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Strengthening Global-Local Connectivity in Regional Innovation Strategies

IMPLICATIONS FOR REGIONAL INNOVATION
POLICY

Paul Benneworth, Adrie Dassen

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ABSTRACT

With innovation increasingly important to economic development, innovation policy is attracting attention from politicians and policy-makers at all levels. Regional policy-makers face a distinctive challenge in that innovation takes place in international networks reaching far beyond their region's boundaries. What regional policy-makers can achieve is therefore constrained by the kind of firms and innovation networks already in their regions. This paper creates a framework for analysing regional innovation policy sensitive to this global dimension. Drawing on a global-local network analysis, the paper develops a regional classification for global-local innovation connectivity. The paper then analyses a set of common innovation policy measures, identifying how these policies can be optimised across these regional classes. The paper then highlights typical policy strengths and weaknesses for each of these various classes of regional global orientation. It argues that regional innovation strategies should pay more attention to their regions' global orientation if they are to become an effective tool across OECD members for improving innovation performance and economic growth rates.

L'innovation étant de plus en plus importante pour le développement économique, les politiques en matière d'innovation attirent l'attention des politiciens et décideurs politiques de tous niveaux. Les responsables régionaux se trouvent face à un défi particulier puisque l'innovation est le fruit de réseaux qui s'étendent largement au-delà des limites de leurs régions. Ce que les décideurs politiques peuvent réaliser dépend donc des types d'entreprises et de réseaux d'innovation déjà présents dans leurs régions. Ce document crée un cadre pour l'analyse des politiques d'innovation sensibles à cette dimension globale. En s'appuyant sur une analyse des réseaux au niveau mondial et local, il développe une classification régionale pour la connectivité entre les niveaux mondial et local en matière d'innovation. Le document analyse ensuite un ensemble de mesures communes des politiques d'innovation et identifie comment ces politiques peuvent être optimisées à travers ces catégories régionales. Enfin, le document souligne les forces et les faiblesses des politiques, typiques pour chacune des différentes catégories d'orientation régionale ou mondiale. Il soutient que les stratégies d'innovation régionales devraient davantage prendre en compte l'orientation mondiale de leurs régions si elles veulent devenir un outil efficace au sein des pays membres de l'OCDE pour améliorer la performance en matière d'innovation et les taux de croissance économique.

JEL classification: D2, H7, L2, O23; O31, O32, R3, R5

Keywords: Regional Development; Innovation Policy; Networks; Regional Innovation Strategies; Firms; Universities; Regional Competitiveness; Economic Development

FOREWORD

This working paper is one in a series of *OECD Regional Development Working Papers* of the OECD Public Governance and Territorial Development Directorate.

This report has been produced by Paul Benneworth and Adrie Dassen of the University of Twente, Center for Higher Education Policy Studies. Andrew Davies, Karen Maguire and Claire Nauwelaers of the OECD Secretariat provided comments to earlier versions of this paper.

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ACRONYMS

CIS	Corporate innovation system
GERD	Gross domestic expenditures on research and development
GPN	Global production network
HERD	Higher education research and development expenditures
IP	Intellectual property
IRE	Innovating Regions in Europe
MNC	Multinational corporation
NIS	National innovation system
OEM	Original equipment manufacturer
PRO	Public research organisation
R&D	Research and development
RIS	Regional innovation system
RTD/ RTDI	Research, technology and development; Research, technological development and innovation
SIS	Sectoral innovation system
SME	Small and medium-sized enterprises
TIMP	Twente Initiative for Medical Products
TNC	Transnational corporation

Introduction

OECD work on regional innovation is concerned with better understanding the nature of the regional innovation process, and developing more effective, targeted strategies for regional innovation which in turn contribute to national competitiveness and productivity growth. The acknowledgement of the importance of the regional dimension to national innovation by the OECD is timely, reflecting an increasing appreciation of the importance of the regional scale to the knowledge economy. In the knowledge economy, it is the accumulation of knowledge capital, as much as other capitals which drives productivity growth, and hence economic well-being. Knowledge capital is embedded in people and develops through personalised and interactive learning processes.

