of existing institutional constraints. Indeed, triple-loop learning empowers agents to partly transform the organisations they work within and their inter-relations with other agents and organisations. Agents are ‘reflexively’ embedded in networks rather than locked within them. Triple-loop learning ‘evolves’ the process of ‘learning to learn’, entailing:

...the capacity of agents to operate on a higher level of abstraction, and to understand, at least in some general sense, the learning system of which they are a part, the kinds of actions needed to engender purposeful change, as well as the limits of such actions. Agents are required to collaborate with other actors in order to reflect on and assess inherited systems of innovation, to consider market situations when innovation was deemed to have been effective, and conversely, when it was deemed to have failed. This allows agents to learn about and to articulate modes of behaviour that facilitate and inhibit learning and innovation, and to evaluate their effectiveness. Redefining existing boundaries between different industries and services so that new niche markets emerge ... and the development of products and services based on intrinsically new technological and/or market structures ... are possible examples of triple-loop learning (Clark and Tracey, 2004, p. 101).

Triple-loop learning, they argue, relies primarily on formal stores of knowledge that can be codified and accessed independently of (or in addition to) the agents’ tacit understandings. Agents interact with each other within and between organisations by drawing on mutually accessible understandings of their shared decision making environments, utilising heuristic ‘metaphors and shared frameworks’. ‘This allows firms to learn about new ideas and ways of operating, to be proactive with regard to opportunities and threats and thus at least partly shape their competitive circumstances, and ultimately to engage in innovative behaviour’ (ibid., p. 102). This approach to learning is implicit in the body of economic theory known as ‘endogenous growth theory’, associated with the American economist Paul Romer (1990; see the discussion in *Section Three*). Although tacit knowledge typically garnered within the firm or organisation is critical to orienting individual behaviour, it is, in this view, the increasingly formalised interactions between organisations that allow novel opportunities to arise and innovative action to realise the mutual benefits of cooperation.



This analysis can be criticised for a tendency to over-stress the differences between the three levels of learning. In particular, it is not clear that tacit knowledge flows exclusively or primarily within the organisation, as Clark and Tracey go close to asserting. Network participation linking disparate agents is a powerful generator of wholly and partly tacit understandings and behavioural routines. Self-transforming networks probably evolve as much under the spur of novel behavioural outcomes driven by the flow of tacit knowledge within a loosely-coupled network, as from the codification, dissemination and application across organisations of formalised knowledge. In fact, it is the interaction and reinforcement of tacit and formal knowledge flows within an evolving network structure that accounts for what might be termed 'the innovative surge'. The partly successful attempts by agents to knowingly mould the environment to their purposes through both competitive and cooperative behaviours leads to innovation which, in turn, re-draws existing institutional constraints and impacts on continuing learning. This means, as Clark and Tracey admit, that double-loop and triple-loop learning processes are intertwined and together drive innovation processes.

It is also the case that the growth of the knowledge economy, dependent in part on the engine of learning-induced innovation, has evolved an institutional structure – defined by networks and clusters – peculiarly well-fitted to encourage double-loop and triple-loop learning in a self-reinforcing, path-dependent manner. Learning as a collective enterprise and innovation as a generator of novelty operate together in a 'virtuous circle of growth'. The attempt to transcend existing institutional constraints leads to the institutionalisation of such attempts!

It may seem like a paradox, but we are essentially arguing that the continual reframing of the social and institutional influences which constitute agents' learning systems itself becomes institutionalised in the information and knowledge economy, and is reinforced and confirmed through the actions of agents. This has enabled double- and triple- loop learning to become internalised and socially embedded, thereby reinforcing innovative behaviour in a cumulative way (Clark and Tracey, 2004, p. 108).

To conclude, overlapping networks, both clustered in space and articulated over space, form the dynamic institutional milieu within which innovation occurs. Individual agents engage in learning activities that collectively transform that milieu in both intended and unexpected ways, throwing up novel opportunities for innovation that create competitive advantage for some and reinforce the incentives and routines underlying continuing learning for those seeking success or simply survival. The nature of the modern firm has evolved to operate successfully within this increasingly complex and turbulent environment.




Small and medium sized enterprises (SMEs), in particular, gain from active network membership. In general, SMEs lack the resource base to efficiently mine market information – to track where the market is heading and who the key players are – invest in R&D and take good ideas forward to market. The flows of information and opportunities to collaborate presented by membership of active networks and clusters reduce these barriers and allow SMEs ‘to find their niches’. Conversely, the entry of SMEs to existing clusters confers advantages on current members. In the first place, it adds to the number of potential, linkages and collaborations, as demonstrated above. Second, new members bring new skills and resources and entrepreneurial energy to the whole; e.g. new technology companies will sometimes start life as spin-offs from university laboratories at the forefront of research in a field. Third, SMEs will often be formed as spin-offs from larger firms, a case of existing talent not being lost to the cluster but returning in a new organisational guise.

It is this last-named advantage that leads to an unexpected conclusion. When it comes to innovation, SMEs often ‘punch above their weight’. It does not always follow – as the older Schumpeter argued (Berry, 2003, pp. 46-48) – that innovation will be monopolised by large corporations. Some innovations, critical to the overall growth trajectory of regional and national economies, appear to depend on SME or spin-off leadership. This point is addressed in the next chapter.





04 Disruptive Versus Sustaining Innovation



Much of the debate over innovation focuses implicitly on the notion of the ‘large leap forward’. Innovation, in this classical, Schumpetarian view, involves a ‘strategic leap’ – the creation of new products, processes and organisational forms based on formal R&D generated knowledge. Spiller (2006) argues that this perspective tends to be associated with a focus on business-to-business networks that favour relatively permanent bilateral strategic partnerships. However, quoting the earlier Australian research of Carnegie and Butlin (1993), Spiller points to a second, less visible form of innovation – organic innovation – that involves piecemeal improvements in existing processes and products. Organic innovation, small-scale, highly focused and low risk, can further be sub-divided into: (a) more-or-less continuous, incremental improvements and; (b) step-change improvements that, although discontinuous, nevertheless are closely tied to the current range of activities, resources and expertise of the firm and closely fit the firm’s current strategic trajectory and organisational design.

Organic innovation, either continuous or step-change, depends far less than strategic leap approaches on large-scale, formal R&D and, hence, on developed bilateral relationships with other agents like universities, standards agencies, intellectual property regimes and the like. Thus, there is far more room for SMEs to play a dynamic role in innovation systems, since they are not necessarily precluded by inadequate access to the large scale resources, important bilateral relationships and heavy upfront investments necessary to engage effectively in strategic leap innovation. On the positive side, SMEs can be active participants in fluid, open-ended networks involving multilateral, rather than bilateral relationships, among agents clustered in ways described in chapter 2. Moreover, as Spiller (2006, pp. 17-22) makes clear, manifold opportunities for organic innovations emerge as a result of the ‘unbundling of the value chain’ – i.e. the breaking down of the primary and support activities of firm, such as operations, logistics and marketing, and outsourcing some of these activities to a range of specialist firms². The matrix of overlapping inter-firm relationships provides a potent channel for the exchange of ideas and knowledge leading to organic innovation along the entire value chain.

² For a summary of these ideas, see Porter (1990, pp. 40-44)



'In the world of unbundled value chains, firms enjoy an operating domain which is altogether more fertile as they continue their search for a competitive edge, through whatever form of innovation...' (Spiller, 2006, p. 21)

Organic innovation can thus be expressed along the value chain by, for example:

- Cost savings generated by improved logistics – in and/or out
- Enhancement of existing products and their packaging through outsourced industrial and graphic design
- The 'bundling in' of complementary services, such as road-side service to automobile purchasers

Recognition of those wider sources of innovation – and their potential to flourish in a milieu of flexible companies open to "unbundling opportunities" – may explain the apparent paradox of Australia's strong economic performance over the past two decades, including its relatively rapid expansion in exports of high value added manufacturing, despite the nation's stubbornly poor ranking in officially measured innovation infrastructure, especially in terms of business expenditure on research and development..." (Spiller, 2006, p. 21)

It is not just the case that many commercially valuable products emerge from smaller, newer companies rather than the large, established market leaders. This is certainly important but not decisive, since most innovation tends to be led or acquired by the established market leaders who are well resourced and well motivated to maintain their dominant positions. There are, according to an influential study by Christensen (1997), some innovations that are only likely to be made by SMEs or larger firms from different industries. Moreover, these innovations – based on what Christensen calls 'disruptive technologies' – tend to have major impacts on market developments overall, including the commercial success or failure of the current market leaders. As was noted earlier, if SMEs are not encouraged and integrated within changing clusters, the whole is denied the value-creating goad of disruptive technological advance.

Christensen characterises and compares two forms of technological change underlying innovation processes:

Sustaining technologies continuously improve product performance and reduce unit costs of products that meet the main current and forecast needs of their major customers. Today's market leaders closely and successfully follow the expressed needs



of their customers, invest aggressively in new technologies that provide their customers with better and cheaper products that they want; and systematically allocate investment dollars to technologies that promise the best returns. So far, so good! Paradoxically, however, the very skill and success with which leaders exploit sustaining technologies to protect and enhance their market position disables them from initiating or successfully responding to disruptive attacks 'from below'.

Disruptive technologies are the mirror image of sustaining technologies. They initially result in worse performance for most current users but are generally smaller, cheaper and offer low key services to some customers, many of whom were previously excluded from the mainstream market. Their initial uses and applications do not point to the unanticipated future uses to which they will be put. This latter point is critical in explaining why such innovations tend to be ignored by larger established firms – they are launched ahead of any clear, quantifiable large-scale market demand. Disruptive technologies are thus not a rational investment proposition for well-managed companies and their financiers. The numbers don't stack up since:

- Expected profit margins are low
- Such technologies usually emerge in currently insignificant markets
- The main customers of the leading firms don't want or can't use the products promised by the disruptive technologies

A sustaining innovation targets demanding, high-end customers with better performance than was previously available... Disruptive innovations, in contrast, don't attempt to bring better products to established customers in existing markets. Rather, they disrupt and redefine that trajectory by introducing products and services that are not as good as currently available products. But disruptive technologies offer other benefits - typically, they are simpler, more convenient, and less expensive products that appeal to new or less-demanding customers (Christensen and Raynor, 2003, p. 34)

Sustaining technological advance typically runs ahead of market need; the performance characteristics of the product outstrip the functionality required by an increasing number of customers, current and prospective. Disruptive technologies, on the other hand, deliver less to more. They are generally smaller, cheaper and initially pitched at marginal or new users who are only interested in relatively basic functionality and looking to pay low prices for it. Thus, initially, disruptive innovation influences developments at the margin, through the creation and satisfaction of low value market segments. However, over time, the products of both sustaining and disruptive technologies are improved in terms of performance features or function and the markets created by

disruptive innovation grow both because the new segments 'take off' and the disruptive technology now delivers acceptable performance at lower cost to mainstream markets. This 'attack from below' is demonstrated in the following figure.

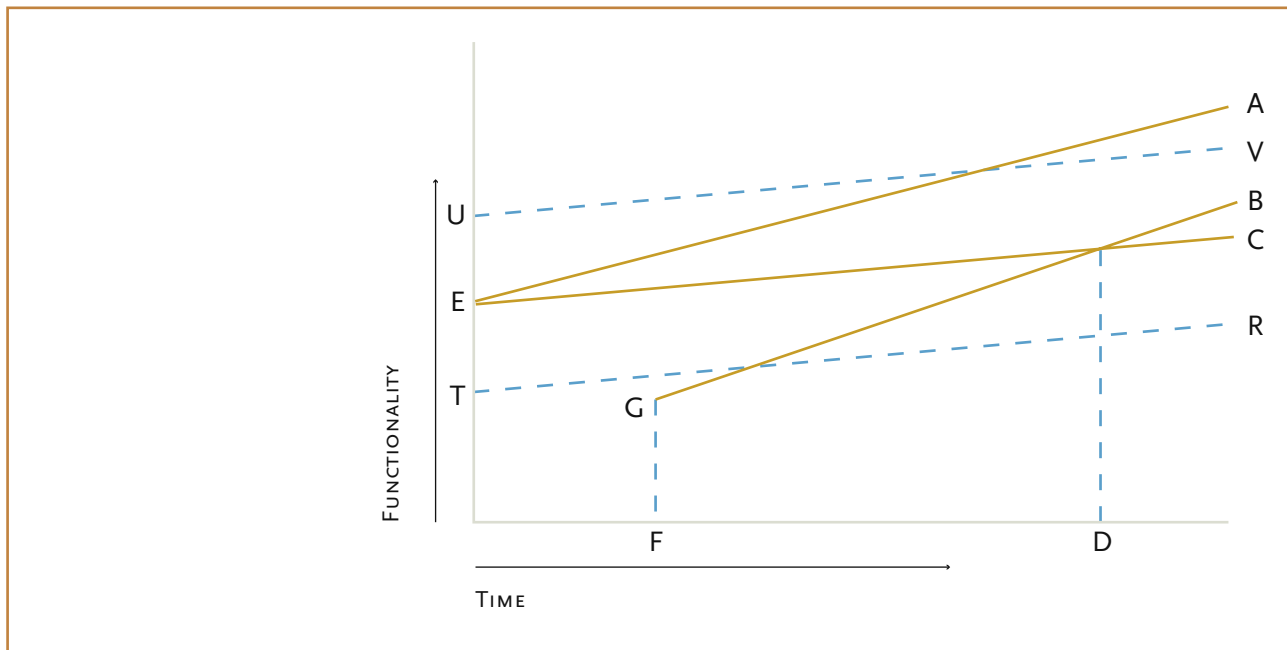


FIGURE 3

This diagram graphs the increase in functionality or performance of a product (y-axis) over time (x-axis). The line EA represents the rapid increase in performance of the sustaining technology – i.e. the technology that meets the needs of the mainstream market. Line EC represents the performance demanded by mainstream customers. At time zero (now) performance delivered and performance demanded are in balance. Over time, however, the performance demanded by mainstream customers increases (moving up EC). But advances delivered through sustaining technologies by market leaders rise much quicker (along EA). At some point in time F, a new, disruptive technology appears offering low performance at a low price. Since it does not deliver the level of performance required by established mainstream customers its products must find new, initially small-scale markets – i.e. undemanding 'low-end' consumers whose performance requirements are pitched at a much lower level and grow along line TR. However, further innovation leads to the disruptive technology improving performance (along line GB), while keeping prices relatively low. At time D the performance delivered by the disruptive technology meets the performance demanded by mainstream customers; from that point on the firms utilising this technology can expand into and



conquer the mainstream market, since they can satisfy customer demands at a lower cost than firms reliant on the previously dominant sustaining technology – while also keeping the low-end consumers whose requirements are more than adequately met at time D. The displaced market leader must ‘go up market’ searching for customers demanding higher performance and willing to pay a premium for it – i.e. those ‘high-end’ consumers whose performance requirements grow along line UV *or* introduce the disruptive technology in an effort to protect their traditional markets *or* go out of business.

Christensen gives numerous examples of this dynamic in industries as divergent as computing, earth moving equipment and steel making. For example, in the case of computers, mini computers disrupted the orderly market of mainframe computing. Personal computers, in turn, disrupted mini computers (though the PC is primarily an example of the second form of disruptive innovation discussed below). Lap tops did the same to personal computing and currently we may be seeing various forms of personal digital assistant undercutting traditional computers of all sizes. Christensen points here to the fact that the firms that dominated mainframe computing were ‘blindsided’ by smaller competitors in the mini computing market who were, in turn, overtaken by a new set of aggressors in personal computers, who were beaten to the lap top market. Market leaders from each market either retired to concentrate on pushing their products up the value ladder or attempted with little success to expand into the new lower value markets or went bust. A parallel story unfolded in the disk drive industry that grew up to service the computing market. Drives of ever smaller size and configuration – 14, 8, 5.25, 3 and 1.8 inches – were each introduced by new firms that eventually despatched the leaders from the larger market segment ‘above’ them.

One key common factor in all the examples Christensen gives is the fact that the market leaders are usually very successful in driving sustaining technologies, even when they are not ‘first movers’ – i.e. when they are not first to market with the fruits of the new technology – but they are almost never successful in either introducing disruptive technologies or taking them on board once they have been established by a competitor. The scale, values, cost structures, decision-making processes and mind-set of large market leaders disqualify them from the hunt for and capture of disruptive technologies:

The very decision-making and resource-allocation processes that are key to the success of established companies [in driving sustainable technological change] are the very processes that reject disruptive technologies: listening carefully to customers; tracking competitors’ actions carefully; and investing in resources to design and build higher-performance, higher quality products that will yield greater profit. These are the reasons why great firms stumbled or failed when confronted with disruptive technological change (Christensen, 1997, p. 98).

Careful planning, followed by aggressive execution, is the right formula for success in sustaining technology. But in disruptive situations, action must be taken before careful plans are made. Because much less can be known about what markets need or how large they can become, plans must serve a very different purpose: they must be plans for *learning* rather than plans for implementation (ibid., p. 156; italics in the original).

This process of disruptive innovation underlies the tendency for much industry development over time to be driven by SMEs. It is they who can risk playing at the edges, following the long shot, aggressively and single-mindedly pursuing directions that the big well managed firm under the eagle eyes of performance hungry shareholders, institutional investors, sceptical banks and cynical financial media can't touch. The failure rate among SMEs is high, both because they will often stubbornly persist in following blind leads ('hunches') and they tend to be under-resourced, lacking access to key skills, information and capital. However, when a project 'comes off' it will do so in a big way. Continuing the computing story, the histories of Apple and Microsoft indicate just how successfully some SMEs become and just how revolutionary their interventions prove. This underscores the point made above – industry clusters empower SMEs by 'hooking them into' an evolving set of business networks that provide continuing access to information, complementary skills and finance. Network participation unleashes collective learning outcomes that can feedback into disruptive innovations. By ensuring that SMEs have a 'place in the sun', clusters play a critical role in the health of a region or nation's innovation system and, therefore, in the overall level of economic prosperity attained.

A Closer Look at Disruptive Innovations

The situation depicted in the diagram above relates to the capacity of the disruptor to undercut part of the market leaders' current market – i.e. to service the latter's least-demanding customers by offering the functionality they require at a lower price and or through more convenient channels – and *not* delivering superfluous functionality that they do not want. Thus, for example, during the 1970s mini-mills successfully took over the production of steel bars for reinforced concrete from the large traditional steel mills because they could produce this relatively basic steel product at 20 per cent less. The large mills were priced out of this low value market segment and concentrated on higher value products. But by the mid-1980s sustaining improvements to the new mini mills enabled them to also produce thicker bars and rods requiring higher quality specifications, again at a lower price than the big mills. Once again, the minis undercut the large mills, driving them further up-market.



This process of ‘attack from below’ continued through the 1990s, with the result that mini-mills progressively took over higher and higher quality/value segments in the steel-making industry, including (eventually) sheet metal. At each stage, the established market leaders – the big mills – were themselves engaged in sustaining innovations allowing them to produce at higher qualities but were remorselessly driven further up-market in search of demanding customers willing to pay a premium for ever-improving quality, leaving lower value segments to the encroaching disruptors, the mini mills, which now dominate the industry. During this process many of yesterday’s leaders – like US Steel and Bethlehem Steel – progressively lost market share or have gone out of business. None of the leading firms, like Nippon, British Steel or Pohong Steel in South Korea introduced mini-mills. Giant firms, successful over long periods, were blind-sided by the new initially smaller producers introducing the disruptive innovation to one market segment after another. This pattern has occurred again and again, in industry after industry and has been termed – ‘low-end disruption’.

This example demonstrates an important point. Many disruptive innovations will not be of a revolutionary or break-through nature (in terms of the earlier typology). They will initially target low-value, low profit margin segments that are willingly given up by market leaders chasing high value/high margin business and more technologically sophisticated customers. The technologies supporting disruptive innovations may be relatively basic, built on piece-meal, organic advances.