An earlier rhetoric that new communications technologies would lead to the ‘death of geography’ (e.g. Cairncross, 1997), there is now a more nuanced understanding of the geographical patterning of knowledge capital accumulation. Research has shown (e.g. Temple *et al.*, 1998) that knowledge capital has increasing returns to scale, which means that all other things being equal, people will cluster in increasingly competitive urban centres. The other regional dimension is that because learning and knowledge capital accumulation is embodied in people, it is to some extent constrained by the personal geographies of employment of key knowledge workers. These personal geographies shape the way knowledge workers mutually interact, and define a kind of common-sense ‘local’ scale at which there are repeated and regular interactions. These dual pressures are driving the increased importance of the regional scale to innovation-based economic growth.

Yet, an excessive emphasis on the ‘regional’ scale ignores the continuing importance of the national and international scales for influencing what can be achieved, and the importance of regional capacity for absorbing knowledge and deploying it effectively in novel innovations (Mahroum *et al.*, 2008). As Asheim and Isaksen (2002) note, it is this capacity of regions to make use of more globalised knowledge which increasingly determines competitiveness, and the “stickiness of some forms of knowledge is seen as one of the few remaining genuinely localised phenomena in the current global economy” (p. 3). It is important also to retain the focus on businesses as a key driver for innovation, and the fact that corporate innovation is increasingly organised and co-ordinated through complex multinational networks (Coe *et al.*, 2004). The region is therefore a meeting point for local businesses and these global innovation networks, as “co-located trans-national and small and medium-sized firms exist in a corporate relationship that enables the SMEs to introduce innovations and reach global markets” (Christopherson & Clark, 2007, p. 1224).

A number of concepts have emerged to understand the way that regions connect with these wider global networks, such as ‘strategic coupling’, ‘global pipelines, local buzz’, and ‘absorptive capacity, development capacity’. Despite a widespread agreement on the importance of better understanding this global dimension, alongside an oft-repeated call for attention to be paid in developing innovation policies, these concepts have at best been weakly operationalised into concrete regional policy lessons.

This working paper seeks to look more closely at the global dimensions of regional innovation strategies, and in particular, how building better global connections can improve local performance in regional innovation. The starting point for the paper is that the ‘region’ to the policy-maker is a place where the regional innovation system (RIS) meets the sectoral innovation system (SIS), and therefore policy-makers seek to influence elements in both these areas within the limits of their policy competence, but not restricting themselves strictly to narrow regional activities. Our argument is that regional innovation policy can be improved by improving the interface between regional and sectoral innovation systems, which we conceptualise as ‘hinges’

between local and global actors. The most appropriate interventions depend on the nature of this hinge between global actors, and we develop a typology of hinges, based in how they connect regional actors to the global system, as well as the existing density of connections between actors on the regional scale.

We then model a set of ideal-type regional innovation systems depending on the number of their hinges, the density and the centralisation of their RISs. From this, we distinguish four separate orientations towards global-local connectivity within RISs, and highlight *i*) connecting globally, *ii*) deepening pipelines, *iii*) cluster-building and *iv*) sustaining momentum as four distinct approaches to improving global-local connectivity. These various policy orientations mean that a single policy intervention can produce very distinct effects and solve different kinds of problems, depending on the characteristics of the region. With science parks, for example, science parks can be a means of both directly building local networks to indirectly improve external profiling, or as a means of attracting high-profile investment in research and development, creating regional innovation poles. The report then sets out an overview of the four global-local policy orientations.

The idea of a policy orientation gives some focus and characterisation to the notion of improving global-local connectivity. Drawing on the artificiality of the distinction between regional and global interventions from regional policy actors, we argue that there are no special kinds of intervention which correspond to building global-local connectivity. Rather, the key issue for policy-makers is to ensure that the interventions that they make locally do help to improve the connectivity of global actors to the region, and improve relative positioning within wider sectoral innovation systems. Within that, they need to be mindful both of the wider sets of multi-level relationships within which they are embedded, and identify the correct policy orientations to maximise both wider connectivity to optimise their local spill-overs and knowledge capital accumulation.