There is also a second form of disruption identified by Christensen and Raynor – ‘new-market disruption’. Transistor radios, personal computers and no-frills airlines are examples of products that created new markets by serving consumers who did not previously use existing products in these fields – fixed cabinet radios, mainframe or mini computers and full service airlines. In this sense, new-market disruptions can be said to compete against ‘non-consumption’, since prior to their impact no consumer inhabited this market space. Initially, these new markets grow by attracting new consumers but as sustaining technological advances are made and performance increases, some consumers who had previously been locked into the pre-existing market are attracted across to the new, simpler, cheaper product; this process starts with the least demanding, most cost-conscious customers. For example, the appearance of low-cost airlines will attract some low-end flyers from the full-service airlines, as well as encouraging people to fly who did not do so before. This can be characterised as cases of ‘attack from the side’, as opposed to attack from below (see figure 4).

The two forms of disruptive innovation are represented in Figure 4 below.

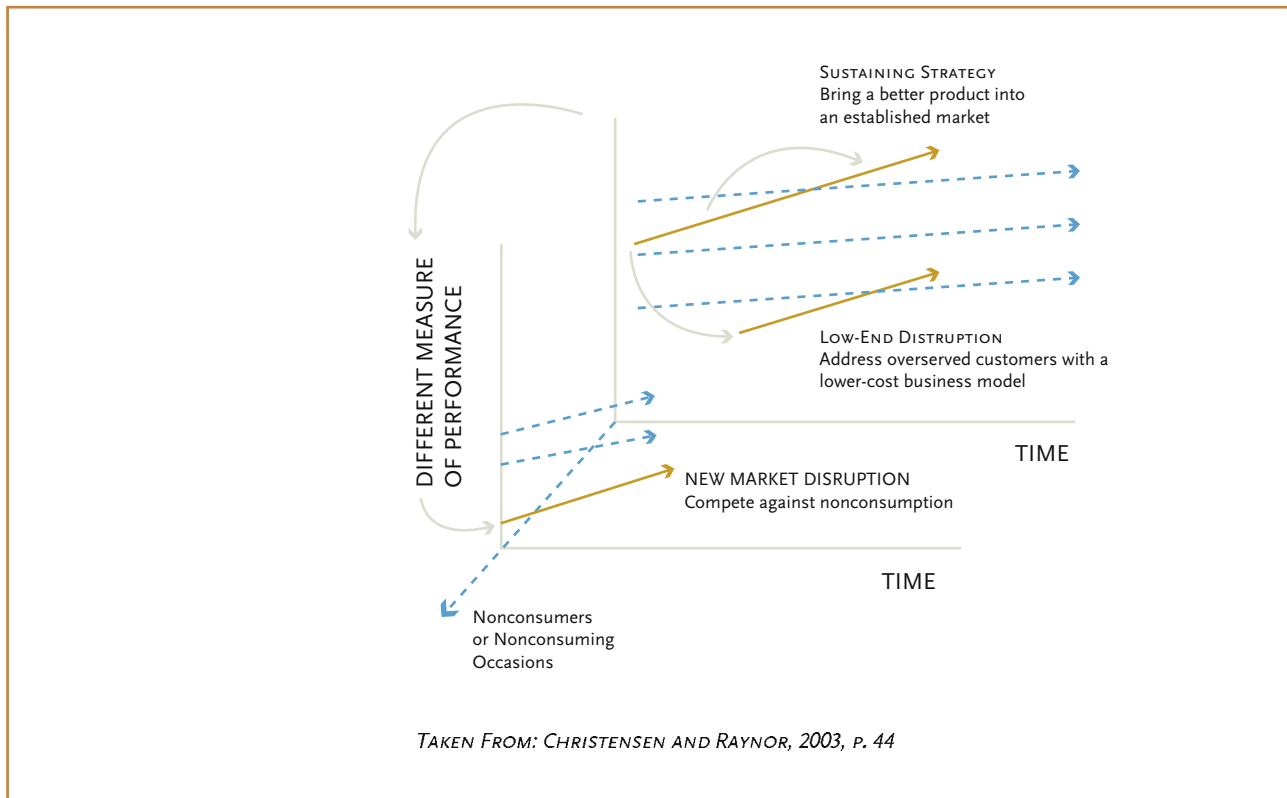


FIGURE 4

There can, over time, be a number of new-end disruptions, each represented diagrammatically by another plane, each driven by follow-on sustaining innovations and each both attracting new consumers and 'poaching' consumers from related pre-existing markets.

The table opposite (table 4.1) provides a list of other examples of innovations that are low-end or new-market or hybrids of both basic types.

LOW –END	NEW-MARKET	HYBRID
DEPARTMENT STORES	BELL TELEPHONE	MCDONALDS
DISCOUNT STORES	HONDA MOTORCYCLES	BLACK & DECKER PWR TOOLS
STEEL MINI-MILLS	SINGLE USE CAMERAS	DIGITAL WATCHES
BARNES & NOBLE BOOKSTORE	MICROSOFT	QUICKBOOKS
SUN MICROSYSTEMS	INK JET PRINTERS	DIGITAL PRINTING
MUTUAL INVESTMENT FUNDS	BLOOMBERG	EMAIL
TOYSRUS	SONOSITE ULTRASOUND	DIGITAL ANIMATION
HYUNDAI	E-BAY	MICROWAVE OVENS
AMAZON	PALM PILOT	CANON PHOTOCOPIERS
ONLINE TRAVEL BUREAUX	WIRELESS TELEPHONY	NO FRILLS AIRLINES

Table 4.1: Examples of Disruptive Innovation
Source: Christensen and Raynor (2003), p. 48

Each of the planes in the above figure represents what Christensen and Raynor (ibid., p. 44) calls ‘a value network’.

A value network is the context within which a firm establishes a cost structure and operating process and works with suppliers and channel partners in order to respond profitably to the common needs of a class of customers. Within a value network, each firm’s competitive strategy, and particularly its cost structure and its choice of markets and customers to serve, determines its perspectives of the economic value of an innovation. The perceptions, in turn, shape the rewards and threats that firms expect to experience through disruptive versus sustaining innovations.

In other words, a firm’s value network is formed by the organisational strategy, set of routines and environment with which and in which it is currently operating. These conditions create ‘perspectives’ concerning expected returns relative to risks for established market leaders that cause them to systematically divert resources towards sustaining – and away from potentially disruptive – innovations. In his earlier book, Christensen (1997) argues that a given value network will mirror and rank the performance attributes of the product in question. Existing mainstream consumers will be prepared to pay varying amounts for the particular characteristics they value. Sustaining innovations, informed by marketing information on the rank ordering and valuation of consumers, will assist market leaders to improve performance on those product attributes at the top of the mainstream consumers’ rankings.



However, associated with each product attribute-driven strategy will be a particular cost structure: ‘...just as a value network is characterised by a specific rank-ordering of product attributes valued by customers, it is also characterised by a specific cost structure required to provide the valued products and services’ (ibid., p. 37). Hence, as the market leader locks into a sustaining innovation technology, it also takes on board a particular set of costs and required profit margin to operate profitably over time. For example, a mainframe computer has a very high built-in cost structure and a high required profit margin due to the heavy overhead costs in production relative to volume, the need to respond to customer configurations and the substantial R&D and engineering costs entailed. By comparison, the costs in competing in the personal computer industry differ, both in scale and type – for example, marketing costs assume a greater role here – and the required profit margin is lower, around 30 per cent compared to 50 per cent.

When disruptive innovators attack market leaders from below they do so by identifying a group of existing undemanding consumers who value a subset of product attributes that can be produced and delivered using a lower cost structure, requiring lower margins than competitive imperatives driving the mainstream market. In effect the disruptors are introducing a new value network pitched at the low end of the market. Because the market leaders’ strategy and organisation are set to deliver within the established value network they will be uninterested in ‘competing down’ since this promises too low a profit margin; instead they will concentrate on extending their current markets by pursuing sustaining innovations – i.e. by delivering more and more performance to their existing customers and the mainstream customers of their strong competitors.

When disruptive innovators attack from the side, they identify a group of non-consumers and deliver a product with a set of attributes that they are willing to pay for – e.g. cheap air flight, first on, first seated, with no frills designed to attract passengers who would otherwise have travelled by bus or not travelled at all. The cost structure here will be tailored to meeting the particular attribute set marketed and will ignore other product attributes not deemed central to the new market. Again, these new customers will be of no interest to the market leaders locked into a value network requiring much higher profit margins and based on high overhead costs.

It is reasonably clear why established market leaders do not rush to embrace disruptive innovations utilising existing product and cost structures. What is less obvious is why, at the strategic level, senior managers do not recognise the potential of, and threat posed by, disruptive innovation and create new value networks to exploit the opportunities and defend against attack. Part of the answer has to do with the highly uncertain nature of disruption. Sustaining innovations tend to occur in a reasonably orderly manner – from plan to execution based on reliable, timely and accurate market



information. Conversely, in disruptive situations, agents have to act ahead of reliable and complete information. In such a highly uncertain world, failure is the norm. For every successful disruption, many fail. Success in introducing disruptive innovations comes from recognising and responding quickly to failure – not by closing down the new avenues but by learning why it failed and reorienting the effort. This is primarily a marketing rather than a technological challenge. Success through failure means discovering the attributes that work for low end or new market consumers.

In terms of the preceding chapter, learning occurs through both double-loop and triple-loop processes. Disruption is a process of learning to learn. It means experimenting with new organisational structures, routines, values and norms.

These conditions and imperatives give a clue as to why large, established market leading firms are normally so poorly placed to exploit or even recognise disruptive opportunities. These firms are usually large and internally structured to impose both processes of authoritative decision-making and patterns of specialisation – a detailed division of labour – designed to maximise productivity. The processes that recognise new projects/markets and direct resources to their undertaking are critical in determining which innovations are introduced – and, just as importantly, which are ignored. The resource allocation decisions of the market leader will, in turn, reflect the set of incentives and interests existing at each level and in each division of the firm. The final decisions of senior management on which directions to take and which projects to prioritise will be heavily dependent on the established value network and on the proposals filtering up from middle management. Middle managers will be under pressure to identify and scope those projects that meet the profit and other targets established for their sections within the prevailing value network(s). Sustaining innovations tend to promise high profit margins on products delivered to well known mass markets against the known threats of established competitors. Disruptive innovations, on the other hand, usually offer little of interest to the firm's existing mass customer base, entail low profit margins and arise in advance of any clear picture of the eventual size of the market.

It is therefore very difficult for middle managers, in particular, to seriously address a disruptive opportunity. In the first place, how does one establish a business case or plan for a product that has no clear market? How does one convince senior managers to invest the firm's scarce resources in a project that appears to be relatively unprofitable and very uncertain in outcome compared to other projects that generate significant profit possibilities based on high projected turnover and well understood consumers? Second, disruptive innovation has a high failure rate; most good ideas turn out to be duds. Chasing 'success through failure' is not a recipe for individual corporate success, either for the organisation as a whole or for middle managers. In the leading firms most internal processes for sorting out good projects from bad are directed towards detecting and weeding out the bad. If individual incentives for managers at various



levels are based on success rather than failure – i.e. success in achieving profit and sales targets relative to existing competitors, etc. – managers are likely to opt to follow established industry-wide trends, rather than ‘gamble’ on the untried, marginal, ‘off the wall’ possibilities. If this results in missing out on a disruptive success, then at least one’s main competitors are likely to have missed out as well; better to fail in company than alone. Moreover, the pressure not to fail within the organisation – since their remuneration, promotion prospects and other rewards are based on succeeding – will encourage middle managers to deny that any project taken on is failing and persist with new projects long after they should be scrapped or radically redirected; behavioural economists refer to this tendency as ‘getting evenitis’ or ‘riding losers too long’ (Sheffrin, 2002). Senior managers are also likely to throw good money after bad, since their reputations and rewards are also riding on resource commitment decisions that they approved in the past. This denial tendency is precisely opposite to the strategic orientation required for disruptive innovation identified above – viz. the ability to identify failure fast and learn from it.

The arguments above suggest why it is difficult, if not impossible, for established market leaders to develop and exploit disruptive innovations from within. There are two alternative paths to disruption open to these firms. First, the firm could ‘buy innovation’ by carefully identifying the successful, generally small, disruptor and taking it over. Second, the firm could acquire the idea and spin-off a new firm within the corporate group to develop and exploit it.

The first strategy of innovation by acquisition has a number of difficulties. There is a large body of research that demonstrates that although most mergers and acquisitions generate extra value through synergies and the like, most of the extra value is appropriated in advance by the owners/shareholders of the acquired firm (Roberts, 2004, p. 246-47). This outcome is most likely when more than one firm is seeking to takeover a target firm and the latter is a publicly listed company. Taking over a firm means taking all its assets and liabilities and it is often difficult to sort out in advance which of the target’s assets have genuine disruptive potential and which are likely to be duds. However, the major barrier to successfully acquiring a disruptive innovation in this way is that once acquired, the disruptive vehicle disappears into, is absorbed within, the larger parent company. The original proponents of the innovation may not be so acquired, leaving open the question – who will be the new champions for the innovation within the larger firm? The established managers will still be under the incentive regime governed by the parent firm’s ruling value network and pressure to succeed. This will also be the case if the acquired firm is allowed to operate as a separate division within the parent company, since its managers will have to compete with the managers of other divisions for scarce resources, on the grounds determined by the overarching value network and incentive structure – unless senior managers deliberately and successfully impose a new organisational design that ‘marries’ the best

of both firms' structures. 'The conclusion from all this is that trying to grow profitably through acquisition is difficult, and that creating value by getting into new businesses by this route may be especially problematic' (ibid., p. 253).

The second strategy is to leave the target company intact as a separate organisation reporting to the parent board or spin-off a new separate company from within the merged whole. This allows the managers of the separate company to establish its own internal resource allocation procedures and to construct and apply its own value network appropriate to identifying and developing a disruptive innovation. The danger is that this new organisation will not, in fact, be able to operate as separately as necessary, that it will be progressively sucked back into the constraining orbit of the parent company and thus be unable to generate the resource investment necessary to successfully and flexibly pursue those disruptive opportunities that work (while quickly jettisoning the duds).

The recent introduction of low-cost airlines in Australia offers an interesting example of this second strategy in operation. Once VirginBlue had established itself as a viable low end and new market disruptor, Qantas launched Jetstar to directly challenge it. Jetstar followed VirginBlue in creating an appropriate value network quite distinct from its mainstream organisation. This meant, for example, negotiating different enterprise bargaining agreements with its flight and ground staff concerning rostering, remuneration, promotion, etc., different leasing and maintenance regimes, different booking and boarding procedures and different in-flight service arrangements. Interestingly, as Qantas was embarking on this disruptive path, Virginblue was starting to attack up from below, introducing preferential booking, business class-like features and club lounges. Qantas's Jetstar strategy has apparently been successful to a degree and to date. But the difficulty of successfully competing by spin-offs is also demonstrated by Qantas's much less successful – and now defunct – efforts to establish a low-cost international carrier, Australian Airlines.

Open Sesame – the networked economics of sharing

The new economy, based on information dissemination and knowledge creation, emerged within the institutional matrix of the old industrial economy. Creating and capturing value through innovation depended on market mediated exchange based on clear property rights, including the enforcement of intellectual property rights. This institutional, market driven process still predominates. However, along side it is emerging a new logic of value creation – non-market or 'social production' – in which individual and cooperative economic activity is oriented towards widespread sharing of outputs at zero price. The paradigmatic case is the development of open source software like the Linux computer operating system, where the underlying programming code is widely and freely accessible for inspection, modification and distribution.

We are beginning to see the expansion of this [open] model not only to our software platforms, but beyond them into every domain of information and cultural production... from peer production of encyclopedias [e.g. Wikipedia], to news and commentary, to immersive entertainment (Benkler, 2006, p. 5)

The individual motivation to contribute in an undirected collaborative manner to common projects like Linux is varied but not, in general driven by narrow profit making aims, since no proprietorial or exclusive rights on outcomes can be imposed. Nor does participation necessarily depend on the universal dominion of altruistic motives. For some participants, altruism, the chance to contribute to the greater good, may be a dominant driver. But the range of motivations also includes the desire to shine among one's peers – peer group recognition – and a commitment to reciprocity and a hard-headed recognition that open collaboration may generate mutual benefits for all active participants over the longer run. Moreover, open-source collaboration or social production may open up new opportunities for innovation that lead to business models that capture private value for the innovator – as when complementary proprietary services can be bundled in with the social product. Finally, the experience of collaborating with a range of different agents, each with particular skills, knowledge and experience can lead to further targeted collaboration around market produced outputs from which value can be privately appropriated. Many of these derivative collaborations will involve 'unlikely bed-fellows', unexpected and unpredictable combinations that generate lateral thoughts and solutions as a result of 'malapropic discourse' – the clash of different perspectives, conceptualisations and values.

'The lesson is that companies stand to gain by giving up a degree of control over their proprietary knowledge - or rather some of their proprietary knowledge' (The Economist, 18 March 2006, p. 71)

The material and economic preconditions for the rise of a sphere of social production is twofold: first, the emergence of a communications revolution built on the production and wide dissemination of cheap information processors and peripherals and; second, the pervasive existence of the internet. This new communications environment has effectively empowered SMEs to actively collaborate through dynamic networks and industry clusters in both market and non-market production, together driving innovation, in all its forms, responsible for the creation of competitive advantage in the regional and national economies.



Concluding Comment

The economic prospects of any regional economy over the longer term will therefore be intimately tied up with how the regional and national innovation systems draw on the collective productive contributions of its knowledge-intensive firms of all sizes and, particularly, the degree to which organic innovation of a disruptive nature is facilitated through the activities of flexible SMEs, active industry clusters and wise public policy.

Section Two

Accelerating Innovation

Prologue

The arguments presented in *Section One* suggest that innovation is a dynamic endogenous process conditioned by the strategic and opportunistic collaboration of agents operating through loosely connected networks and broader industry clusters. To some extent, the outcomes for individual firms and whole regions can be seen as unexpected and unplanned for. However, it is also clear that some organisations may play critical roles in the constitution, operation and transformation of existing networks and clusters, and thus influence the path-dependent patterns of development that emerge. Some organisations, then, are strategically located as ‘gatekeepers’ able to facilitate or constrain innovation and the patterns of competitive advantage thereby created (see the discussion above in chapter 2). This facility is of particular interest to governments seeking to implement an active industry policy in support of local, regional or national economic development. The organisations briefly profiled in this section each attempt to identify and accelerate innovation at some scale – be it industry sector, region or nation.

Each of the organisations can be seen to operate along a spectrum of activities that attempt to ‘broker’ innovation outcomes – i.e. to directly support or otherwise facilitate innovation at the individual firm level or to support system conditions that indirectly encourage innovation via both individual and collaborative activities. As such we can distinguish three main types of brokerage.

1. Information Broker. Information is the life-blood of dynamic, functioning networks. Many of the benefits that come from networked activities, including those that create effective functioning clusters, arise in the form of ‘externalities’ or ‘spillover effects’. That is, value is created by the way the whole develops and ‘hangs together’ not simply or only through the direct interactions of individual parties. This argument is implicit in the discussion in chapter 2 about the tendency for the number of linkages to explode as new members are added to the network and applies, in particular, to network-based industries like telecommunications, airlines and the internet itself Shy (2001). Third parties not directly involved in particular exchanges benefit from those exchanges (positive externalities) or lose by them (negative externalities). As economists have argued for a century, where positive externalities exist market processes left to themselves will under-provide the product or service from the point of view of maximising value or ‘economic welfare’ in a society.

Shy (ibid., pp. 2-3) argues that externalities and the complementarities and compatibilities on which they rest are particularly powerful drivers in the market for information-rich goods and services and have become increasingly important in the age of the internet. The impact on market outcomes – in this context, the effectiveness of information flows and scale of collaborative productive activity generated – partly depends on how existing and potential network members expect the network to grow. When expectations are ‘bullish – as, say, they were with respect to the take up of fax machines in the mid-1980s or the use of the internet during the early 1990s – actual growth explodes, witness what happened to fax and internet usage.