1. Local innovation in global networks

More countries and regions are taking an interest in systemic approaches to innovation policy and strategies (OECD, 2007). This is true at the regional scale, but the key issue for regions is that many of the determinants of their regional capacity are external to the region: funding decisions made by science councils, investment decisions by large firms, purchasing decisions made by Original Equipment Manufacturers (OEMs) all shape the environment within which regions innovate. But, as Gertler & Wolfe (2006) observe,

“Non-local (inter-regional and international) relationships are crucial sources of vitality, complementing the local buzz that has come to be regarded as the hallmark characteristic of the cluster”.

How can regions develop innovation strategies which meaningfully come to terms with these external drivers? The answer lies in building connections and coupling capacity between regions and external partners, to improve global-local connectivity. This section sets out an underpinning rationale for this approach, looking at how regional innovation strategies can help regions couple themselves to global innovation networks, to optimise their position within those networks and maximise the benefits to the region of that economic activity.

The rise of the regional innovation system & policy

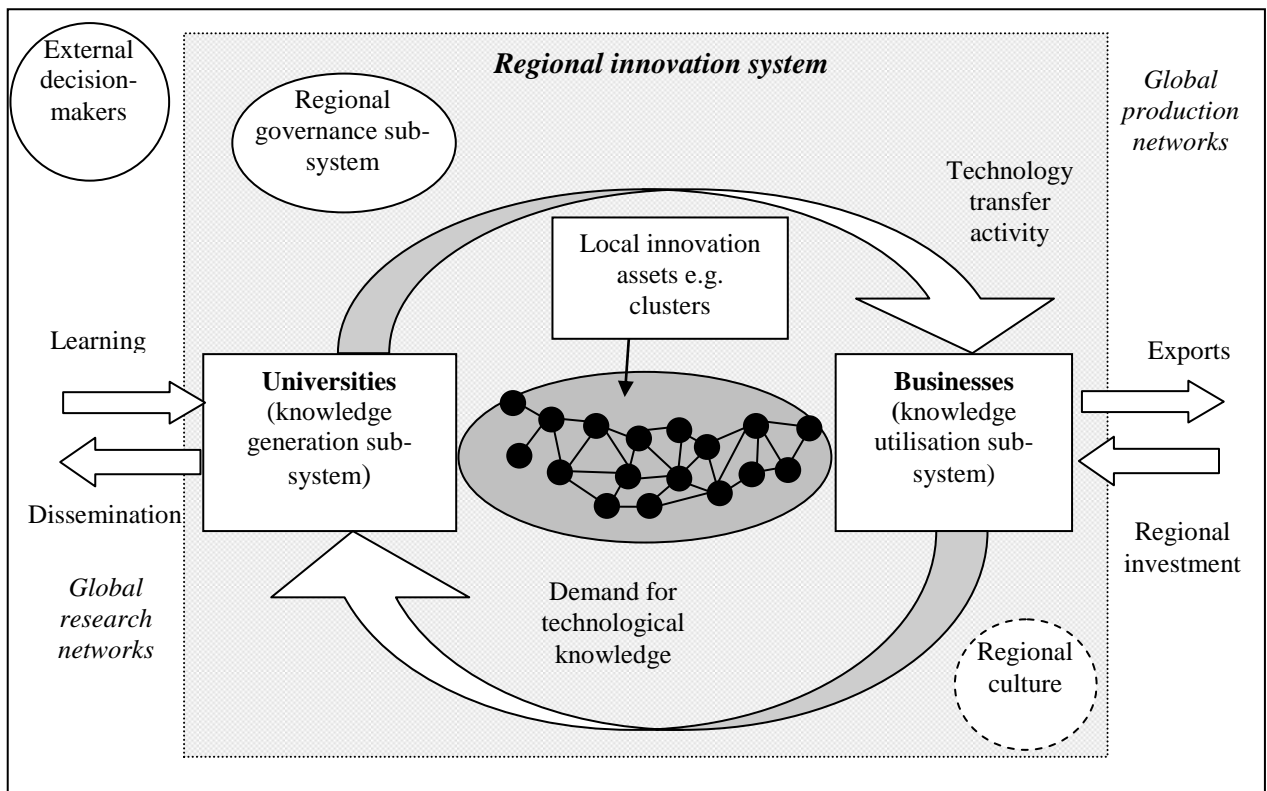
There is widespread recognition and acknowledgement of the increasing importance of innovation for economic growth and competitiveness. Innovation in its broadest sense involves creating new ideas, and diffusing them into economies, driving changes which improve welfare and create economic growth (NESTA, 2006). Gibbons *et al.* (1994) highlighted that innovation is also increasingly dependent on inter-personal relationships as ideas are developed within