Information brokers (like lab.3000, discussed below in chapter 11) can also play a very important role in originating, transmitting and disseminating market-relevant information to other network and cluster members. This role is particularly critical to network success when the information is tacit or otherwise difficult to charge a price for. Thus, some information scenarios may entail:

- *Non-exclusiveness in consumption* – i.e. once one agent receives it, all receive it. An example would be the publicly quoted price of shares on the stock market and the signals to investors provided by share trading patterns over time
- *A wide diffusion of benefits* among many beneficiaries, none of whom individually have the incentive to pay adequately for its provision
- *Prohibitive* transaction costs in constituting a market – i.e. identifying beneficiaries and collecting the appropriate price from them

In each of these situations, information will be underprovided unless a broker fills the void. Interventions here can include:

- The creation and continuous updating of a fully functioning ‘intelligent’ web site
- Creative use of the internet through dissemination of e-newsletters, notices of upcoming events, etc.
- Access to directories of expertise
- Access to display facilities
- Profiles of current leading-edge developments in the field
- Organisation and conduct of a stream of relevant events – showcases, seminars, conferences, biennales, etc.
- Conduct and dissemination of applied research, including research into how clusters form, grow and deliver



Externalities and other forms of ‘market failure’ provide a strong economic justification for policy intervention. In the absence of effective network communicators/builders some interaction and collaboration is likely to occur, due to the self-organising properties of complex systems – but the resulting networks are also likely to be stunted and skewed, limited in their scope and composition and, hence, less than optimal in their impact. There is, therefore, a strong economic rationale for governments to support this information broking role of key organisations like lab.3000.

2. Strategic broker. A strategic broker looks to proactively influence the direction and content of information flows and to facilitate particular collaborations arising. Rather than allowing partners to (only) find each other through serendipitous network navigation, a strategic broker plays a match-making role in pushing the parties together where and when this looks likely to create innovative possibilities. In addition, by being located at critical points within the whole network structure, the broker has a very important task – viz. to ensure that the network does not fragment as one segment loses contact with the other segments. In this role such agencies function as ‘glue organisations’. The work of the Design Council and Scottish Enterprise in the United Kingdom fits partly into this mould (see chapters 6 and 8).

3. Active broker. Many gatekeepers, as active agent in their clusters, are well placed (i.e. have the market intelligence) to identify partners with whom to directly collaborate in jointly beneficial projects. In this sense, they become just another cluster member – but with a unique view and knowledge of the overall nature and internal structure of the cluster and its changing environment. The informational and other advantages that this location gives them means that they may be able to identify and bring off successful collaborations, appropriating significant commercial and goodwill benefits in the process. Revenue streams can be generated via internal agreements on IP or normal equity arrangements. In this guise an active broker appears as a ‘clusterpreneur’.

However, the more ‘active’ a gatekeeper becomes in this sense, the less effective will it be in playing the informational and strategic roles, both of which require a degree of distance from the direct commercial exploitation of its strategic location in the network or cluster. The more an organisation is focused on appropriating value for itself through collaboration, the less will it normally be able to facilitate the overall functioning and growth of the network as a whole. This, as we will see in *Section Three*, has important implications for government policy. The organisations discussed in *Section Two* each combine some combination of the three brokerage roles briefly summarised above. They each look to accelerate innovation and industry development in a chosen area, drawing – at least initially – on deliberate government policy and resources.

Selecting the Cases

The remainder of *Section Two* provides brief profiles of seven organisations, based in England, Scotland, Ireland, the Netherlands and Australia, each of which is attempting to broker innovation and growth in their regional economies. These cases were selected because of this fact, since the primary aim here is to illustrate the range of strategies and approaches adopted in countries like Australia to stimulate the innovation process. Other criteria for selection entailed choosing organisations that had:

- A focus on industry development in technology and design intensive sectors
- Some level of government policy and/or funding support
- A track record of success
- Available data on their activities and performance

The cases were also selected with an eye to covering the diversity of approaches adopted – there being no obvious ‘world’s best practice’ in such a complex world. This means that the organisations represented here occupy different points along the spectrum of brokering interventions outlined above. This point is underscored in the brief summary presented below in the Epilogue to *Section Two*.

A Note on Method

The data presented in the following cases were gathered in the normal ways. An extensive literature review of secondary material was followed by intensive documentary analysis of material sourced from government reports, internet web sites and the media. In addition, the author undertook semi-structured interviews with key agents in most of the organisations concerned. This was made possible by a research trip to the United Kingdom and Ireland in January 2004, supported by RMIT University and *lab.3000*. The interviews were undertaken on an understanding that the interviewees would remain anonymous. The views expressed in this section are, in general, those of the author; where the views of the interviewee are reported, they are referenced as ‘personal interview’. I wish to thank the interviewees who generously shared their knowledge and ideas with me.





05 Creative London

Since the late 1990s increasing interest has been sparked by claims that regional and national economic growth is increasingly dependent on the contribution of creative workers. The best-known recent argument in this vein has been provided by Richard Florida (2002) in his book, *The Rise of the Creative Class* – for a discussion and critique of Florida's work see the following publications by the author: Berry (2003, chapter 4; 2005).

Since 1998 the British Department of Culture, Media and Sport (DCMS) has attempted to map the growing creative sector of the British economy. The Department defined the creative sector as:-

[...those industries which have their own origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property (DCMS, 1998)]

The creative sector was seen to comprise those who worked in the creative industries (listed below) and workers in other industries whose jobs are essentially creative, requiring the generation, use or dissemination of knowledge. The creative industries were defined as:

Advertising; Architecture; Arts & Antiques; Crafts; Design; Designer Fashion; Software & Computer Services; Music; the Visual & Performing Arts; Publishing; Radio & Television; Video, Film & Photography.

Creative occupations outside the creative industries could be located in a range of industries, like financial services (e.g. investment bankers), education (e.g. research and curriculum development leaders) and design-intensive manufacturing (e.g. aerospace, medical instrumentation, etc.). (The author used a similar typology in a recent study of the emergence of a digital design industry cluster in Melbourne – see Berry [2004].)

The DCMS subsequently subdivided the creative sector, as defined above, into four subsectors – Audio-Visual; Visual Arts; Books and Press; and Performance – and is using this typology to capture data in order to estimate the size and growth of the four

subsectors, separated into six stages along the value chain of production – creation, making, dissemination, exhibition/reception, archiving/preservation, and education/understanding (see also, details of the ‘creative economy program’ of DCMS, and recent evidence on the growth of the creative industries in the UK at: <http://www.cep.culture.gov.uk/index.cfm?fuseaction=main.viewSection&intSectionID=334>).

The creative factor in production is...

“The capacity to deliver customised products to tight deadlines from incomplete or abstract specifications” (GLA Economics, 2004)

‘We are creating the currency for capitalism to work successfully. Designers are always trying to make things a bit better, so that people are dissatisfied with what was there before’ (World Creative Forum, 2004, p. 10)

‘The perceived value of any given product is equal to Design plus Quality plus Brand all divided by price. Designers add value by attention to any of the first three of these’ (World Creative Forum, 2004, p. 10)

The consulting firm GLA Economics (2004) carried out a detailed economic analysis of the scope and contribution of the creative sector in London in 2002, updated in 2004. The main conclusions of the study commissioned by the Greater London Authority (GLA) were:

- London is the UK’s creative heart; London has 40 per cent of the total jobs in the creative industries and 29 per cent of jobs in the creative sector overall
- London is at the centre of a broader South-eastern England conurbation that accounts for 62 per cent of the total UK jobs in the creative industries and 53 percent of jobs in the creative sector
- In 2002, the creative industries contributed £21 billion to London’s output, second only to advanced business services £32 billion
- London’s creative sector is growing faster than all other major industries except advanced business services and accounted for almost a quarter of job growth between 1995 and 2001



- One in seven jobs in London is in the creative sector, with 525,000 employed in the creative industries
- Creative occupations are concentrated or clustered in the city centre and two bands emanating to the north and west of the city. The creative core is stronger in London; within the creative industries, nearly half the jobs are in creative occupations, compared to 30 per cent in the rest of the UK
- Women and members of minority groups are significantly underrepresented in London's creative sector, especially in architecture, software, crafts, design and film and video
- London's creative sector is more volatile than other economic sectors; 47 percent of job losses in 2002 were concentrated in the creative sector

The Mayoral Initiative

In 2003 the Mayor of London, Ken Livingstone, established The Commission on Creative Industries to advise government and industry on the most effective ways of encouraging continuing growth in the creative sector. The Commission collected data and submissions from a wide range of industry sources and analysed the results of existing research in order to both better understand the dynamic forces driving this sector and the forms of intervention most likely to remove barriers and stimulate further growth.

Innovation requires diversity. No one knows where the next successful film maker, fashion designer or musician will come from. London's population can offer this diversity, but developing this requires cultivating the marginal, radical or edgy, as well as the mainstream (GLA, 2003, p. 9)

'Already well established, London can lay claim to being the UK's foremost "ideopolis" or city of ideas' (ibid., p.17)



The Commission found that:

- Increasing income and leisure is likely to underpin continuing rapid growth in the creative industries, especially in areas like digital content, music, design, including designer fashion
- There is a need for policy interventions that inform and stimulate interaction between creative workers: 'This will help individuals develop the sort of portfolio skills and *personal networks* needed to succeed in these sectors' (ibid., p. 14)
- The partial exclusion – 'disenfranchisement' – of minority group members from the creative industries requires reversal
- London's 'creative underclass' of SMEs struggle to access appropriate and affordable space in a city where property values have run rampant; if space can't be found for SMEs and start-ups, the long term future of the creative sector in London is bleak

Creative London – www.creativelondon.org.uk

Following the Commission's report, Mayor Livingstone established a new program within the Greater London Authority – 'Creative London'. This program is advised by a group of 'creative champions' drawn from the creative sector and supported by a team from the London Development Agency, a unit of the GLA.

The stated aims of this intervention are to:

- Enable and nurture the work of the creative industries and people of London into the future
- Enhance the regeneration capacity of London through the increased engagement of its citizens in the arts and cultural activities of the city
- Support leadership in London that 'commits to, pursues and projects the core values for what is missing today but needed tomorrow'
- Be a knowledge-rich resource, chasing ideas and promoting best practice in the development of the creative industries

...the key role for Creative London is in brokering partnerships across the Initiatives (GLA, 2003, p. 25)



Creative London has launched a number of “Initiatives”

1. Cross-sector programme of support. This programme provides a number of events and services:

- *The Open College* sponsors events and opportunities for creative people to develop their skills and make connections. These activities are to be delivered through the network of ‘creative hubs’ envisaged (see below) and at partner locations throughout London.

Working via partnerships such as business advisors, employers, trade associations, industry networks and FE/HE institutes, we will support a broad package of outreach services which can seek out talent outside the formal education system and which can help individuals develop the sort of portfolio skills and personal networks needed to succeed in these sectors (ibid., p. 27)

- *An Enterprise Seed Fund and Investment Readiness Fund* has been established to help SMEs prepare themselves to seek development capital. This recognises the fact that many new entrants to the creative sector in London are under-capitalised and that this constrains the rate of innovation and growth in the sector.

... we will ensure that any start-up firm in receipt of (this) funding, also gets access to a mentor, specialist market knowledge and start-up expertise (ibid., p. 27)

- *An Intellectual Property Service* will offer advice and low-cost IP expertise to creative enterprises, recognising the fact that many especially younger creative workers are unaware of the importance of developing, protecting and exploiting IP to grow their businesses. This service will draw on the pro bono expertise of established IP advisers and the higher education sector.
- *Networking and Showcasing* events will celebrate and promote creative talents. A special fund will support activities focused on the creative outputs of people from black and minority ethnic communities.
- *The Space Agency’s* task is to provide a property advice service, facilitating the access of creative enterprises to appropriate space. This recognises the great difficulties many such enterprises face in locating and expanding their activities in the London area, given the ruling landscape of property and rental values. It also recognises the value creation outcome of ‘clustering’ creative producers in space. *Creative London*, in collaboration with the Arts Council, undertakes to systematically liaise with London property owners to identify and access empty and under-utilised space suitable for creative production.



- *Creative Planning Gain* refers to the capacity of the GLA as the relevant strategic land use planning authority to negotiate the inclusion of the creative industries in large new urban development projects. Access to reasonably priced space in these developments can be secured as a condition for local authority development permission or as a trade-off for other value-adding planning permissions, such as density bonuses to the developer. This service requires Creative London to collaborate with the GLA Planning Decisions Unit and the relevant local governments.
- *Local Markets* will be stimulated by supporting street markets, roadshows and open studios, designed to bring producers and consumers closer together at the local level. Marketing activities will target local clusters of retail activity around distinctive creative products.

If we want to encourage creative milieu, we need to allow for consumption of locally made products, and to do this Creative London will support a series of initiatives to strengthen local markets and shorten production chains (ibid., p. 31)

2. Sector specific services. Creative London aims to support existing sector organisations, like the Arts Council, Film London and London Design Festival, to address areas of perceived market failure in the creative sector. As part of this activity, the model for ‘creative incubation’ by the Centre for Fashion Enterprise will be extended to other areas. The intention is to work with higher education institutions and agencies like Business Links to identify new creative talent and link this talent to the specific services of business support and investment readiness available (noted above).

3. Major showcasing initiatives. Creative London aims to work with and encourage the coordination of the existing major national and international showcasing festivals – like Notting Hill Carnival, London Design Festival, the World Creative Forum and related events, to see that they are better funded and better promoted. Creative London will also work with Team London to promote London’s creative enterprises on the international stage. This entails collaboration with a series of key agencies, including the Department of Trade and Industry, London First, Visit London, UK Trade and Investment and relevant trade associations. As a first step, the creative industries figured prominently in the successful bid to host the 2012 Olympic Games.



... to ensure that London's creative industries have the skills to trade internationally, and are prominent in trade missions, promotional literature, conferences and showcasing events (ibid., p. 33)

4. Creative Hubs. *Creative London* has committed to 'roll out' eight to ten 'Creative Hubs' throughout London over the next few years. A Hub will bring together and display creative work, educational and training opportunities, advisory services and access to finance.

In general [hubs] will provide a space for work, participation and consumption. This includes the help to nurture emerging talent and to link it to broader networks, a first-stop for business support and access to finance, and the promotion of local talent and local businesses.

The hubs will combine place-based activities with 'outreach support' both via technology and through networks of mentors, talent spotters and other specialised support staff.

The Hubs will normally have a location and property presence – a shop-front – but will not usually be confined to a single building. They are intended to support a range of community activities and organisations or 'communities of practice', rather than being focused only on businesses. They are not intended to be business incubators but have a wider remit. The role of Creative London is to support the Hubs by providing expert advice, access to private and public funding, links to industry, the higher education sector and the resources of London Development Agency. The focus of this collaboration is:

- *Talent* – identifying and nurturing emerging creative talent and linking it to employment and enterprise activities
- *Enterprise* – business support, investment readiness and access to finance
- *Property* – facilitating access to appropriate and affordable work space across the business life-cycle
- *Showcasing* – promoting London's creative industries, nationally and internationally and supporting their growing export performance

In short, the Creative Hubs are intended to be the major organisational vehicle for the implementation of Creative London's mission.



For more information on the creative hubs – consult the following web site:

www.creativelondon.org.uk/server.php?show=nav.009002

Creative London collaborates with organisations like the Design Council (see next chapter) and CABA (see box below).

CABA- Commission for Architecture and the Built Environment

.. A UK Government agency that advises governments, industry and the broad community on architecture, urban design and public spaces.

CABA conducts research, advocacy campaigns and education programs - all designed to improve Britain's built environment.

"Fundamentally, CABA works on behalf of the public. That's why we're determined to *inspire people* to demand more from buildings and spaces. They, after all, are the people left behind after the planners and architects have moved on" (<http://www.caba.org.uk/default.aspx?contentitemid=149>)

Concluding Comment

Creative London is, in fact, a diverse set of activities, events and policies, partly held together by clever branding that trades on London's international reputation as the focal point of 'Cool Britannia'. Equally as important in the genesis and early operation of CL has been the strong political and public leadership of London's Mayor. However, the material base for this initiative is provided by the plethora of well-established events, organisations, creative workers and cultural resources that characterise London as an internationally connected, functioning regional economy. At one level, CL provides a useful cover or acronym for this diverse, historically embedded growth ensemble. The idea of CL trades off London's creative credentials. Very few regions have as much real and symbolic capital to work with as London, in this respect. At another level, CL can be seen as an 'add on' to what already exists; in this sense, it is merely another component of an organically developing (complex) city system. This latter view somewhat deflates the image but probably better captures the real impact of this initiative. It also suggests that CL, like other branding and marketing exercises, will have its day and then be overtaken by subsequent developments.



06 Design Council

The Design Council has renewed itself to get a grip on the future. We've embarked on a new strategy to improve performance in British business, in our public services and in the design sector (The Practical Power of Design: A Design Council Handbook 2004 p. 2).

The Design Council was established by central government in 1944 as 'The Industrial Design Council' with an initial mission to stimulate Britain's post-war economic recovery program. This heralded a very early recognition of the role of design in economic development. The Council has operated continuously since then, with its operations falling into three main phases:

- *Phase 1* focussed on the demand side, promoting design awareness among consumers and producers through festivals (e.g. Design of Britain Festival), community education programs, prizes, etc. These activities were aimed at 'the promotion of design as a product'. This phase lasted until the early 1990s.
- *Phase 2* during the first half of the 1990s involved a radical re-think and initial down-sizing in the light of the government view that the challenge of design awareness in the broad community had largely been met (personal interview). This interregnum saw the Council operate mainly as a small think-tank, advising government and industry on design strategy – 'promotion of design as a strategy'.
- *Phase 3* from the mid-1990s onwards, involved the Council in a much more interventionist, hands-on role with the responsibility of identifying strategic economic and industry development opportunities and engaging with key actors/stakeholders in product-oriented 'campaigns' – 'promotion of design through targeted campaigns' – addressed to the business sector, government agencies and the education sector.

The Council is run by a government appointed independent board and currently operates with about 60 staff and an annual budget provided by central government of around £7 million.

In its current operational phase, the Design Council has targeted five economic and social aims and taken on ‘*nine challenges*’ (Design Council, 2004).

The aims are to:

- Boost business
- Improve public services
- Turn new technologies into winning products
- Give managers the right tools
- Build design skills

The challenges are:

In Business

- Demonstrate design’s strategic role in business processes and the commercialisation of new science with robust first-hand evidence
- Develop, support and influence national programmes which assist UK managers seeking to use design to transform their businesses
- Connect business advisors, front line managers and educators with international best practice in design

In Public Services

- Create new models of public procurement in which the value of design is a key element
- Demonstrate through practical interventions, the role of design in modernising public services
- Influence opinion formers in key government departments and agencies to encourage strategic design thinking and applications

In the Design Sector

- Help to strengthen design sector infrastructure in relation to training, representation and education
- Facilitate stronger links between design and other business and organisational disciplines
- Initiate a public engagement programme which promotes the practical power of design

The history of the Design Council traces a trajectory from a focus on the information broker role, through strategic broker to active broker. Increasingly, Council officers are centrally involved in the campaigns that seek to drive design-based innovation in targeted sectors of the economy. A campaign is a loose but strategically constructed collective (network) of stakeholders with overlapping interests in a particular sector (an example is described below). Each campaign employs a 'multiple stakeholder model' which entails:

- 'Buy-in' from all stakeholders from the beginning of the process
- Commitment at CEO level by the companies engaged; a diversity of companies by size and type, all from the same sector
- Identification of the key issue(s)/problems to be resolved, upstream and downstream in the value chain
- A strong connection of policy to design to product
- Joint commitment to achieving a quantum jump in improvement

The anatomy of a campaign is set out schematically below. The first stage is problem identification, resulting in a progressively expanded exploration that focuses on an agreed set of issues, problems, barriers and opportunities, culminating in an agreed brief. The second stage takes the brief and through stakeholder collaboration and resourcing seeks a design solution to some or all of the target issues. The final stage puts in place processes to implement aspects of the design solution, including follow-on arrangements to resource further R&D work required.