networks seeking solutions to particular problems. As a consequence of this, innovation can be regarded as ‘systemic’ (Lundvall, 1998): where innovation takes place, these relationships shape informal cultures and formal institutions to create more conducive environments for particular kinds of innovation. There is also a territorial dimension to innovation because innovation relationships depend on proximity for interaction, and geographical proximity can allow actors to interact more easily (Braczyk *et al.*, 2003; Boschma, 2005).

These two consequences have been brought together in the notion of a regional innovation system, most clearly articulated by Cooke (2005). In this concept, depicted in Figure 1 below, a distinction is made between knowledge producers (universities and research laboratories) and knowledge exploiters (clusters and innovative businesses). These two groups interact in seeking to create and exploit new knowledge, and are supported on the one hand indirectly by regional culture, and on the other hand directly by policy interventions supporting innovation.

The critical point about a regional innovation system is that unlike national innovation systems, they can rarely be regarded as closed systems because so much of the institutional and cultural environments are at least partly determined. Knowledge producers and exploiters also participate in their external networks, and the value to them of regional co-operation is in providing a means to secure a unique knowledge advantage that is not as easily secured elsewhere (*cf.* Markusen, 1987). Regional innovation systems can better be regarded as nodes or clusters within national innovation systems than as free-standing systems in their own right.

Figure 1. A stylised version of global-local connections in regional innovation systems

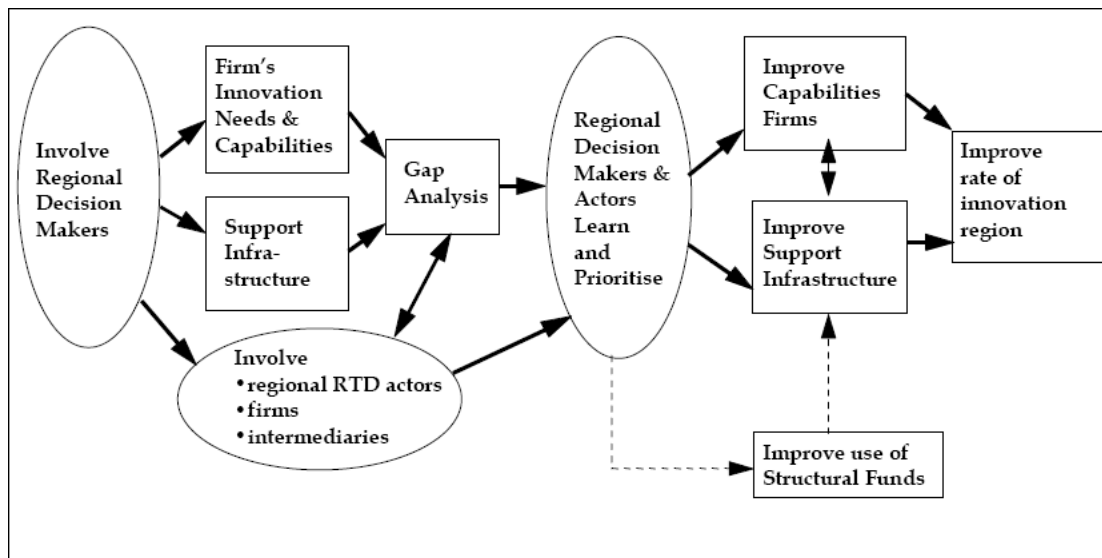


Source: Authors' own design after Cooke, P (2005), "Regionally Asymmetric Knowledge Capabilities and Open Innovation: Exploring 'Globalisation 2' – A New Model of Industry Organisation", *Research Policy*, 34, pp. 1128-1149.