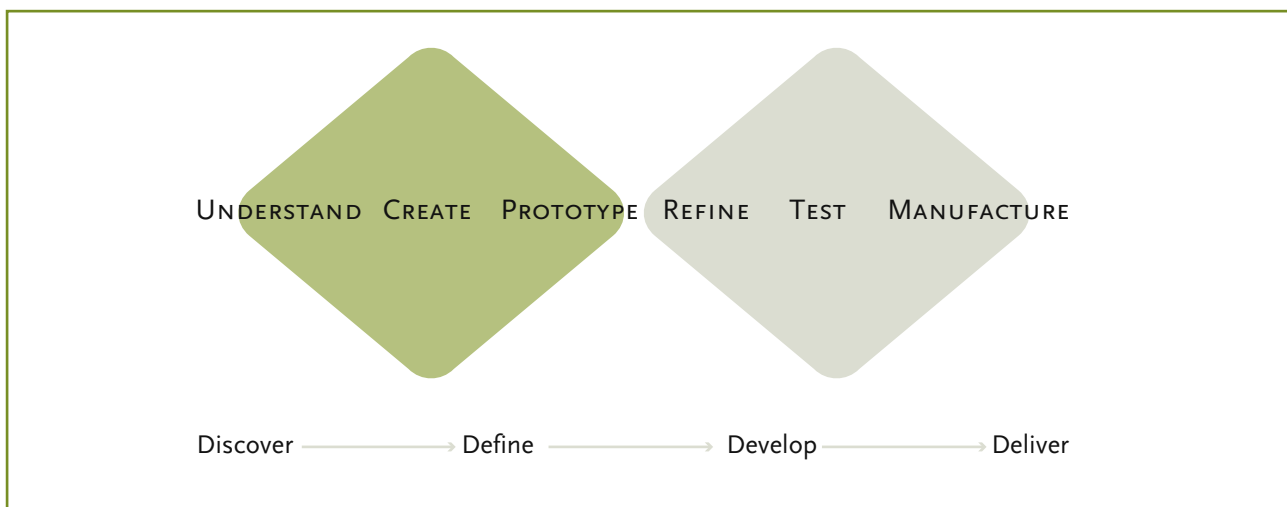


FIGURE 6



The Council has embarked on four campaigns:

Manufacturing – working with regional development agencies to pilot a ‘national design immersion programme’ that embeds design and designers into the management and on the boards of manufacturing companies.

Technology – working with incubators and venture capitalists to test the contribution of design to the humanising and commercialising of science in more than 1,000 emerging high-tech enterprises.

Skills – working with schools and universities to define and match British design skills with the demands of the economy and broader community.

The fourth campaign – *Learning environments* – is discussed in more detail, below.

As the Council has attended more to the strategic and active brokerage roles, aspects of its traditional information brokering function have been taken up by government agencies. For example, the Department of Trade and Industry (DTI) now operates a ‘Business Links’ network that provides advice to SMEs in a range of financial, legal and marketing areas, including how to access resources in fields like industrial and graphic design.

The other two foci of the Council’s work are:

Design solutions – an in-house resource dedicated to disseminating design best practice knowledge, case histories of successful design-based innovation and the monitoring results of an index that tracks the economic performance of stock exchange listed, design-driven companies.

Design Biennales – a ten-year program, starting in 2007, that will deliver five major design biennales in five regional cities in the UK. Each event will be supported by regional government, key business organisations and the education sector.

The aim will be to put design centre stage and support local design infrastructures as a magnet for industry and investment... Design stories will make their mark across the regional landscape of Britain (Design Council, 2005, p.27)

The Learning Environments Campaign

Yet we know remarkably little about what actually makes a good learning environment or even what learning will look like in 20 or even 10 years time (Design Council, Learning Environments Campaign Prospectus, 2005, p. 21)

This campaign is based on the view that a radical reversal in approach is necessary in order to bring the physical environment for education – the buildings, facilities and internal fit-outs – into line with the requirement to educate and train people for a lifetime of productive input to a rapidly changing world. Over the 20th Century school learning environments were designed as an ‘outside-in’ exercise, an approach that prescribed a ‘one-size-fits-all’ solution, entailing standardised, inflexible classrooms, halls and playgrounds. Over the past 50 years there have been major innovations in educational curricula, media and methods but the classroom, its fittings and surrounds, remains pretty much as it was in the 1960s, reinforced by established, inflexible regulations and procurement systems. In this context alone, around £1 billion per year in the UK is spent on the internal environment of schools – the furniture and facilities. It is increasingly clear that embedded ways of spending this money are not returning value for money; more importantly, the opportunity costs of poorly performing learning environments in a knowledge-driven global economy are rising. Poor educational outcomes are reinforced by the result of decades of under-investment in the ‘external environment’, the school buildings and fixtures. In 2004-05 the British government committed to spending £5.2 billion on new and existing school buildings and to replace or renew every school in England over the next 15 years. This Campaign seeks to develop, for the 21st Century, an ‘inside-out’ approach to the design and development of new learning environments in British schools.

An ‘inside-out’ approach makes the users of the environment - students, teachers, service providers and the wider school community - the focal point of change. These users ultimately own the process: their needs and unique collective vision of what they want to achieve in terms of learning are identified at the outset and they are involved in developing solutions that realise that vision. An ‘inside-out’ approach follows the well-proven design process to translate an educational vision into an actual working environment, through research, creative thinking, prototyping and iteration (Design Council, 2005, p. 22)

The Campaign aims to:

Work with teachers, students and other stakeholders to design and evaluate innovative and effective learning environments

Develop practical tools to inspire and support schools to identify and then tackle problems and issues by engaging in a user-led process

Understand the underlying systematic factors that inhibit innovation in schools and work in partnership with key stakeholders to address them

Campaign for an 'inside-out' approach to school design throughout the educational and related sectors.

The Campaign is led by a team from the Design Council and draws on the support of an external expert panel the members of which come from leadership positions in education, industry and government.

Since 2003, the Learning Environments team has been working with 12 secondary schools to develop and disseminate effective practice in the design and procurement of the internal school environment, focusing in particular on the classroom and furniture within. Using the 'double-diamond' process outlined above, groups of students worked with the head teacher and a range of other school staff to first discover and define outstanding problems with their current environments. This 'immersion' identified *what* they wanted to improve and *how* to go about doing it. 'So at the "understand" stage the group researched the causes of the issue, while at the "create" stage they brainstormed ideas for addressing the issue and democratically discussed and identified the ones to take forward. At the "prototype" stage they used available materials to develop rapid prototypes as a way of exploring and testing their ideas and making them tangible' (Design Council, 2005, p. 26).

A Case Study – St. Margaret’s Church of England School in Liverpool

During the ‘immersion’ stage in this all-boys school, the team of students, staff and designers identified the well-documented fact that boys are falling behind girls in average educational attainment. Sourcing research that found that boys generally had shorter attention spans and depended more on kinaesthetic learning strategies, the team moved in the “create” stage to explore ways of lifting male educational performance – for example, by varying learning activities more, setting more physically active tasks and giving students greater opportunity to demonstrate their work. To facilitate these changes the team developed rapid prototypes of a ‘360 degree flexible classroom’ that entailed all-around display boards, circulation space and easily moved furniture. Following the immersion stage, the team developed a design brief for such a classroom and invited tenders. Each design team spent time in discussion with the students and staff and made presentations to a panel drawn from the latter. A preferred design team was selected from eight contenders.

The design concept produced was organised around a ‘heart’ – a multimedia projection unit situated and secured in the middle of the classroom. The combined table/chair proposed throws a smaller space footprint than a conventional classroom table and chair, leaving more space for circulation. The table/chair is on wheels and easily repositioned, facilitating paired and group work and the seat swivels for a 360 degree view of the room. Display and writing white boards are positioned on all walls. The aluminium window blinds move individually to adjust for light and cooling purposes and can also be used as whiteboards, thus allowing the teacher to trace a spatial ‘learning trail’ built up around the four walls. Storage space has been designed into the lower sections of each wall. The Design Council subsequently negotiated with furniture manufacturers to create and commercialise a version of the combined table/chair emanating from this case. [For more details on this case, see Design Council, 2005, pp. 34-47.]

The Learning Environments Campaign also addresses issues other than those impinging on the physical environment, notably to do with organisational systems and processes. The Campaign aims to develop a series of information resources for school communities:

- An ‘inspirational magazine’ – ‘part Which, part Elle Decoration’ aimed at teachers and school managers, providing up-to-date practical information on effective building and classroom layouts, furniture, support systems and teaching approaches. A “Kit for Purpose: Design to Deliver Creative Learning” has already been launched (available on the Council’s web site: www.designcouncil.org.uk)
- A special web site – designmyschool.com – is being developed for the Council by Ultralab that will provide school communities with interactive tools for identifying key learning issues and receiving feedback, and offer practical examples, relevant research summaries and advice on ‘next steps’ to address the identified issues.

Concluding Comment

The Design Council has successfully reinvented itself as a strategic and active broker, a player in contemporary British industry policy. The Council has been one of the first organisations in the country to recognise and embrace the ‘creativity discourse’ as central to the continuing economic prosperity of British society and to re-position Design as a critical factor. Strategically, the Council has focused on directly intervening in industry development where it believes that design intelligence can make a difference. This has resulted in the ‘campaigns’ approach. It shares this space with other organisations like Creative London and the Commission for Architecture and the Built Environment, with these and related agencies forming a loose ‘ecology’ of intervention. In moving away from a traditional statutory government public education role the Council will increasingly be judged by its impacts on the ground, the degree to which its interventions visibly result in improved industry and government agency performance. The increasingly crowded brokering space makes it more difficult for the Council to claim a monopoly on the Design brand.



07 Zernike

The Zernike Group was formed in 1992 by the Zernike Science Park in the Netherlands. It was originally established to assist the University of Groningen commercialise patents developed by its researchers and has broadened its scope to assist entrepreneurs in advanced technology fields, in general. Zernike establishes 'Funds' for each of its major entrepreneurial projects. A Fund brings together various representatives of the local innovation system – banks, city government officials, university researchers and administrators – with the chosen entrepreneur(s) and The Zernike Group. The principal task of the Fund is to direct seed and development funding and managerial support to member companies in order to assist the latter develop their businesses to a self-sustaining level. In exchange, the Fund receives an equity share (to a maximum of 30%) in the resulting business. Management support includes assistance in drawing up business plans and developing strategies for market analysis, feasibility studies, financial planning, staff recruitment and training, production planning and the like. Support extends to the development and market testing of product prototypes and the marketing of final products.

Zernike group has come a long way and has established itself as a young and vigorous company that manages science parks and incubators all over the world and a growing number of seed funds that amount to over 150 million euros in total. (www.zernikegroup.com)

Each Fund is overseen by a Board of Directors representing the stakeholders. A Zernike management team provides the management support to the companies entering the Fund. Zernike only receives its management fee (and seed funding returned) when a company exits the Fund by securing external financing, either by buying back its equity or being sold to a larger company. The remainder of the equity realised resides in the Fund to assist further companies or is returned to the stakeholders. University patents that are commercialised generate another stream of revenue to both Zernike and the stakeholders. Funds must be profitable within 3 to 5 years or management teams are changed (or the Fund wound-up). Zernike can also retain equity in accelerated companies, so benefiting from future dividends. Clearly, a critical success factor in

this approach – that can be called ‘the accelerator model’ – is the capacity of Zernike ‘to pick winners’; the selection of entrepreneurs to enter the Fund is a major task. One Finnish commentator on the Zernike approach has likened it to a rowing race:

[The] Acceleration model as business development can be compared as [to a] rowing competition. [The] Entrepreneur can row all alone. Supporters and business developers encourage him from the shore. In [an] acceleration model [the] boat is the eight-man crew rowing in the same direction. [The] Entrepreneur is one of the rowers, others are business developers, business angels, investors, marketing people and other different experts needed in the company business (Laapio 2003, p. 337).

The **science parks** that are or were **managed** by the Zenike Group include:

- **Amsterdam Science Park.** A collaboration between the University of Amsterdam, a commercial bank (Rabobank), the City of Amsterdam and the Organisation for Scientific Research, the Park’s main goal is to stimulate the transfer of knowledge from research institutions to SMEs, particularly in high-tech areas.
- **BioPartner Centre Amsterdam.** Six centres, including this one, have been funded by the Dutch Government to provide incubator space and facilities for start-up life sciences firms. The centres offer affordable space, laboratories and other basic infrastructure to start-ups and are located near established centres of research excellence in the life sciences.
- **Twinning Centre Amsterdam.** A centre established by Zernike in 1998 aimed at stimulating ICT entrepreneurship in the Netherlands by offering venture capital, incubation space and managerial support.
- **The IDEA centres.** The object of these centres is to spark business-to-business connections for incubated technology companies co-located near universities and other knowledge institutions. They are funded through Zernike’s core investment fund. The first centre was established in Groningen in 2001 and the second a year later in Zaanstad. The Normandy IDEA Centre has also been established on the Normandy Enterprise Park in Northern Lincolnshire, UK, and is managed by Zernike UK Limited.

Two Zernike forays into Australia include:

- **Technology Park Western Australia.** This park started in 1985, prior to Zernike’s involvement, and has grown rapidly over the past five years. Attracting established technology-based businesses, around 30% of people employed in the Park are engaged in R&D activities.

- **Brisbane Technology Park.** This Park is an initiative of the Queensland government's Smart State program and focuses on research, training and tech transfer in the biotechnology and information technology industries.

Zernike Ventures is the venture capital arm that establishes and manages the funds (noted above) to support technology-based SMEs with a 'proven concept' ripe for development. However, this service moves beyond the normal scope of venture capitalists by drawing on other services and skills in the Zernike Group – sales, business planning, export facilitation and networking to potential partners, suppliers and customers.

Zernike Ventures can be involved with issues such as: succession, management buy-out, merging and management buy-in.

Vast experience has proven that new, commercially promising technologies often get stuck in an early stage, due to the lack of risk-bearing capital and a proper market approach. This means that important innovations have often been lost. The 'usual' finance companies (banks etc.) are not too keen on providing capital in the pre-start up phase of highly innovative businesses.

www.zernikegroup.com

The sales and marketing services offered by a purpose-built company housed within Zernike Group for its clients, entail:

1. Sales

- Direct sales to clients on commission or to business as distributor
- Development of a sales organisation within clients
- Identifying, appointing and training sales agents for clients
- Search for potential customers

2. Marketing

- Creation of a marketing strategy
- Creation and implementation of an advertising and communications strategy
- Organising and executing exhibitions, trade missions, etc.

3. Commercial Planning

- Market research
- Business planning and implementation

In addition, the Zernike Group offers legal advice and assistance in developing and protecting intellectual property and on human resources management.

An Australian venture...EIR Pty. Ltd. – “Entrepreneurs in Residence”

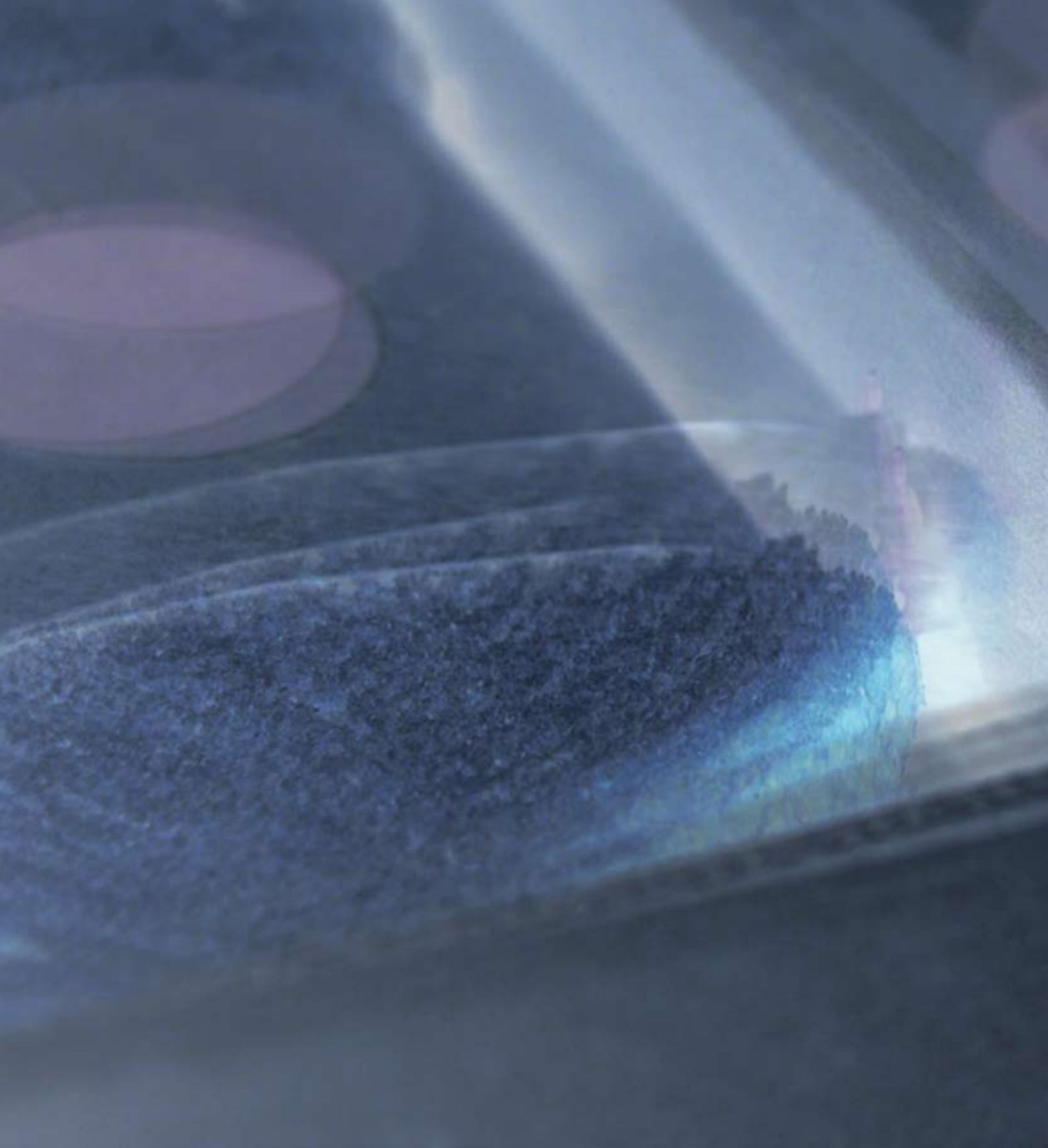
EIR is an investment management company based in Western Australia and one-third owned by Zernike Australia Pty. Ltd. EIR's main aim is to identify and help local entrepreneurs develop leading-edge technology from conception to commercialisation, offering the Zernike-like bundle of services from finance, through management to marketing assistance. EIR received \$10 million from the Australian Government under its “Building on IT Strengths” program.

The international Zernike Network...

- Zernike Australia Pty. Ltd.
- Gruppo Zernike Italy
- Meta Group Sri Italy – a joint venture between Zernike Group and Meta Consulting Italy
- Zernike UK Ltd.
- Zernike Group Malaysia Sdn. Bhd.
- Zernike USA
- Zernike Thailand
- Hermia Development Oy Finland – a joint venture between Zernike Group and Nokia

Concluding Comment

Zernike is an active brokering organisation that seeks to accelerate the growth and international market reach of new technology-intensive businesses. It has created a development model and infrastructure to identify, facilitate and launch new ventures. Starting with a conventional Science Park approach, Zernike has moved somewhat to a client-based focus. Nevertheless, its antecedents are still clear and much of its revenue stream comes through successful estate development and management. Zernike has developed strong relations with particular universities and local government agencies but operates essentially as a commercial enterprise, unlike most of the organisations discussed in this monograph. It is also the most determinedly international in its strategy and operations.