There has been a parallel increasing policy interest in the potential to use systemic approaches to innovation to develop better innovation policies (OECD, 1997). At the regional level, the European Commission has been at the vanguard of developing new policies for regional innovation (Landabaso, 1999; Bellini & Landabaso, 2007). There have been a number of synthetic reviews of regional innovation policies, including Charles *et al.* (2000) and the *Best Practise Guides* produced by the Network of Innovating Regions in Europe (IRE, 1999; 2005; 2006; 2007; 2008). From these various systemic reviews, an ‘ideal type’ regional strategy process has emerged.

The hallmark of this ideal-type process has been a strategic, programmatic approach, identifying and assembling an innovation coalition of actors within the RIS who drive that process through a series of stages from the decision to create a regional strategy (namely assembling an evidence base, designing a programme, establishing pilot project priorities and mainstreaming innovation policy). Knowledge producers, intermediaries, exploiters and public government actors develop together a strategy for improving regional innovation (Boekholt *et al.*, 1998). In working together, partners learn not only about solving innovation policy problems, but also how to work together more effectively and build up future innovation capacity. A stylised model of this process is shown in Figure 2 below.

Figure 2. The role of a strategy process in mobilising a regional innovation coalition



Source: Boekholt, P., E. Arnold, & L. Tsipouri (1998), “The Evaluation of the Pre-pilot Actions under Article 10: Innovative Measures regarding Regional Technology Plans”, report to the European Commission, accessed through CORDIS database, available at: www.innovating-regions.org/download/RTPreport.pdf.

Figure 1 above makes a point upon which there is broad academic agreement, namely that even in ideal type regional innovation systems, what Asheim & Isaksen (2002) call regionally networked RISs, part of what those RISs can achieve, and the competitiveness of their constituent firms, depends on the connections of those actors to elsewhere. On the one hand, it depends on the capacity of smaller firms to compete in global markets, and larger firms to compete against other locations, to generate sales and bring renewed investment into the region. On the other hand, it depends on the capacity of the knowledge generation sub-system to retain its strong position within a set of broader global technological networks, and to ensure a steady stream of talented individuals and knowledge assets into the region to sustain its competitive position.

The increasing recognition of (global) sectoral innovation systems

Alongside an increasing interest in regional innovation, there has also been a parallel set of literatures which have considered the global dynamics of innovation, and feature at best peripherally within these RIS representations. “Supply chain management is the vehicle of knowledge spill-overs in [the aerospace] industry. This chain is basically international” (Niosi & Zhegu, 2005, p. 12). Although large firms which increasingly act as co-ordinators and managers of global innovation networks do have regional profiles, the extensiveness of those innovation networks means that regional influences play a very limited role on the innovation network logics. Yet, clearly, these sectoral innovation systems are salient for regional innovation – the question is how responsive can they be to the instruments and measures that regional policy-makers may have at their disposal?

Niosi & Zhegu (2005) note that the main mechanism underpinning the increasing globalisation of innovation networks does have local consequences because “large OEMs create some economies of specialisation and more often labour market economies” (p. 26). Chen *et al.* (2008) highlight the “role of MNCs as facilitators of knowledge and technology for production and the potential spill-overs to local or indigenous firms” (p. 3). But these are emergent outcomes, that is to say that even where firms pursue similar strategies, the results of those strategies can differ depending on their competitive context. Bartlett and Ghoshal (1989) distinguish between four types of multinational company, differentiating between different corporate approaches to managing relationships between multiple corporate locations:

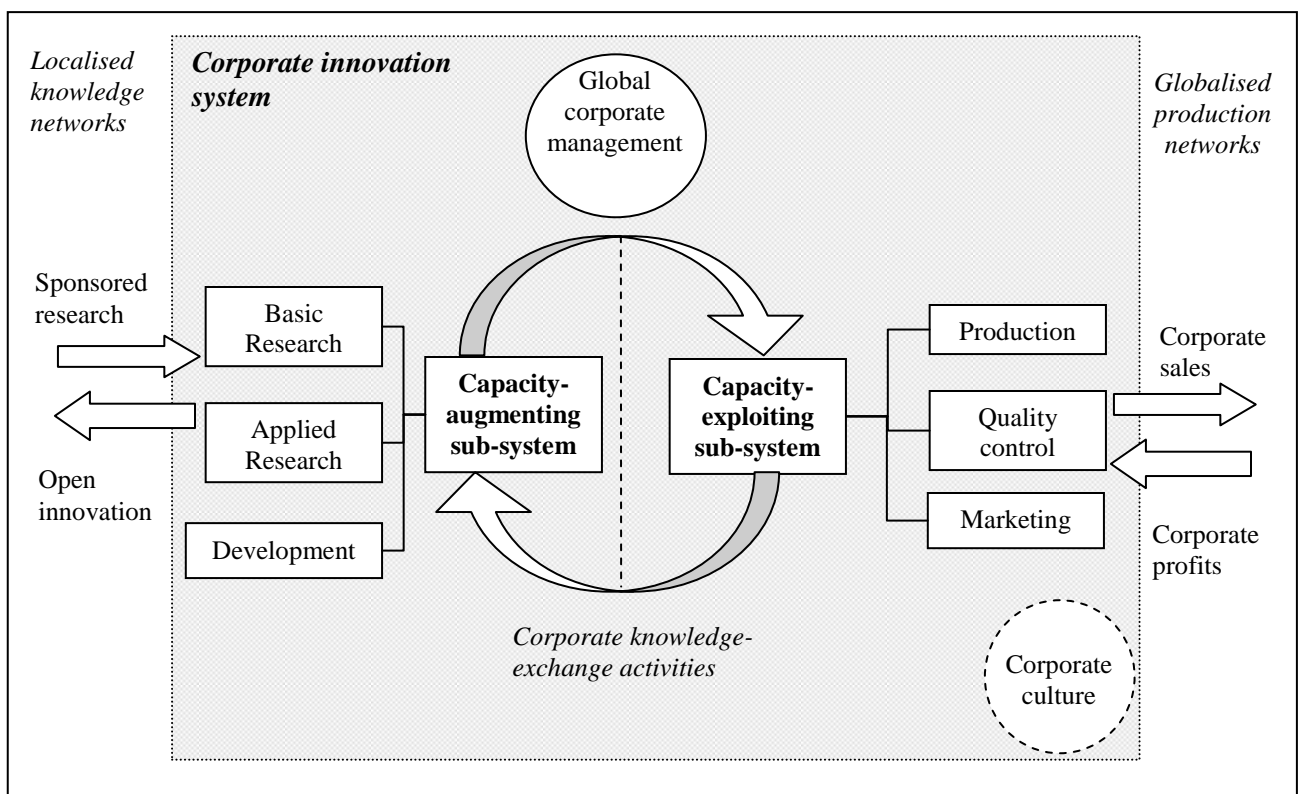
- multinational companies which have similar activities in different countries (selling highly differentiated products to national markets);
- global companies which have a very strict corporate division of labour (selling common products in many markets);
- international companies which have local specialisations (related to but not dictated by local market specialisation); and
- globally-linked companies with diffused centres of expertise which have limited local connections but an internal division of labour geared toward programs of corporate significance.

Mattes (2006) argues that an alternative way of understanding the corporate division of labour, and in particular, its permeability to regional/ local influences, is in understanding that there is also a split within corporate innovation. “The combination of such diverse knowledge across firms or within a single company is by no means trivial” (Mattes, 2006, p. 3). Storper (1995) opens up the idea of a Corporate Innovation System (CIS), “inter-regional and international networks for technology development are systems which exchange the specialised knowledge that is valued in each of the nations and regions in which they are active (between different parts of the firm)” (Storper, 1995, p. 897).