08 Scottish Enterprise

Scottish Enterprise (SE) is Scotland's main economic development agency and is funded by Scotland's government, the Scottish Executive. The stated main aims of SE are to assist business start-ups and support existing businesses in Scotland, while helping them to establish 'a strong presence in the global economy'. SE was created by British Act of Parliament in 1990 and functions as a 'non-Department Public Body' or Quango. It was formed by the merger of the Scottish Development Agency (SDA, formed in 1975) and the Scottish Training Agency. SE's budget for 2006-07 is £550 million.

SE has changed significantly over the past decade, moving from a traditional economic development agency focused on infrastructure provision and attracting inward foreign investment to concentrating on fostering new technology-based businesses and facilitating industry cluster growth in key knowledge-intensive industries (personal interview). R&D investment and the encouragement of endogenous innovation are now seen as more important strategic drivers of growth in the Scottish regional economy than simply relying on foreign investment flows.

SE has two broad divisions, one focused on start-ups and the other on well-established high-growth clusters.

1. Business development for SMEs

In-house staff provide a series of free incubation and acceleration services to SMEs through 'the business gateway'. These services include: advice and training sessions on business planning, finance, entering into partnerships, and on how to access necessary information, market intelligence, networking skills, etc. This often entails close interaction within SE with 'business information officers' who are recruited from industry.

'SE is moving away from grant giving to advice/facilitation. The aim is to build trust between the SME and SE; relationship management is a key role at senior levels within SE. Giving money without leverage and assistance is a barrier to indigenous growth' (personal interview).

Although SMEs can apply for (very) small start-up grants (of £1,000), the emphasis in the gateway is to direct them to other sources of development finance and to provide them with the skills necessary to access seed funds.

SE also operates a **'high growth unit'** that focuses assistance on SMEs with rapid growth prospects and aspirations. To access this service firms need to:

- Be starting a business that will achieve a minimum £5 million valuation by the end of its third year of trading
- Be involved in a project where technology and know-how form the competitive advantage
- Have the potential to trade globally
- Have a 'commitment, passion and hunger to succeed'

The unit is comprised of specialists with commercial experience in a range of technology-based industries and who can call on consultants in the law, accounting, finance and organisational design. SMEs assisted to date have come from a range of industries, including optoelectronics, biotechnology, software, chemical engineering, oil and gas and microelectronics. The unit works intensively with the start-up to establish its organisation and develop a viable business plan, in order to 'enable a viable and fundable investor-ready proposition to be finalised and presented'.

'Since 2002 the team has helped to create 30 new high-growth technology businesses'

The key elements of the assistance package include:

- Identification of an appropriate business model – optimise route to market, channel partners, revenue model, etc.
- Identification of funding requirements, tactics and strategy
- Preparation, revision and finalisation of a business plan
- Undertaking customer/supplier visits, as necessary – making use of SE's extensive network of international contacts to accelerate this process
- Identification of funding sources and optimal balance of debt/equity/grants
- Preparation of investor presentation materials
- Identification of suitable investors, successfully engaging and undertaking series of presentations

- Securing appropriate IP advice, protection and optimal exploitation strategy
- Selection of appropriate legal and financial professional advisers
- Identification of potential candidates for additional management team posts
- Identification of potential non-executive directors/chairmen
- Finalising key staffing/recruitment plan
- Finalising equity structure and completion of funding package
- Launch of the new company

SE will contribute funds towards the process of getting the start-up 'business ready' to present to potential venture capitalists.

Smaller SMEs, including those with high growth prospects, are assisted through 'the Gateway'; larger SMEs are then 'client managed' to assist them to 'accelerate' their development, particularly through the development of export capacity. Large, well established companies are 'account managed' by SE teams, looking to assist them to prosper on the global stage by continuing innovation. The aim is to move start-ups through the Gateway and 'up' the pyramid presented schematically in the Figure 7 below.

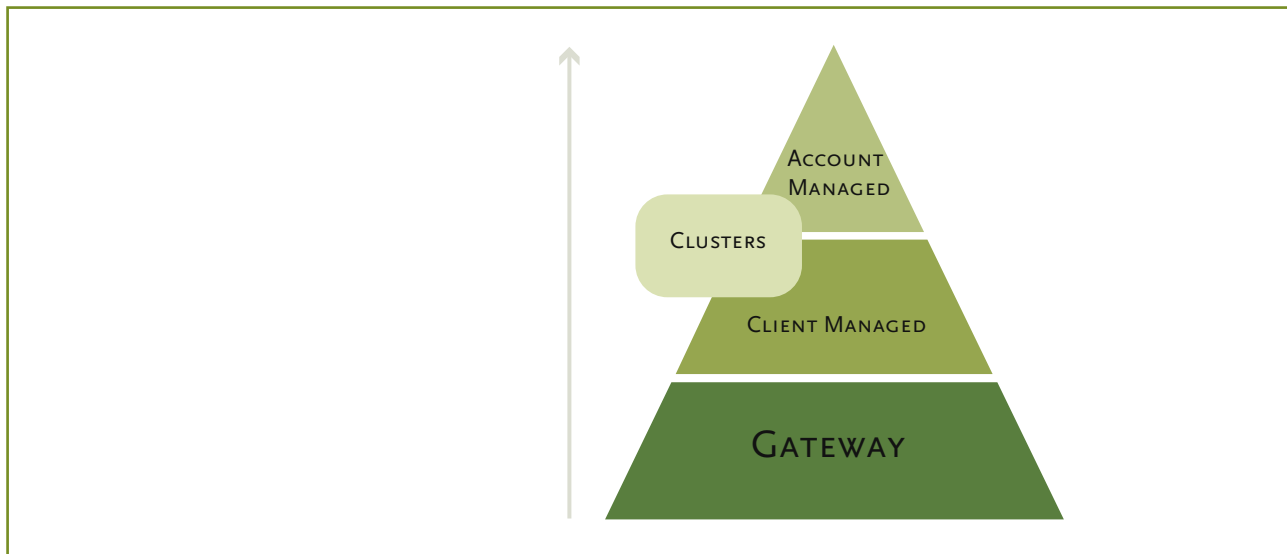


FIGURE 7

2. Economic development

SE concentrates support on industries that are seen to have high growth prospects in the Scottish economy. These industries are:

Aerospace; Chemicals; Digital Media & Creative Industries; Electronics; Energy; Financial Services; Food & Drink; Forest Products; Life Sciences; Microelectronics; Optoelectronics; Software/e-business; Textiles; Tourism.

In many of these industries, viable **industry clusters** have formed which SE contributes to by facilitating the commercialisation of R&D, access to 'business angels' and financial infrastructure. However, there appears to be significant differences of view on and commitment to a fully-fledged clusters strategy within SE and the broad range of industry sectors targeted suggests a less focused approach (personal interview).

Funding Support

There are three main funding mechanisms utilised by SE to support emerging, technology-driven SMEs and industry clusters.

a) Scottish Co-investment Fund. Part funded by the European Regional Development Fund, the SCF is a £45 million equity fund which can invest between £50,000 and £500,000 in company finance deals of up to £2 million. The Fund is opened to SMEs based principally in Scotland, in an approved business sector with up to 250 employees and net assets of less than £16 million. SE will only invest if another equity partner matches its investment and assumes the active equity role; i.e. SE leaves it to the partner to establish the value of the business, negotiate the full financial arrangement, etc.

Partners come from a range of sources, viz.:

- Corporate ventures
- Institutional investors
- Professional fund managers and investors
- Business angel syndicates
- Private individual investors

b) Business Growth Fund. The Business Growth Fund was launched in July 1999 in order to improve the availability of finance for start-up and growing companies in Scotland. The Fund assists these SMEs at the critical formation stage when many experience difficulties in raising sufficient funds from banks and private investors due to their size and risk profile.

The Business Growth Fund provides loans of between £20,000 and £100,000 to businesses that satisfy various criteria relating to their size, commercial viability and growth prospects. Since its launch, over £9 million has been lent to around 120 companies.

A government policy change in 2002 resulted in Scottish Enterprise's Business Growth Fund being re-launched as a debt and equity vehicle working in the same funding bracket. The new equity option means that young companies can use the Business Growth Fund to improve their balance sheet in order to leverage support from banks and other investors. Eligible SMEs can apply for assistance in the form of a loan (usually 5-year term), equity injection or mix of both forms of finance. The option also exists for the SME to convert loan funding to equity.

The Fund is intended to complement rather than displace other sources of finance; a condition of Fund support is that other funding sources have been adequately explored. At least 50% of the company's financing requirements must be met by non-public sector sources.

Private sector funding can come from:

- Bank debt, including Small Firms Loan Guarantee, if appropriate
- Venture Capital or Business Angel investment
- Further investment by the existing owners of the company, or new investors
- The introduction of assets 'in kind', such as equipment, tangible assets, buildings

The Fund prioritises businesses that can demonstrate high potential for growth in terms of new products, markets and increasing employment. To qualify for support under this Fund, businesses must:

- Be a limited company with its head office in Scotland
- Meet the European Commission definition of a small or medium sized company (SME). This means companies with less than 250 employees and with turnover of less than £24m or net balance sheet assets of less than £16m (as for the Scottish Co-Investment Fund)

c) Intermediary Technology Institutes (ITIs). SE has established institutes in three high-tech industry sectors – life sciences, energy and ‘techmedia’ (digital media) – chosen on the basis of Scotland’s current perceived competitive advantage and associated strengths in R&D.

The main functions of the ITIs are to:

- Gather market intelligence
- Offer membership
- Commission research
- Manage and exploit intellectual property (IP)

SE has committed to investing £450 million over a ten-year period in the ITIs, each of which is intended to have around 15 people conceiving and commissioning ‘pre-competitive research’ leading to ‘market focused technology platforms’ accessible to the member companies. Each ITI will develop close links with relevant research groups in the universities. Membership promises companies access to valuable market intelligence, a global network of companies and researchers, and market-ready technology.

ITI Life Services

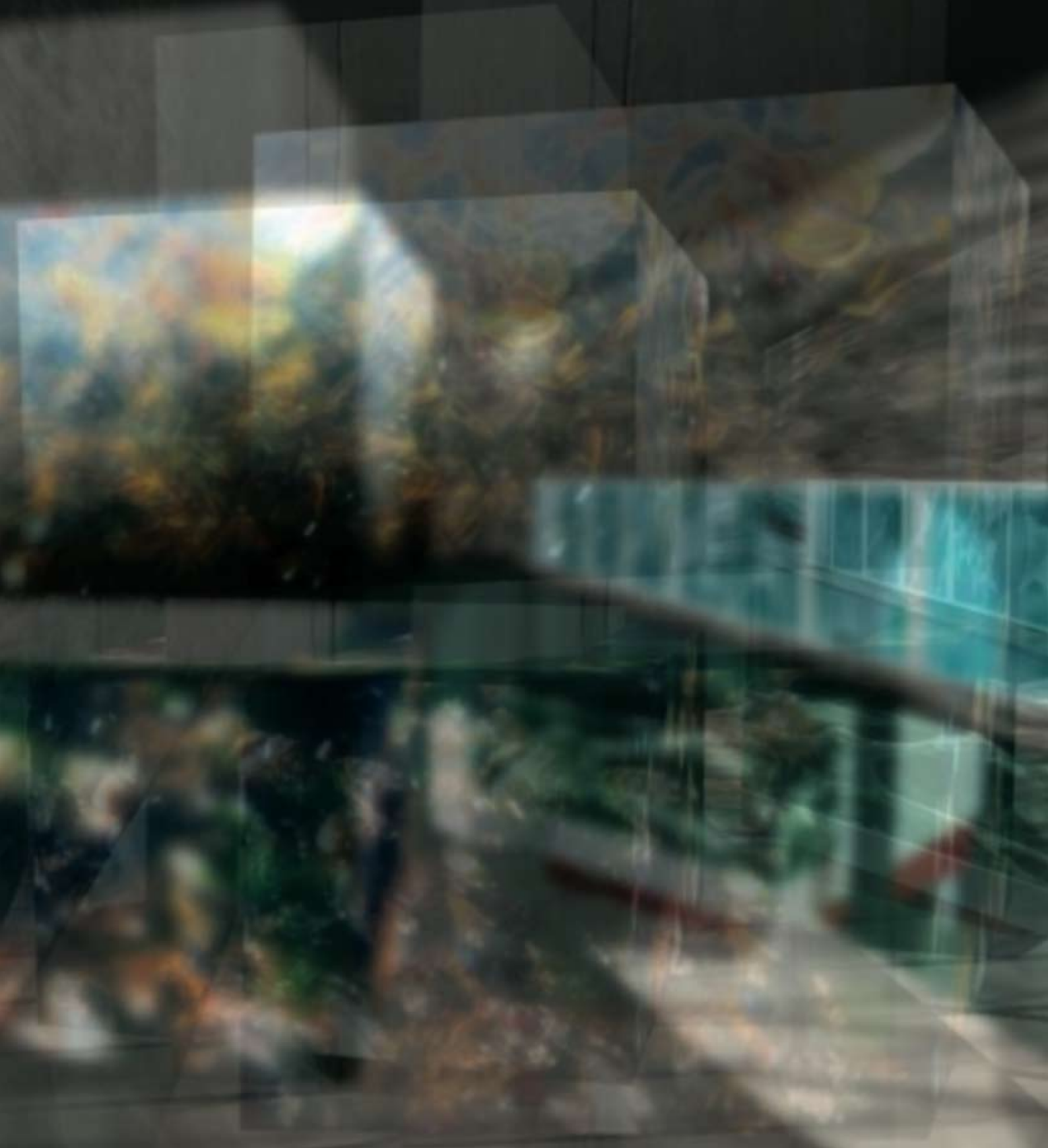
‘Publicly funded, but 100% commercially driven, we fund and manage early stage technology research and development programmes in the life sciences arena. We select and invest in programmes based on assessing future market needs, identifying technology opportunities, and responding to ideas, initiatives and proposals from the research and business communities. We do this in collaboration with partners from industry, academia and the financial community.’

(www.itilifesciences.com)



Concluding observation

The ITI program is a departure from SE's primary concern to support the growth of SMEs and reflects, to a degree, a commitment to a more focused, cluster-based strategy. Overall, the approach and funding regime now in place at SE suggests that the organisation has moved significantly from its initial mission as a traditional economic development agency to one focusing on innovation processes and outcomes and on the strategic importance of playing an intermediary or brokerage role in facilitating start-up and cluster growth in an increasingly internationalised regional economy. In terms of the typology outlined earlier, SE has assumed, along with a continuing information function, strategic and (increasingly) active brokering tasks, particularly with respect to its funding schemes and direct equity involvement. That said, SE is still a government owned agency responsible to the Scottish Executive and therefore subject to the political, policy and fiscal priorities of the government of the day.



09 The Digital Hub

The Digital Hub Development Agency was established in mid-2003 as a major national government initiative. The Agency's task '...is to implement some of the most radical enterprise and social development strategies so far attempted by the Irish Government'. The Digital Hub is a joint initiative of the national government and Dublin City Council. It reflects an established economic development policy commitment at the national level to an industry clusters strategy and a specific focus on the growth of the information and communications technology sector in particular.

The Hub supports a cluster of 'next generation' digital media enterprises, located about 2 kilometres from the centre of Dublin in an economically run-down, old working class section of the city that has experienced considerable employment losses over the past 20 years.

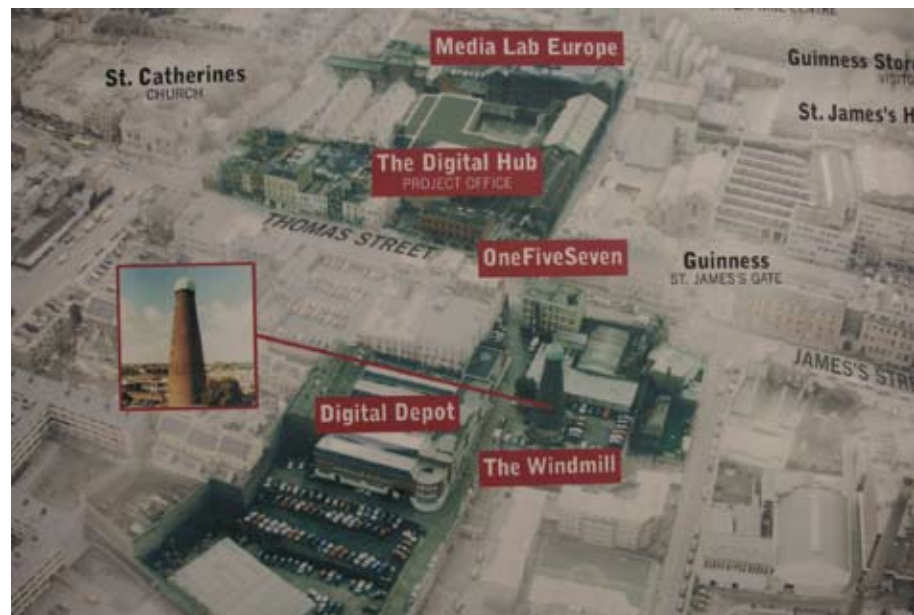


Focus

In broad terms, the government's aim for the Hub is twofold: first, to create an indigenous self-sustaining cluster in digital media and second, to use this initiative to drive an urban regeneration program intended to physically upgrade the area and

increase local job opportunities. The 'cluster' principle behind the initiative is apparent in the deliberate attempt to engage a range of stakeholders – the new media companies, Enterprise Ireland, the Industrial Development Agency, Dublin City Council, and a range of 'third-level organisations', including local community organisations, local and national educational providers and research facilities.

The Hub is located on a nine-acre site next to the famous Guinness Brewery. Industrial restructuring has seen the total workforce of Guinness shrink from around 15,000 at its peak to less than 2,000 today. Many of the existing buildings in the area – 'the Liberties' – are underutilised or vacant. The Hub site itself is partly developed. Heritage planning controls restrict redevelopment options. The progressive redevelopment of the site has to be negotiated through the normal planning system of the City Council. The Act establishing the Digital Hub requires it to 'consult with local community interests in or adjacent to the Digital Hub as part of the implementation of the development plan'. (www.thedigitalhub.com/digital_hub/cppp_process.php) To meet this requirement a Community Public Private Partnerships Steering Group has been established with members drawn locally from the residential community, business sector and government. The aim of the steering group is to engage community interests in a range of activities, including working with local school children to develop their digital media skills, delivering community-focused courses and offering train-the-trainer courses to enable local organisations to deliver these skills. This photo is from the model at Digital Hub.





Planning

Following the initial planning phase, the Hub is to be developed through three stages:

Preparation Phase (2002-2003): advanced telecommunications infrastructure embedded; initial property redevelopment and fitout commenced; property development begun

Phase 1 (2004-2005): aim to embed 50 companies, employing around 400 employees, displaying a mix of local and foreign enterprises ranged across the digital media value chain; private developer contracts awarded for redevelopment of site; social and community engagement projects launched

Phase 2 (2006-2011): enterprise and research cluster growth engendered; major property redevelopment completed; growth in interactions with community

Phase 3 (2012-onwards): a vibrant self-sustaining digital media cluster operating with 3,000 employees; substantial urban regeneration evident in the area; substantial impact on the community and learning activities evident

Magnets

The Hub offers co-locating businesses a mix of resources, including ‘hard assets’ – purpose built office space with state-of-the-art connectivity – and ‘soft assets’ – like opportunities to network and partner and access to strategic business planning and marketing skills. More specifically, enterprises gain:

- Flexible office space, from 10 to 1,000 sq. metres, at reasonable rents
- Super-fast broadband, with IP based voice and data services
- Quality studio, meeting and exhibition spaces
- Access to government agencies and their enterprise support services
- Exposure through use of the Hub brand
- Security services on-site

Researchers looking to commercialise their research can work with embedded companies at the Hub, to develop and test prototypes, and present their work to attract commercial partners from or through Hub participants. Within 5 km of the Hub there are 10 relevant centres of learning and research – including Ireland’s premier institution of higher learning, Trinity College, Dublin. Hot-desking facilities are provided to encourage these connections.