Mattes cites Kuemmerle in making a distinction between capacity-augmenting subsidiaries, that integrate global knowledge flows, and capacity-exploiting subsidiaries, that exploit existing regional knowledge. This is in a sense a complementary model to that of the regional innovation system, between the knowledge exploiting and the knowledge production sub-systems. Mattes’ contribution comes in arguing that there are different ‘arenas’ within a corporate innovation system, and that the position of different arenas within the corporate knowledge production system affects their capacity to interact with regional environments.

Mattes distinguishes six such arenas: *i*) basic research, *ii*) applied research, *iii*) development, *iv*) production, *v*) quality control and *vi*) marketing. The received wisdom is that the further one proceeds from basic research, and the closer to marketing, the less the requirement for capacity augmenting and the greater the requirement for capacity-exploiting activities. Her own example demonstrates how –a medical devices company draws upon a global network of key customers to shape a new device specification prior to the specification being passed to the R&D team. The global orientation of the various arenas affects the capacity that regional partners have to interact with them, and also hence the capacity of regional policy to influence their innovation outcomes. This is represented in Figure 3 below, a stylised model of one corporate innovation system in which the basic and applied research as well as development arenas of the CIS are open to localised knowledge networks, while the capacity-exploiting sub-system is much less open and more concerned with generating sales and profits within the global production network.

Figure 3. A stylised version of global-local orientations in a corporate innovation system



Source: After Mattes (2006), authors' own design from Benneworth, P. & G.-J. Hospers (2007), "The New Economic Geography of Old Industrial Regions: Universities as Global-Local Pipelines", *Environment and Planning C: Government and Policy*, 25(6), pp. 779–802.

Figure 3 above also makes a point upon which there is broad academic agreement, namely that there is clearly some potential for corporate innovation systems to overlap and fit with regional innovation systems. This will primarily take place where the **regional** knowledge exploitation sub-system corresponds effectively with the **corporate** capacity-augmenting sub-system. In the regional knowledge exploitation sub-system, regional and local knowledge capital is created through activities, institutions and practices linking firms and universities. This in turn adds value to the region through firms active in global production networks. In the corporate capacity-augmenting sub-system, the corporate need for exploratory learning comes together with

regionally-specific knowledge to bring ideas into the corporation which are then implemented in profitable new products, services and techniques. “This combination of small firm flexibility and innovative capacity, with large firm access to global markets, theoretically enables regions to escape the dominant logic of convergence and price-based competition” (Christopherson & Clark, 2007, p. 1225).

But the authors also make the clear point that there are no automatic reasons why corporations should permit local networks of firms to benefit from their own global networks. Christopherson & Clark (2007) argue that it is in fact remarkably difficult for SMEs to benefit from their participation in local networks anchored around what Markusen has popularised as the ‘lead firm’.

Taking the admittedly rather aggressive environment of Rochester, NY (USA), they observed that transnational corporations (TNCs) were in reality able to configure local networks so that they maximised their benefits from them, whilst peripheralising local SMEs and marginalising the benefits that they received. Gray *et al.* (1996) noted this problem in their observation of the impact of several hub firms on the Seattle/ North West Pacific region. Gray *et al.* were at best able to recommend a principle for policy under such circumstances, namely to ensure that lead firms acted as hubs to SME networks and did not exclusively appropriate the benefits of policy intervention, without really being able to say in practice the kinds of intervention this might encourage.

Foley & Watts (1996) were sceptical about the potential for incremental innovation in branch-plants (drawing on proprietary, synthetic knowledge) to interact substantively with knowledge producers more involved in the production of ubiquitous, analytic knowledge. As Radosevic (2002) argues in the case of central and eastern European countries with relatively weak local innovation networks, the “innovation linkages between different regional firms or groups of firms may be much stronger with other national or foreign firms than with local firms” (p. 6). Gray *et al.* (1996) generalise this point arguing that for regions with dominant large firms, “the hubs are likely to be embedded in far-flung relationships of exchange (and in some areas, co-operation) with branch-plants, suppliers, customers and competitors outside of the region as well as locally” (p. 654).