The Digital Hub fosters collaboration between the digital media research and enterprise communities. It facilitates the exposure of concepts and product innovations to a consumer test-bed and within this environment speeds innovation and market entry (www.thedigitalhub.com)

The Hub offers support and facilities for start-up companies: fully serviced office space for one-person companies and upward, flexibility as the company grows and access to enterprise support services from government agencies. For growing companies the Hub delivers an internationally recognised brand increasing their visibility to investors, international linkages to new markets and an expanding network of peer companies opening up opportunities for strategic partnering. Large international companies can also locate there as a base for their European operations, benefiting from the state-of-the-art telecommunications, low set-up costs, access to world-class research facilities and a range of government taxation and assistance programs. Thus, the aims of the Hub include incubation, acceleration and expansion for participating companies.





The Companies

By mid-2006, the Hub had listed 57 co-located companies on its web site. These companies were concentrated in the first stage of the Hub development – ‘the Digital Depot’ and included:

Athena Media (www.athenamedia.ie) – a multimedia digital production company which produces radio, television, online and text projects and is a content creator for www.podcastingireland.ie.

Capiche Design (www.capichedesign.com) – a graphic design company. “Capiche aim to deliver original ideas and dynamic design solutions across a range of disciplines, including; corporate identity, packaging, reports, brochures, exhibition graphics, new media.”

Cyesta Technologies (www.cyesta.com) – a software systems company that “provides anti-piracy services and systems to the owners of intellectual property rights. Its core customers are in both the entertainment industries and other industries marketing branded goods that are affected by piracy and counterfeiting”.

Design Ireland (www.designireland.ie) – a peak body established by the main Irish design organisations to enhance the image and encourage the development of new international markets for Irish design. Design Ireland is a broad-based coalition of the Graphic Design Business Association (GDBA), the Institute of Designers in Ireland (IDI), the Royal Institute of Architects in Ireland (RIAI), and the Institute of Creative Advertising and Design (ICAD).

Pixel soup (www.pixelsoup.ie) – a design/multi-media company providing cross-platform media solutions utilising: Digital Design, 3D Modelling & Animation, Compositing & Effects, DVD & Video Compression, Interactive CD ROM Production, Flash & Web Services, Wireless Application Development.

Eirplay Games (www.eirplaygames.com) – produces digital media entertainment content for the online and wireless consumer markets. Its core products are: Java mobile games, mobile logos and screensavers, monophonic & polyphonic ring tones, web & online games and animated movies.

Concluding Comment

For the Dublin City Council, the Hub represents an opportunity to engender substantial urban regeneration and job creation in a 'problem area' of significant heritage value close to the heart of the city. This policy driver does not necessarily sit well with the headline national aim of establishing the Hub as an IT hothouse, especially given the financial context in which the overall development is being managed. This latter point is critical to the success of the venture.



The Hub was initially funded by an upfront government grant of the existing land and buildings, in their varying states of repair, to the development agency. The assets transferred were nominally valued at around EUR 50 million. In addition, a further cash grant of about EUR 6 million enabled the Hub to begin operations and move through the preparation phase. However, beyond these initial subsidies, the Act establishing the Hub required that all further development and operations were to be self-funding. The major source of ongoing revenue is intended to be the stream of rents charged to companies locating there. In order to generate an adequate, increasing flow of rental income, the property assets had to be re-developed to house and service the companies. This means that the Hub has to partner with developers and private equity investors to develop the site, effectively taking its share of the development gain in the form of redeveloped and re-fitted premises suitable for letting to digital media companies, and associated researcher support services and the like. The remainder of the site will thus be turned to other, not necessarily complementary commercial uses. An early element of the development plan seeks to develop the site closest to the Liffey River for up-market residential apartments. The commercial success of this and other early property projects will largely determine whether and to what degree the Hub, as originally conceived, will be realised.

The vulnerable financial position of the overall project was underscored in the 2004 Annual Report (the last listed on the Hub's web site) which disclosed that, at June 2004, the accumulated financial operating deficit was EUR 1.4 million with a net operating deficit for the 2003-2004 year of EUR 2.1 million. In that year administration costs alone (EUR 1.65 million) dwarfed rental income (EUR 0.7 million). The deficit is being managed by recourse to short term debt, including bank overdraft arrangements. The net assets of the Hub were listed on the balance sheet at EUR 47 million – but most of this related to the nominal value of yet-to-be developed property assets. The future viability of the Digital Hub will thus depend on how quickly and efficiently the key properties can be developed and how effectively and quickly the Hub attracts relevant companies, assuming that cash flow can be managed in the short term – or government bail-out financial payments can be negotiated.

This means that the Hub effectively bears part of the development risk associated with a major urban regeneration project and political risk associated with the land use planning regime and the active involvement of a range of community interests. Such a situation is common when a particular venture must meet the multiple policy objectives of government, particularly when more than one level of government is involved.



10 NovaUCD

NovaUCD is an innovation and technology transfer centre located on the main campus of University College Dublin (UCD). Formally launched in October 2003, it developed out of UCD's earlier technology transfer vehicle – the 'University Industry Program'.

The linked primary aims of the centre are to facilitate the transfer of technologies developed at UCD to successful commercialisation, so boosting the revenues of the university and to help incubate and launch new high-tech start-up companies, thus contributing to Indigenous innovation and economic growth in Ireland.

NovaUCD is responsible for managing UCD's policies relating to intellectual property and provides advice to university researchers on identifying IP, protecting and exploiting it. The centre works with the researchers to develop appropriate business models for commercialising the IP, which can include licensing arrangements with external parties or the creation of spin-off companies. A major driver for the centre is a general concern that universities are failing to properly identify and exploit the value of their tax-payer funded research and that this means lost growth opportunities for the Irish economy and foregone revenue for the university sector; furthermore, the suspicion is that many of the benefits of the research are being freely appropriated by large, foreign multinational companies with limited benefits for Ireland (personal interview). This reflects a highly proprietorial view of IP and its exploitation, at odds with the development of 'open source' approaches to innovations noted in chapter 4.

It is vital that academics realise they should not disclose information before it is commercialised and patented. Otherwise they are simply disposing of an asset that could be of great value to themselves and the country as a whole. It is always possible that the idea could be the next Elan or Microsoft. Technology transfer is also the key to the nation getting a return on its investment (Dr. Cormac Kilty, Chairman of the Irish Biotechnology Association).



TOP LEFT: A work in progress
BOTTOM: An incubation unit



The second function of the centre is to incubate new technology based start-ups by offering space for three years in a purpose-constructed building serviced by advanced telecommunications and accessible to university researchers and facilities. By mid-2006 over 80 per cent of this space had been taken up by 23 co-locating companies, employing around 150 people.

The centre also offers training sessions and courses for university researchers seeking to commercialise their research and the co-located companies as they develop their business plans.

The centre is being established in three stages:

Stage 1 – the incubation wing: 42 incubation units of varying sizes have been provided to meet the changing needs of growing companies

Stage 2 – the training wing: provision for training programmes has been made on-site, with seminar and meeting rooms, exhibition spaces and workshop facilities

Stage 3 – laboratory wing: facilities for developmental work in bio-technology-related areas. To date, a 'bio-incubation wet-lab' has been constructed offering facilities for 4 to 6 biotechnology companies

Within this purpose-built facility, the companies are also provided with professional reception and secretarial services, 24-hour access, car parking and security. A café style coffee bar provides informal meeting opportunities for the resident companies and their clients – a neutral 'third space'.



A 'Third space' setting up for the day

Services – UCD Tech Transfer

NovaUCD provides advice to university researchers in the following areas:

- The commercial aspects of research proposals and contracts
- The preparation of non-disclosure agreements, material transfer agreements and industrial research contracts
- Identification, disclosure/registration and protection of IP
- The development of business models and commercial plans
- Finding licensees and negotiating licence agreements
- Establishment of new ventures and sourcing of finance

The centre offers training/continuing professional development on various aspects of the commercialisation of IP.

Services – creating ‘a community of entrepreneurs’

Start-up companies located at the centre are assisted in a number of ways related to venture formation, including:

- Project development
- Building an entrepreneurial team
- Developing the business model
- Financial planning and management
- Preparation of the business plan
- Forming a new company
- Accessing finance – including seed and venture capital
- Managing business growth

NovaUCD will also assist in the transition of ‘mature incubatees’ out of the centre at the end of their three-year tenure. The first resident company reached that point towards the end of 2006.

The resident companies have access to specialist expertise in technology development and management, business planning and the like, drawn from the UCD academic community and the industry sponsors (see below). As part of the ‘pre-incubation’ process, the centre also runs an annual ‘Campus Company Development Program’

funded by BT and Enterprise Ireland. The nine-month programme aims to assist university researchers and academics to establish knowledge-intensive enterprises through the creation of spin-off companies. It offers a series of half-day workshops and a mix of intensive coaching, mentoring and practical business assignments. At the end of the year awards are presented to successful projects on the recommendation of an independent expert panel. The top award in 2005 went to a UCD engineering PhD student for the new company, *Vocal Health Screen*.

Funding

NovaUCD was established with capital funding of EUR 10 million, three-quarters of which was contributed by six large industry sponsors and the balance by Enterprise Ireland and UCD. The six founding sponsors are: Ericsson, Deloitte, Arthur Cox, AIB Bank, Goodbody Stockbrokers and Xilinx. This investment paid for the centre's first two buildings. The biotech wet-lab was subsequently jointly funded by Enterprise Ireland and the University, entailing a further investment of EUR 1 million.

The six industry sponsors each receive a one-per cent equity share in each of the start-up companies, and UCD a further one-per cent. The sponsors provide senior staff to run weekly 'lunch-time clinics' for resident companies and are available for one-on-one mentoring sessions. More importantly, the sponsors, each a leader in its field, gain first-refusal access to successful start-ups and through the incubation process establish relations of trust that can later be exploited for mutual gain.

The centre's recurrent revenue comes from infrastructural and other support from the University, rents paid by the resident companies and royalty flows from successful commercialisation.

The Companies

Commercially successful companies incubated at NovaUCD include:

ChangingWorlds (www.changingworlds.com) – a provider of intelligent personalisation technology to the mobile telecommunications industry. The company's flagship product – ClixSmartTM – is an intelligent mobile portal platform utilised by a number of mobile network operators, notably Vodafone, O2 and Mobikom. ChangingWorlds opened its Advanced Research Centre at UCD in late 2005 and by mid-2006 employed 17 software engineers there, collaborating with academics in the University's School of Computing Science and Informatics to further develop personalisation technologies for the mobile telco industry.

BiancaMed (www.biancamed.com) – a spin-off company established by academics in the School of Electrical, Electronic and Mechanical Engineering that specialises in products used to diagnose sleep apnoea.


Eventznet (www.eventznet.ie) – providing software that enables organisers of conferences and other events to take and manage bookings over the internet. All information is stored in a data base that enables the organiser to monitor registrations, send reminders and updates, collect moneys and manage correspondence.

Java Clinical Research (www.javacr.com) – provides an integrated clinical trial service to the Pharmaceutical and biotechnology industries, entailing, protocol design, investigator selection, trial management, analysis, reporting and regulatory compliance. The aim is to assist clients from research through to market with new products.

Concluding Comment

The development and ongoing operation of NovaUCD is constrained by the fact that it is owned and based within a large university and therefore subject to the regulations and systems of a large educational institution. The University's decision-making structures, personnel procedures, budget arrangements and compliance requirements do not always facilitate the quick-response environment of a commercially oriented organisation like Nova. In a broader context, there is an important but unresolved national policy debate in Ireland on the best ways of exploiting indigenous intellectual property. The received wisdom at government level has been to make IP developed in the publicly funded university system widely and largely freely available to incoming foreign investors, since this is seen as a major magnet to attract large international firms. The opposing view, expressed in the Nova approach, is that 'giving away' local IP constrains indigenous innovation and economic growth; in this context, even the granting of non-exclusive licences on new products or technologies undercuts domestic growth potential (personal interview).





11 lab.3000

lab.3000 is a 'centre of excellence in digital design', funded by the State Government of Victoria and hosted at RMIT University in the heart of Melbourne, Australia. The centre started as an initiative of RMIT's then Vice-Chancellor, Dr Ruth Dunkin, as part of a plan to develop a digital design hub or precinct in central Melbourne. It was formally launched in late-2001 and has quickly evolved to be a key component of the state government's design strategy – 'Design Victoria' – which is itself embedded in the government's broader economic development strategy for the state. *lab.3000*'s structure and role are predicated on the assumption that, in economic terms, design matters!

As a brokering organisation *lab.3000* operates in a number of ways that mirror the activities of the organisations described in earlier chapters. Where *lab.3000* differs is in the (large) range and scope of action undertaken and, perhaps, in the degree of government support and collaboration across the university and professional worlds. Its major activities can be broken down into: business facilitation, design education, showcasing, communication and research.

The Business Bureau (<http://lab.3000.com.au/industry.jsp>)

The Business Bureau provides design entrepreneurs and professionals with the facility to profile their businesses and ideas by:

- 'Locating' on *lab.3000*'s web site and listing in a diverse and growing 'Business Directory'
- Developing and communicating 'business case studies'
- Participating in special *lab.3000*-organised events like 'the State of Design' (see below)

The *Business Directory* is an online resource allowing users to search for design companies and freelancers by name, location and area of expertise. In late-2006, there were around 400 businesses listed.

The Tertiary Network (<http://lab.3000.com.au/news/news/index.jsp?page=article&id=323b8362-9d44-4e05-8626-4950ee234564>)

The Tertiary Network aims to connect, promote and grow design across the education and research sectors, in Victoria and beyond. This entails engaging design students and staff in schools, universities and across the technical and further education sector (TAFE). Design educators and students are encouraged to participate in the key events – competitions, exhibitions, seminars – initiated and/or facilitated by *lab.3000*.

lab.3000 – an unusual beast

“Not only do we cross all educational sectors – we link education, government and the business sector.”

Education

The centre-piece of *lab.3000*'s educational program has been its 'educational incubator', a computer-enabled training facility offering digital design programs to students and teachers, located in Melbourne's CBD. The programs encompass sound, animation, pod-casting and digital storytelling. The incubator's activities have included:

- Piloting a new program for the Victorian Certificate of Applied Learning; VCAL is designed to provide an alternative secondary school qualification for students who opt out of the mainstream curriculum. This program has had a very high completion rate and is now taught by most of the state's TAFE colleges
- Offering some 70 short courses to around 2,000 students and 80 teachers; continuing professional development courses have been undertaken by teachers from the primary, secondary, TAFE and university sectors
- Delivering these courses in both Melbourne and non-metropolitan regions

lab.3000 has undertaken educational research focused on:

- 'Schools for 2020', that explores the implications of integrating digital technologies in the school system and the requirements for relevant policy development within the state education department
- 'Framework for Essential Learning' for K-10 schooling: establishing the theoretical underpinnings for design knowledge as part of the framework, aimed at students from kindergarten to year 10

Showcasing

Much of the effort at *lab.3000* goes into initiating and driving a host of public events aimed at raising the profile of Victoria's design capacities and practitioners, both locally and internationally, in ways that demonstrate the creative role of design in boosting regional economic performance on the global stage.

Major events have included:

- The first *Digital Design Biennale* – held at Melbourne Museum. This event, run over late 2004-early 2005 in a 'shell' created by internationally renowned Melbourne architect Tom Kovac, demonstrated the 'collision' of new digital technologies and design processes.

"...the exhibition demonstrated the impact of digital design on our everyday life – its economic, cultural and social context. In particular, it focused on the Victorian digital design industry, digital design education in Victorian educational institutions and the work and future of *lab.3000*. It also exhibited examples of leading international designers, positioning Victorian digital design within the international context"

The *Biennale* presented the work of selected international and local designers and of design students studying in Victorian schools, TAFE colleges and universities.



- *State of Design* – a suite of events during late-2006 – workshops, seminars and exhibitions – celebrating Victoria’s leading-edge design capacities. The Premier’s Design Awards formed the core of the activities, recognising the state’s leading design innovators. A one-day conference brought design perspectives and business practices together.

“Putting an emphasis on design brings creativity into an organisation increasing the chance of producing market-leading products.”

Other seminars and meetings picked up aspects of Victoria’s design culture and stressed the increasingly important international environment in which Australia’s design-intensive businesses operate. The coming of China as a major player was dissected in a forum led by Philip Dodd, creative director of the China Festival 2008. The finalists in the Premier’s Design Awards were exhibited at Melbourne Museum in late 2006. The Museum also ran a broader exhibition at the same time exploring Australia’s design history.

- *Young Designer Showcases* – are held regularly to give young practitioners ‘airspace’, to demonstrate their wares and develop their presentational skills. It also offers a platform for new connections with established designers and design-intensive businesses, financiers and entrepreneurs.

Competitions

- *Lightrail 2020* – a student competition to design Melbourne’s next tram was launched during 2006. University undergraduate teams of no more than three students were challenged to come up with a future-tram that could operate on Melbourne’s existing network in 2020, focused on the vehicle, inside and out. The competition is sponsored by the French-owned company, Alstom Australia Ltd.



Teams had to take into account the likely pattern of Melbourne's future development, reflecting the state government's current metropolitan planning strategy – Melbourne 2030 – and the possible changes in passenger expectations and needs. The winning team will fly to Paris and work for two months at the Alstom Transport Design Centre.

- *Worldskills* – The Worldskills Australia National Competition for 2006, supported by *lab.3000* and RMIT, included a Design category for the first time. Three design teams, from Victoria, NSW and Queensland, were invited to enter. Each team had to include an undergraduate university student, a TAFE student and a secondary school student. The Victorian team, - an RMIT electrical engineering student, an apprentice plumbing student from RMIT TAFE and a student from Bayside Secondary College undertaking a TAFE course – won the design competition. The challenge was to design a way of dealing with the increasing waste of water experienced in an agricultural, industrial or residential context within Australia. The winning design produced a system for reducing water consumption in large shopping complexes by capturing and storing storm water and condensation from air conditioning cooling coils, resulting in a halving of drinking water consumption in the typical complex.

Research

lab.3000 commissions and publishes research focused on the intersections of design and digital technologies in the context of industry development, improving economic performance and building educational assets. The *lab report* series (of which this monograph is a member) brings a critical and expository eye to key developments in education, industry development and public policy concerned with the role of design in the economy and broader culture.

lab.3000 is working with industry partners to develop case study methodologies designed to capture leading-edge business developments for dissemination through *lab.3000*'s e-network. The aim is to stimulate further collaborations and share workable models for innovation within design-intensive enterprises.

lab.3000 also offers a range of consultancy resources to practitioners, industry, the education sector and government.

Broker, Gatekeeper, 'Clusterpreneur'...

lab.3000 seeks to operate in a domain defined by all three 'spaces' in the Brokerage typology, identified above in the *Prologue* to *Section Two*.

Information Broker: lab.3000-as-communicator facilitates the free flow of information across the expanding and overlapping networks making up the digital design cluster. In so doing, *lab.3000* helps expand the networks and increase the complex cross-connections between cluster members that have the potential to throw up useful collaborations. A network in which the information flows subside is headed for the scrap heap. Information and serendipitous connections are the life blood of healthy networks. As was graphically pointed out earlier, growing networks add potential collaborations much faster than the rate at which membership increases. In its information facilitation role *lab.3000*, like a number of the other organisations discussed in this monograph, is a 'network builder'. In its capacity as gatekeeper, *lab.3000* also imparts a degree of 'bias' to the evolving system, enhancing the self-organising powers of the overlapping networks and reducing the likelihood of complexity catastrophes.

The act of building and guiding the overlapping networks is achieved through a number of the avenues described above, including:

- Creation and continuous updating of a fully functioning 'intelligent' web site
- Creative use of the internet through dissemination of e-newsletters, notices of upcoming events, etc.
- Organisation and conduct of a stream of relevant events – showcases, seminars, conferences, biennale, etc.
- Conduct and dissemination of applied research, including research into how clusters form, grow and deliver

The growth of 'open source' production (see chapter 4) places a premium on the internet-based generation and exchange of information, the raw material from which knowledge is created and exploited, driving innovation and productivity growth at the levels of the firm, cluster and regional economy.

Of the organisations described in this study, *lab.3000*, Creative London, the UK Design Council and Scottish Enterprise all seek to play a strong information broking role and are supported to do so by the regulatory and financial policies of relevant governments.

Strategic Broker: lab.3000-as-gatekeeper also seeks to influence the links made and their outcomes through developing strategic collaborations with government departments (education, innovation & regional development, information technology), professional associations (Design Institute of Australia), innovative businesses (XMedia Lab), cultural organisations (Melbourne Museum) and others. The development of its educational incubator has provided *lab.3000* with leverage over the directions of design education in Victoria, further accentuated by the operation of its Tertiary Network. At the international level, *lab.3000* has identified current and prospective design-driven developments in China as critical to the future growth of design-intensive industry and practice in Australia and has established links with Philip Dodd's creative enterprise, *Made in China*. This role is one characterised by facilitation, enhancement and 'match-making'. It defines much of the activities of organisations like Scottish Enterprise (chapter 8) and The Digital Hub (chapter 9).

Active Broker: lab.3000-as-clusterpreneur is a work-in-progress. Active brokers participate as primary partners in innovation, bearing some of the commercial risk and reaping some of the commercial and reputational rewards. Active broking leads to new revenue streams appropriated through partnership agreements, licensing or other IP avenues. Organisations like Zernike (chapter 7) and NovaUCD (chapter 10) are well along this path. *lab.3000* has just begun, mainly focused in new product development in its education program – via the highly innovative and successful educational incubator – and in event management.

Concluding Comment

There are considerable advantages for organisations like *lab.3000* that bring together all three brokering functions. By standing at the electronic junction of expanding information flows and engaging in strategic matchmaking activities, *lab.3000* is itself strategically well located and informed to identify and *actively* pursue wealth creating, revenue generating activities. However, it is critical to note that the capacity of *lab.3000* (or any other similar organisation) to generate and appropriate value in this way is heavily reliant on it (or someone else) also playing the two other brokering roles of communicator and strategic gateway. Without these roles and the intelligence gained from them *lab.3000* would become just another entrepreneur out to maximise individual returns. Here is the rub – if neither *lab.3000* nor anyone else helps build and glue together the networks forming a viable cluster, most of the potential collaborations a commercially-minded *lab.3000* sought to consummate would never eventuate. This fact, as we will see in the final chapter, has important implications for government policy.



Like NovaUCD, *lab.3000* is part of a host university, RMIT. This, inevitably, creates tensions between the expectations of the host and the other stakeholders, notably the State Government, as to *lab.3000*'s primary aims and identity. In particular, the expansive identity lab has sought to establish, based on its claim (mission) to engage with stakeholders from across government, industry, all education sectors and the design professions, requires a degree of independence that can sit awkwardly with RMIT University's corporate interests and operating procedures. At a more mundane level, the various financial, personnel and reporting procedures of a university can reduce the flexibility and quick-response imperatives that organisations like *lab.3000* need to display in order to effectively intervene in their environment. On the other hand, the support offered by a host university, including access to expert educators and researchers, can be a powerful resource. Although episodes of tension and occasional cross-purpose are inevitable in such arrangements both host and hosted have a strong mutual interest in dealing with them.



Epilogue

The seven organisations profiled in this section all have a self-proclaimed mission to boost innovation in their home economies. Although their particular priorities and organisational forms vary, they – each in their own way – engage in brokering activities identified in the Prologue to this section. The table below summarises and compares the organisations with respect to this typology.

ORGANISATION	INFORMATION BROKER	STRATEGIC BROKER	ACTIVE BROKER
CREATIVE LONDON	***	**	
UK DESIGN COUNCIL	**	***	*
ZERNIKE		*	***
SCOTTISH ENTERPRISE	***	***	*
DIGITAL HUB		***	**
NOVAUCD		*	***
LAB.3000	***	***	*

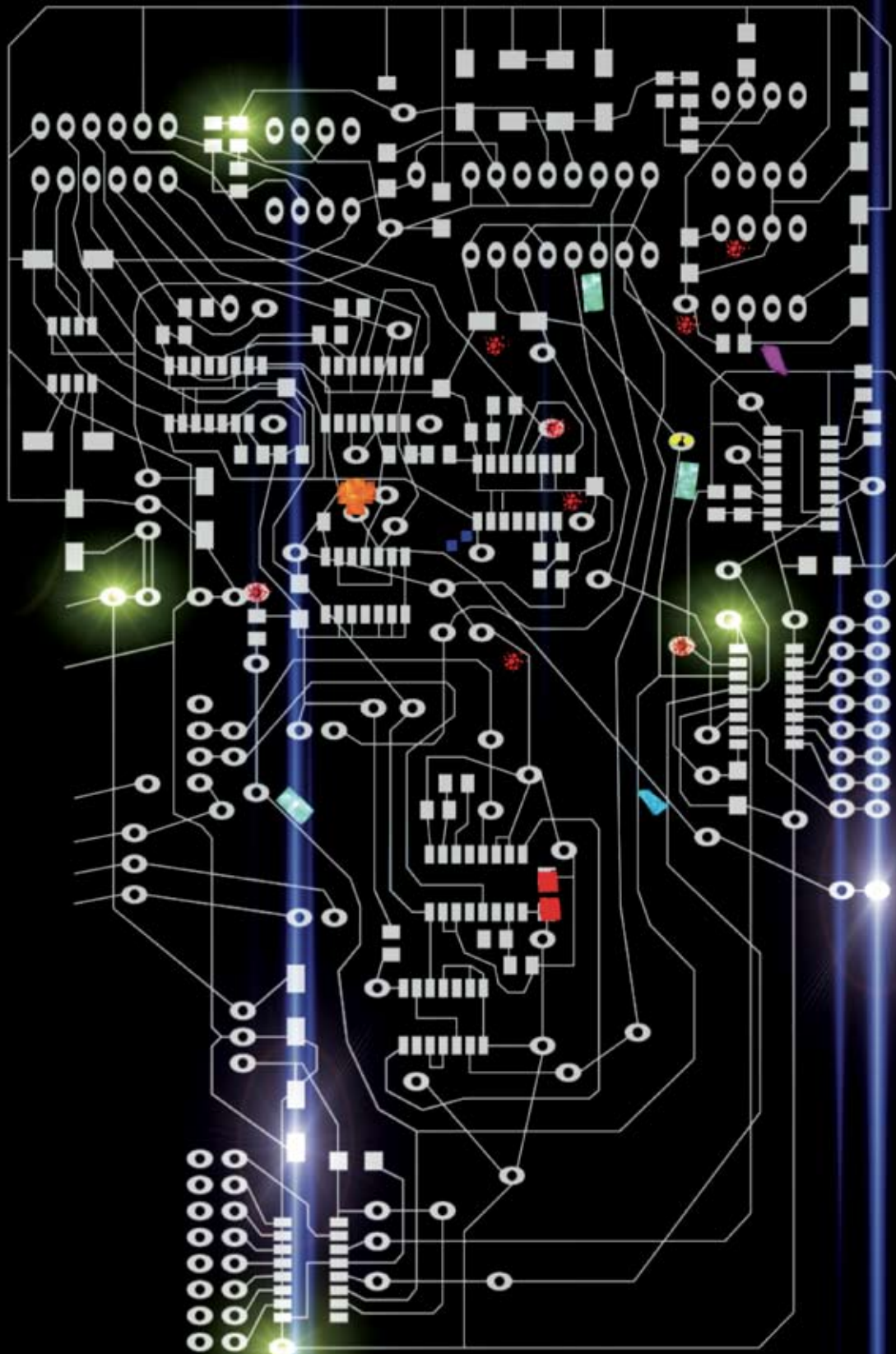
* – MINOR ROLE ** – SUBSTANTIAL ROLE *** – MAJOR ROLE

Creative London, Scottish Enterprise and *lab.3000* each have as a primary if implicit task the dissemination of market-relevant information to fuel network formation and growth. Together with the Design Council, SE and Digital Hub, *lab.3000* also concentrates on encouraging strategic connections within and across sectors in support of the growth of viable industry clusters in selected advanced technology areas. At the other end of the spectrum, Zernike and NovaUCD are focused on actively generating wealth by incubating and accelerating to world market potential new technology-driven businesses; these organisations appropriate part of the wealth generated through equity and licensing arrangements. *lab.3000*, to date, has had only minor involvement at this commercial end, primarily with respect to its educational programs.



The Digital Hub is engaged in creating an advanced IT cluster, bringing together in co-location a range of complementary businesses provided with state-of-the-art IT infrastructure services. However the Hub is also actively engaged in appropriating value through rental streams and property development gain, the latter revenue stream built into the Hub's organisational development plan and long term financial viability.

The role of government is vital to the formation, mission and operation of these broker organisations. The remainder of this monograph deals with the implications of this fact.



Section Three

Governing Innovation

12 Where Does the Government Fit?

This study, and the two preceding it (Berry, 2003, 2004), have attempted to explain and better understand the dynamic economic processes driving growth in the regional and national economies. More particularly, I have sought to locate ‘Design’ as a powerful element of the innovation-productivity-growth cycle of advanced economies in an increasingly integrated world. *Section One* of this monograph extended the analysis of innovation introduced in *lab report 01* (Berry, 2003) by: firstly, further exploring the structure and role of networks; secondly, by linking network and cluster dynamics to learning ‘loops’ or processes and; thirdly, by focusing on the impact of ‘disruptive innovation’. *Section Two* then focused on a number of organisations in the United Kingdom, Ireland, the Netherlands and Australia that, in various ways, are attempting to broker or facilitate innovation and new firm growth in design-and-technology-intensive industries. In some cases, this has been accompanied by an explicit ‘clusters’ policy. Most of these organisations are, to varying degrees, supported or funded by government. A raft of important questions remain – what is the appropriate role of government here? Is it enough simply to fund the brokers? Should conventional R&D policies be extended or scrapped? Can government influence dynamic, path-dependent economic growth in a globalised environment? What policy approach makes sense and has some chance of generating positive economic and social outcomes?

Section Three attempts to answer, in outline, these large questions. The next section revisits and extends the *theoretical framework* sketched in *lab report 01* and *Section One* of this monograph. The discussion then moves onto a consideration of the *policy implications* of this analysis for countries like Australia, suggesting that a nuanced, multi-dimensional approach is most likely to encourage innovation-driven growth in the inherently uncertain world in which we live.

Theoretical Framework Revisited

The dominant understanding of advanced capitalist economies is provided by orthodox (neoclassical) economics. This paradigm models the economy as a self-equilibrating system of interactions between countless individual producers and consumers. Competition and strong assumptions about agent rationality and knowledge, diminishing

marginal returns in production and well-behaved consumer utility functions ensures optimal economic outcomes at any point in time. A perfectly competitive and complete capital market allows all-knowing consumers to allocate their work efforts and incomes over time to maximise their lifetime utility or happiness.

In this world, innovation comes 'from the outside' – it is seen as external (exogenous) to the economic system which reacts to essentially uncontrollable and unpredictable forces for change. The neoclassical theory of economic growth, associated with American economist Robert Solow (1956) and Australian economist Trevor Swan (1956), holds that an economy grows by accumulating more labour and more capital, with knowledge increasing at a given, steady rate beyond the control of economic agents or governments. In effect, knowledge or technical progress was treated as a 'residual' factor. Attempts by Solow (1957) and others to measure empirically the relative contributions to growing national output found that, once population growth was accounted for, this exogenous residual accounted for more than 80 per cent of the growth in average living standards or output per head. Eventually, as capital and technologies move freely between national economies and diminishing returns to production set in, countries will tend to converge to a similar rate of growth and bump along buffeted occasionally by unexpected exogenous shocks.

An analogy might be a car driving steadily down a straight road. Everything proceeds smoothly, with the speed of the car (growth) changing as the pressure on the accelerator is increased or relaxed (savings rate changes), until an unpredictable gust of wind pushes the car towards or even for a time off the road, whereupon the steering wheel (perfectly functioning product and factor markets) corrects and brings the car back to the middle of the road. Technological progress can be represented as an improvement under the bonnet allowing the car to go faster; but the motor mechanic is brought in from outside the car, maybe from a nearby town. Eventually traffic congestion slows the car to a sustainable speed.

The alternative economic paradigm presented in this and previous *lab.3000* reports drew on three main sources:

1. Behavioural economics. Instead of assuming that all economic agents are perfectly informed super-rational calculating machines, they are conceived as displaying 'bounded rationality', characterised by incomplete information, limited decision-making competence, search behaviours and valuations guided by 'heuristics' – or 'rules of thumb' – and biases. For an individual agent, economic successes and failures will, in part, arise from trial and error behaviour and other learning strategies (see chapter 3).

2. Evolutionary economics. Instead of focusing on the self-equilibrating tendencies of the economy, the latter is conceived of as a ‘complex adaptive system’. Economic agents interact in an uncertain world that leads to path-dependent trajectories in real time (and space), due to the pervasiveness of increasing returns in production, less than perfect information and foresight and the existence of externalities and network effects. Such systems display recurrent crisis tendencies, unexpected and large shifts in economic outcomes, the emergence of both new paths and the extinction of existing ones, well beyond the predictions of orthodox economic theory (Omerod, 2005).

More specifically, the economy is literally specified as a complex open adaptive system, obeying both laws of thermodynamics. An economy in this view is in continual disequilibrium as new energy and information drives the physical transformation of resources into usable products and services, creating structure and order via the interaction of real human beings as agents, and expelling disorder or entropy in the form of pollution, resource depletion, rusting machinery, failing businesses, death of agents and the like.

The contrast between orthodox, mainstream economics and evolutionary or complexity economics is apparent in the table, below, taken from (Beinhocker, 2006, p. 97).

CONTRASTING TRADITIONAL (NEOCLASSICAL) ECONOMICS AND EVOLUTIONARY (COMPLEXITY) ECONOMICS

WITH RESPECT TO:-	COMPLEXITY ECONOMICS	TRADITIONAL ECONOMICS
DYNAMICS	OPEN, DYNAMIC, NON-LINEAR SYSTEMS FAR FROM EQUILIBRIUM	CLOSED, STATIC, LINEAR SYSTEMS IN EQUILIBRIUM
AGENTS	MODELLED INDIVIDUALLY; USE INDUCTIVE RULES TO MAKE DECISIONS; HAVE INCOMPLETE INFORMATION; ARE SUBJECT TO ERROR AND BIASES; LEARN AND ADAPT OVER TIME	MODELLED COLLECTIVELY; USE COMPLEX DEDUCTIVE CALCULATIONS TO MAKE DECISIONS; HAVE COMPLETE INFORMATION; MAKE NO ERRORS AND HAVE NO BIASES; HAVE NO NEED FOR LEARNING OR ADAPTATION (ARE ALREADY PERFECT)
NETWORKS	EXPLICITLY MODEL INTERACTIONS BETWEEN INDIVIDUAL AGENTS; NETWORKS OF RELATIONSHIPS CHANGE OVER TIME	ASSUME AGENTS ONLY INTERACT INDIRECTLY THROUGH MARKET MECHANISMS (E.G. AUCTIONS)
EMERGENCE	NO DISTINCTION BETWEEN MICRO- AND MACROECONOMICS; MACRO PATTERNS ARE EMERGENT RESULT OF MICRO-LEVEL BEHAVIOURS AND INTERACTIONS	MICRO- AND MACROECONOMICS REMAIN SEPARATE DISCIPLINES
EVOLUTION	THE EVOLUTIONARY PROCESS OF DIFFERENTIATION, SELECTION AND AMPLIFICATION PROVIDES THE SYSTEM WITH NOVELTY AND IS RESPONSIBLE FOR THE GROWTH IN ORDER AND COMPLEXITY	NO MECHANISM FOR ENDOGENOUSLY CREATING NOVELTY OR GROWTH IN ORDER AND COMPLEXITY

...a complex system is a system of many dynamically interacting parts or particles. In such systems the micro-level interactions of the parts or particles lead to the emergence of macro-level patterns of behaviour. ...Scientists refer to parts or particles that have the ability to process information and adapt their behaviour as agents and call the systems that agents interact in complex adaptive systems (Beinhocker, 2006, p. 18)

3. New Growth Theory. The Solow-Swan neoclassical growth model banished the dynamic drivers of economic change to the nether regions, beyond the reach of economic understanding. In this view, the macro economy grows in balance (equilibrium) through time, pushed by population growth and savings turned into new capital – until some exogenous shock like war, a system-wide banking crisis, or technological advance (just) happens, forcing rapid readjustment in product and factor markets, leading to a new stable moving equilibrium until the next exogenous shock. New growth theory, associated with Stanford University economist Paul Romer (1990) ‘endogenised’ technological progress. In this model knowledge becomes the central factor of production. It is the accumulation and exploitation of knowledge to create new products and organisational forms that drives the economy forward. Hence, the economic processes that create knowledge assume central stage.

Romer identifies two key characteristics of the production of knowledge (see Warsh, 2006, chapter 22 for a fuller description). First, knowledge is ‘a non-rival good’, by which is meant that once produced it can be widely used by everyone who has access to it; if one person uses it this doesn’t reduce the potential use of other people. Thanks to the internet and the rise of open source social production (see comments above in chapter 4) the wide and costless dissemination of knowledge through effectively functioning networks can quickly create wealth. But – and this is where the second characteristic of knowledge impinges – knowledge can also be turned into intellectual property, monopolised and used to establish and entrench market leadership. Moreover, knowledge builds on itself, allowing innovating organisations to exploit increasing returns to production – i.e. a situation where the innovator enjoys progressively falling average costs of production allowing it to undercut competitors and strengthen its market leadership and share. The market position of the leader is further strengthened to the extent that network and lock-in effects characterise consumption of the product. However, as chapter 4 makes clear, market leaders are also forever at risk of being blind-sided by disruptive innovation, as competitors launch new-end or low-end attacks, based on the application of open source and/or proprietary knowledge of their own.

These three alternative or heterodox approaches to economics are partly inter-linked. Hence, evolutionary economics (as the table above notes) makes use of behavioural economics in specifying how economic agents act and interact. New growth theory provides a rigorous macro-level explanation of how knowledge that is accumulated within the economic system drives economic growth through the creation and exploitation of increasing returns by firms displaying varying degrees of monopolistic power. However, new growth theory does not have an endogenous explanation for how new knowledge – innovation – occurs; innovation appears as a black box in the model. To get within the box a full evolutionary approach is required, one that shows how new ideas lead to new knowledge through the processes of differentiation, selection and amplification, via the dynamic operation of networks and clusters and the learning behaviours of real economic agents. The outline of this approach is presented above in chapters 2 to 4.

What Can (Should) Governments Do?

The orthodox answer

The primary prescriptive policy implication of neoclassical economics is laissez faire – leave it to the market. The main economic role of government here is to constitute and ensure the smooth running of the market. Laws defining and enforcing clear property rights are central to this view. Second, government must step in and intervene where ‘market failure’ arises. For example, some industries display an inherent tendency towards monopoly, through predatory tactics or due to the existence of large economies of scale; in other words, they display significant increasing returns to scale. Monopoly prevents the optimal operation of markets, reducing economic welfare – some people could be made better off without other people being made worse off if all markets are made fully competitive. Hence, over the past 20 years, governments in the advanced capitalist nations have focused on ‘competition policy’, introducing or strengthening regulations and incentives that establish more competition in key industries, including government owned monopolies. Competition policy is based on the view that stimulating more competition will increase allocative efficiency at a point in time and encourage innovation and growth through time.

However, neoclassical economics has long recognised the existence of other pervasive forms of market failure that justify corrective government intervention – in particular, externalities (positive and negative) and the provision of public goods. Defence is normally presented as the archetypal public good, something that everyone in the society benefits from if it is provided to any citizen. The problem is, who will pay for services like defence if you receive the benefits anyway and if you not paying is but a drop in the ocean and doesn’t matter if everyone else pays for it. Since every citizen has the same rational choice, no one pays, the public good is not provided at all, so no one benefits – a case of extreme under-provision. In such circumstances governments usually respond by taxing citizens and providing the service, either directly or indirectly.

The leading neoclassical economist, Kenneth Arrow (1962) pointed out the likelihood that scientific research underlying R&D would be under-provided because investors are not able to appropriate all the economic benefits of research; in other words, there are positive externalities since some of the benefits are captured by other agents who haven’t paid for it. Arrow’s analysis provides much of the economic rationale for the existence of national government research funding schemes like the National Science Foundation in the U.S. and the Australian Research Council. Other policies like R&D tax benefits are aimed at reducing the cost of individual agents investing in and commercialising research relative to the portion of expected returns they can appropriate, while intellectual property laws attempt to ‘internalise’ as many of the benefits – enable the investing and innovating firm to capture as much of the benefits – as possible.

There is also a strong case for seeing mainstream education as a generator of positive externalities. A Canadian study of 14 advanced economies (not including Australia) found a very strong relationship between growth and general literacy competencies in the national population Coulombe et. al (2004). The researchers found that for every 1 per cent increase in literacy standards against the international average, labour productivity rose 1.5 per cent and GDP per head 2.5 per cent over time. This suggests that all employers (as well as individual employees) benefit from having a literate (and by implication, numerate) population. Governments therefore have a strong economic incentive and widely recognised role to ensure that formal (K-12) educational and other agencies are actually delivering high rates of literacy and numeracy. They normally do this in countries like Australia by imposing compulsory school attendance to a minimum age, as well as through supporting educational research and curriculum development, monitoring and regulating standards and direct funding to providers.

Since the 1960s economists have been used to treating workers as ‘human capital’, investing in themselves through education. The skills developed are costly in time and money (income foregone while training) but can be expected to increase an individual’s productivity and lifetime income. All this can be handled within the standard Solow-Swan growth model. However, if positive externalities or spillovers are generated – say by an increasingly literate workforce – then workers collectively are more productive than they otherwise would be. In the mid-1980s a leading neoclassical economist, Robert Lucas (1985), generalised this argument by suggesting that merely by working in teams – ‘rubbing shoulders in the workplace’ – knowledge is exchanged and enhanced, improving productivity and, hence, economic growth. He suggested that the increase in output in the American economy due to these positive spillovers may be as much as 40 per cent. Moreover, labour tends to migrate to successful, fast-growing economies, reinforcing the potential for further spillovers. This analysis suggests that those economies that engender robust positive spillovers will forge ahead and stay ahead, not converging to an average rate of growth, as the standard model concludes, a finding which appears to be borne out by the large and seemingly permanent differences in growth rates between developed and underdeveloped nations.

The policy implication of this is clear – governments who want their economies to stay ahead of the crowd need to recognise and encourage positive spillovers, through appropriate education, industry, industrial relations, immigration and other policies.

In the longer term the Lucas model was a blip, generally perceived by the orthodox as an embarrassing slip from grace by a leader in the profession. The theoretical retort was levelled by Mankiw et al. (1992) who argued that as long as knowledge was freely available to all parties, growth would remain driven by the accumulation of physical and human capital, as Solow-Swan decreed. All economies would converge to a common growth rate, but the time taken to converge would be much longer than the standard model predicts – hence, current differences between countries are real but tend to disappear in the (really) long run. This has been termed ‘the augmented Solow model’ (the Australian Swan has faded from view, at least in the eyes of U.S. economists).

The policy implication of this response is that governments can retreat to the basics – keeping industries competitive, providing public goods, minimising the worst negative externalities, supporting schools, universities, basic research and R&D.

The Critique

New Growth Theory takes the augmented Solow model head on. The latter assumes that all knowledge produced is widely and immediately accessible to all economic agents, an example of the extreme assumptions underlying the perfect-rationality model of individual decision making – *homo economicus* – in conventional economics. Romer’s model, on the other hand, holds that (much) knowledge is appropriable as IP and routinely deployed to establish monopolistic power based on exploiting increasing returns in production. This leads to path-dependence and increasing productivity in those industries where the market leaders and innovative newcomers are most active.

The policy implication here is that the neoclassical economist’s concern with competition is partly misplaced.

Innovation and productivity growth result in and depend on a degree of monopoly in the system. *Microsoft*, in this view, is not an aberration but a particularly visible example of the new growth machine at work. Competition occurs but not at the level of the industry. Even Microsoft will meet its match eventually, blind-sided by an as yet unknown competitor with a ‘killer technology’ or a simple disruptive innovation. By attempting to control the tendency to monopoly in a single industry, by trade practices and similar regulations, governments risk cutting off the life-blood of innovation.

Omerod (2005, p. 14) points to the high death rate of large companies. Of the largest 100 industrial companies in 1912, 48 per cent had disappeared by 1995 – bankrupt or taken over. Only 19 per cent were still in the top 100. Individual failure is much more frequent than orthodox theory suggests; it follows from the reality of ‘wild randomness’ in complex systems (Mandelbrot and Hudson [2004]).

Evolutionary economics also suggests that knowledge passes through and is enhanced by networks and clusters, with economic agents interacting in both formal and informal ways, sharing, learning and collaborating, on the one hand, while also competing, on the other.

The key policy implication here is that governments need to encourage network and cluster formation, not through regulation or exhortation but by ensuring that the background conditions conducive to their functioning are in place.

This imperative involves:

- *A focus on the ‘health’ of SMEs*, Policies designed to encourage new start-ups and accelerate their development provide much of the ‘raw material’ for innovation and, in particular, are ‘natural’ incubators of occasionally decisive disruptions.
- *The implementation of an effective but ‘light’ IP regime*, providing innovators with the incentive to exploit their innovations – but without unduly limiting future disruptive attacks through over-protection. This balance is a difficult one to achieve, especially when considering areas like biotechnology, when issues of patenting the underlying science arise.
- *Introduction of state-of-the-art infrastructure*, particularly in telecommunications.
- *Support or provision of brokering organisations*, like those discussed in *Section Two*. The range of particular activities and policy directions described there are indicative of the approach to innovation proposed in this and the preceding monographs.

The role of brokers has been highlighted in this monograph, in part because it is a relatively under-appreciated and under-researched driver – or more accurately, midwife – of innovation and growth in the dynamic, uncertain world we inhabit. As the evolutionary economic paradigm underscores, policy makers cannot closely predict future economic outcomes, since the level of complexity is too great. Governments, at best, can facilitate the processes that lead to innovation, monitor outcomes and intervene, carefully, where opportunities arise.

Three ‘types’ of broker organisation were identified in the Prologue to *Section Two*. In fact, they can be located along a continuum of action, with different funding requirements for government (see diagram overleaf). Pure information brokers require substantial, continuing funding by government, industry peak associations or private non-profit organisations, if they are to carry out this role, as outlined in the Prologue. This is increasingly so now, given the pervasiveness of information technology and the internet. To properly play an information broking function, an organisation will not be able to capture revenue flows sufficient to survive financially, except to the extent that it moves towards more *strategic* and *active* levels of operation, identifying opportunities to exploit its connections and strategic location as gatekeeper. As an organisation moves from left to right along the spectrum, the level of self-funding rises and the dependence on government or related funding falls. However, in moving towards the strategic and, especially, active ends of the spectrum, the organisation risks losing its perceived ‘honest broking’ role, with negative consequences for existing networks for which it plays this role. It is possible that a commercially successful active broker could choose to cross-subsidise the information role; however, even assuming that it is able to retain broad credibility in this context, the nature and internal culture of commercially successful organisations will work against an effective internal system of cross-subsidisation and the organisation’s effectiveness as an information broker will deteriorate. If the basic intra-network and cluster communication falters, so too will the networks and clusters facilitating innovation and growth. In the end, failure to preserve and enhance organisations fulfilling the information and strategic brokering roles will undercut any attempt at successful active brokering, while reducing endogenously-driven growth in the regional economy.

The policy implication here is that governments need to fund brokerage at the information and strategic poles as a relatively permanent component of a viable innovation strategy.

Failure to do so will undermine and threaten the processes of networking that engage and grow the SMEs that provide much of tomorrow’s innovative charge. Most of the organisations discussed in *Section Two* therefore depend on secure sources of funding from government, universities or the like.

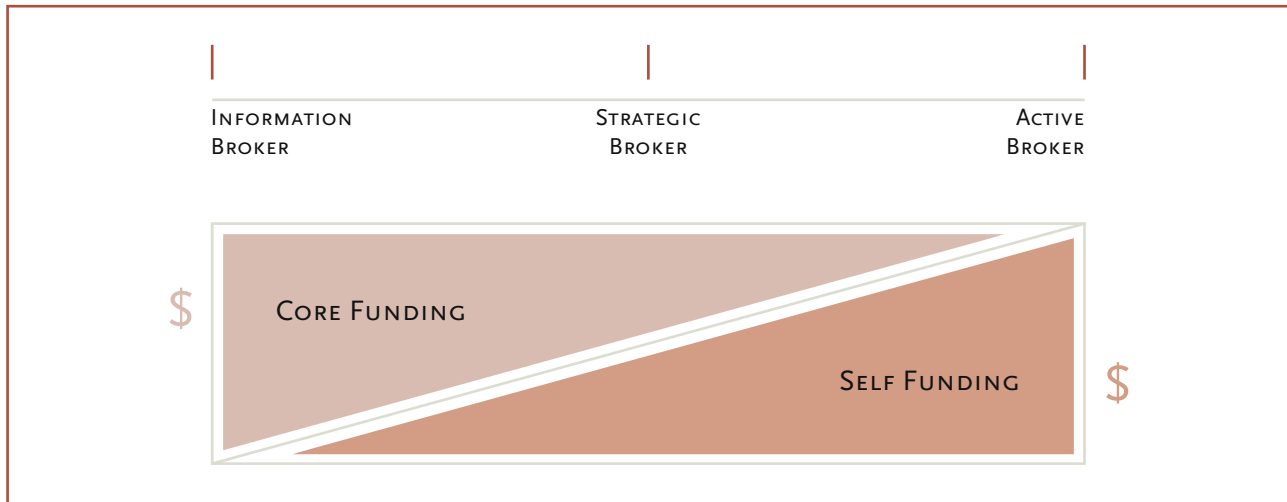


FIGURE 8

Beyond the central role of broking organisations in the process of innovation, the focus for this monograph, the economic approach adopted here suggests a number of important background or environmental conditions for dynamic, innovative economies. The most important of these are:

- *The importance of the K-12 education system.* Government's traditional role in ensuring the provision of universal, high quality education assumes ever-more importance in a world where knowledge is the crucial factor of production. However, recent research in developmental psychology and the cognitive sciences has identified the ages 0-5 years as critical in the intellectual and emotional development of the person, suggesting that pre-school education may be even more important to get right than in later years. This is particularly likely given the gross neglect of early education to date in countries like Australia.
- *The importance of liveable environments.* Innovation is, in the end, driven by innovative people operating in conducive environments. Regional economies now compete to attract and keep talented, creative people. 'Soft infrastructures' – safe public places, vibrant night life, good restaurants, clean air and water, diverse cultural and leisure opportunities, quality schools, tolerant communities, etc. – are as important as the harder elements like energy and transport, perhaps more so.

- But *'hard infrastructures' matter too*. The provision of affordable housing in the right locations is an under-recognised but very important condition for continuing economic growth in a region. If workers of all skills cannot access available jobs then, not only do they suffer deprivation, but the regional labour market fails. The problems that some large US and UK cities experience in attracting sufficient key or essential workers in areas like teaching, nursing and emergency services is a case in point. More broadly, workers at the low skill-low wage end of the labour market may find it difficult to afford housing close to available jobs in areas like retailing, tourism, hospitality, warehousing, etc. (For a discussion of this issue, see Berry [2006]). The efficiency of regional labour markets will also depend on the extent to which public transport services effectively articulate with the operation of housing and labour markets. Cities, it should be noted, throw up 'wicked' challenges to policy makers; the city is a paradigmatic open, complex adaptive system. As such it is hellishly difficult to grasp future developments beyond a very short horizon.

The policy directions suggested above do not replace but should complement well-established policies, like government support for R&D, currently aimed at building effective 'national innovation systems' (see Berry, 2003, chapter 6).

It is now possible to address the general questions posed in chapter 1.

What are the lessons we can learn from the organisations profiled in Section Two?

It is clear that these organisations reflect a similar government intention to go beyond traditional industry-specific growth policies, to provoke interactions across industry boundaries, drawing at least implicitly on a clusters strategy. This, in turn, signals acceptance - at least in part - of an economic paradigm in which knowledge drives growth through positive spill-over effects and innovation is seen as network-dependant. These *broker* organisations are implicated in the construction and evolution of inter-agency networks and broad clusters and, thus, relevant to the processes by which creativity works through design to boost innovation, competitive advantage and growth in the regional reaches of the global economy.

It is also clear that brokerage is but one element in the evolutionary process of growth in the knowledge economy. By itself, a policy of supporting organisations like lab.3000 does not make a coherent and effective development strategy. Some of the other elements are noted above: viz. support for SMEs, the provision of 'smart' infrastructure, and the importance of 'getting the IP regime right'. Nevertheless, governments can make a significant move in the right direction through supporting and encouraging these organisations to play the mediating/mentoring role, to assist in the incubation and acceleration of SMEs, while always recognising the impossibility of 'picking individual winners'.

The final lesson to be drawn here is that the range of broking activities is wide and particular organisations sit at different points along a spectrum of possibilities. This point is made explicitly in the Table presented in the Epilogue to *Section Two*. Some organisations will choose to focus on particular activities associated with information generation and dissemination; others will be more concerned to be active agents for innovation. The requirements for government engagement and support vary between these different modes of action, not least with respect to funding, as argued immediately above.

Are there particular levers that governments can pull to encourage innovation and growth?

The main conclusion here is negative. Governments, like other agents in the economy, do not have any privileged knowledge that allows them to accurately forecast the future outcomes of particular economic interventions. *The economy as a complex adaptive system is simply too complex*. Instead, governments can concentrate on getting the basic pre-conditions for growth in order, closely monitor actual developments and facilitate the feedback of market relevant information to economic agents whose interactions will determine (in unforeseeable ways) actual economic outcomes over real time and space.

Are there useful and productive ways for government agencies to interact (work with) broker organisations to encourage growth outcomes?

The answer here is a ‘qualified yes’. Government agencies, mainly departments or sections of departments, have an important role in briefing the organisations as to current and prospective government priorities, identifying particular opportunities for showcasing ‘success stories’ in the local economy and engaging in joint activities that highlight major government initiatives. However, it is also important that broker organisations maintain a widely perceived degree of independence from the government of the day if they are to effectively operate as ‘midwives of innovation’. Where the broker is, in fact, an in-house government agency like Scottish Enterprise, their actions will be constrained by established public sector rules and routines and other economic agents will factor this into *their* interactions with that organisation. This raises the more general point about the barriers posed by government sponsorship, to which we now turn.

Are there things that governments should not do if we are to reduce barriers to growth?

The futility of governments picking individual winners in an economic system defined by complexity has already been stressed. It is also the case that a successful brokerage program facilitating innovation and growth through a clusters strategy requires a degree of cross-departmental cooperation rare in our system of representative government. The policy imperatives outlined in this chapter imply a commitment to a holistic or ‘joined up’ approach. In reality, in Parliamentary democracies like Australia, most policies are developed and implemented through individual departments responsible to a particular Minister. Budget allocations are fiercely competed for and separate

policy fiefdoms emerge and are just as fiercely defended. The role and activities of broker organisations sometimes cut across conventional departmental jurisdictions, suggesting that their actions and outcomes will be relevant to a range of policy areas and to the oversight of central agencies. On the other hand, the realities of government, including the processes of budget determination, imply that such agencies will depend on the patronage of a particular Minister, preferably a senior Minister. This means that broker organisations in each of the countries covered by the cases in *Section Two* need to walk a fine line between establishing their independence and engagement across the segmented structure of government – in Australia, further complicated by the federal system – and the imperatives of survival characterised by the support and protection of a particular ‘lead’ government agency. Governments will find it difficult in some circumstances to adopt a ‘hands-off’ approach in order to allow the broker organisation to both establish credibility as an independent mediator and successfully pursue productive interactions across the different areas of government that impact on regional economic performance.

A Victorian Commitment

Section Two discussed the range of broking activities undertaken in the countries covered. A more recent initiative offers a final example of this policy approach in action. In mid-2006, the Victorian state government announced, in its 2006-07 budget statement, that it would fund a ‘Design Package’, as part of its continuing state economic development strategy. In committing to the package the government quoted conservative data to show that the design sector, broadly conceived, contributes about \$6.8 billion annually to Gross State Product and provides some 67,000 jobs in the state.

The funding commitment is \$14.9 million over 4 years and is to be delivered through 4 programs:

1. *Design Ready* – increasing the number and proportion of Victorian businesses that are capable of using design to increase their competitiveness and export-readiness. This program aims to facilitate:

- ‘*Business immersions*’ – strategic linkages between businesses and design practitioners, with mentoring and facilitation included (cf. NovaUCD [chapter 10] and Scottish Enterprises [chapter 8])
- *Seminars and workshops* – dissemination of knowledge gleaned from international developments (such as those discussed in *Section Two*) and in case studies developed through the Business Immersions program

2. Business Ready – increasing the competitiveness of Victorian design consultancies and design teams working within businesses through seminars and workshops pitched at identifying benchmarks for strong design performance tied to boosting the export of design services and design-intensive products.

3. Design Knowledge – building awareness as to how Victorian design-based businesses are and could be generating ‘triple bottom line’ (TBL) benefits through:

- *Tracking and disseminating data* on how Victorian businesses have improved TBL performance over time and assessing to what extent design has contributed to these outcomes
- *Mining the immersive case studies and developing ‘How-to-Kits’* to assist new businesses, especially SMEs and start-ups add value through design initiatives
- *Creation and updating of an extensive website* offering onsite information (showcasing), links and resources, and access to the case studies, kits and key upcoming events

4. State of Design – promoting Victoria’s national and international reputation as a centre of design excellence and leadership through:

- *The Premier’s Design Awards*, held biennially, aimed at recognising and celebrating design excellence across all design areas
- *State of Design Events Program* – a series of seminars, exhibitions, competitions and other events held around the Premier’s Design Awards to promote Victoria’s design community and achievements and aid in the international branding of Victorian design-intensive exports of products and services

Clearly, *lab.3000* is strategically placed to contribute to each of the four program areas noted above. Indeed, it is already doing so. Thus, *lab.3000* assisted in delivering the State of Design 2006 program (see chapter 11). In doing so, *lab.3000* is reinforcing its primary role as an information and strategic broker (like Scottish Enterprise, the UK Design Council, Creative London and Commission for Architecture and the Built Environment), rather than moving strongly towards the active brokering end of the spectrum, as are organisations like NovaUCD, The Digital Hub and Zernike.

Concluding Comment

The analysis presented in this monograph has focused on some of the intermediaries in the innovation process, although the alternative economic paradigm outlined is more generally applicable. The organisations covered all relate in one way or another to the potency of Design as an economic driver – and reflect the view among their governments that “Design matters”. Design, in this view, figures as both input to and output of the innovation-productivity cycle. As an input, design skills and perspectives condition the creative process and characterise occupational areas as diverse as fashion and aerospace. As an output, Design is central to the branding and ‘production/perception of quality’ of the product.

A Final Thought

“The age is running mad after innovation” (Boswell’s Life of Johnson, vol. 4)

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Professor Mike Berry a Senior Research Associate of *lab.3000* and author of both lab report 01 and 02, builds a wider picture of the extent and locations of evolving design clusters in Melbourne; the factors influencing cluster growth; and whether functioning networks can be forged from the linkages between industry, education and government. Berry uncovers the strengths and limitations that distinguish digital design in Victoria and ways in which designers, industry leaders, educators and government can contribute to its growth. He also assesses whether conditions stimulating innovation overseas can be translated to the Victorian economy centred on Melbourne.