The limiting perspective of the RIS approach

There is an growing consensus that it is increasingly important to situate understandings of regional innovation systems in these wider corporate innovation networks which generate wealth. In short, it is critical to better understand **the global dimensions and contexts of regional innovation systems**. Doloreux and Parto (2005) note that “successful RISs make use of endogenously generated and exogenously available knowledge to strengthen competencies and maintain competitiveness” (p. 14). Considering clusters, Wolfe *et al.* (2005) argue that “[a] key challenge involves the local versus global dimension of cluster development. Clusters are viewed primarily as local phenomena ... however, there is increasing evidence ... that the external linkages drive the internal dynamics of clusters (Wolfe *et al.*, p. 3). Oinas & Malecki (2002) argue that “it seems increasingly clear that the connections of regional actors to extra regional actors stand as momentous in technological progression” (p. 117).

There is certainly an increasing dissatisfaction amongst academics of the problems which come from taking an excessively regional focus to these activities. Uyarra (2009) criticises these regionally-fixed perspectives for assuming “that the sources of regional development are not only endogenous, but also indigenous” (p. 12). This leads to an excessively restrictive understanding

of the nature of the regional innovation process. As Oinas & Malecki (2002) note, “Innovation systems may originate in one place ... but often they are spread beyond local, regional and even national borders” (p. 113). Gertler & Wolfe (2006) argue that neglecting external actors is a consequence of an excessive reliance on a Porterian (1990) perspective on competitiveness, rooted in strong local markets and vigorous competition between local producers, which is unhelpful for understanding innovation systems which are “not locally self-sufficient in terms of knowledge” (p. 220). What is striking concerning these various authors is that although they exhort more emphasis on global-local relations, what there is not is an effective explanation of how global-local connection building can improve the quality of regional innovation.

The obverse of this issue is the fact that the ‘global’ is greatly simplified in these dimensions, and reduced to knowledge located outside the region, seemingly ubiquitously available, when the reality is, as the previous section shows, that it has its own geography. Critically, the geography of ‘external’ knowledge production for a region is tied up with the sectoral innovation networks which are salient to that region. The position that regional actors have within these regional production networks influence the access that regional actors have to external knowledge sources: in aerospace, for example, first tier contractors are far more powerful, as systems integrators, than component and fittings suppliers. SMEs in regions with aerospace OEMs often find it easier for their innovative products to become more integrated in these supply chains than SMEs elsewhere. Understanding the position of a region therefore requires understanding the relative position of the region within its wider networks, and the capacities and opportunities that its firms, universities, laboratories and business service organisations have to access external knowledge.

Alongside that, there has been a set of practical problems in that accepted approaches to regional innovation have tended to exclude this external dimension. This is in part a consequence of the fact that the natural space for regional innovation policy tends towards territorial (regional) boundaries. This is a consequence of the fact that it is often territorially bounded regional partners who have the responsibility and the interest for promoting innovation policy. This has one potentially unwelcome side effect that what takes place outside the region is regarded as being ‘global’, and consequently a simple dichotomy is drawn between local and external, which does not adequately reflect the types of external connections which may influence economic trajectories. As Yeung (2006) notes “Regional authorities and government agencies should not be paying excessive attention to building regional capability without carefully assessing and understanding the kinds of GPNs with which the region can have a good chance of strategic capacity” (p. 31).

This has indeed been a problem for developing effective regional innovation strategies. “Rather than conceiving of the regional innovation system as an open holistic system, it was seen as closed and narrow in scope. The consequences have been initiatives which have struggled to achieve success” (IRE, 2007, p. 44). The key focus of regional innovation policy is in improving global innovation outcomes within firms which then translate into improved territorial economic growth. “In this kind of region, it may be relevant to ‘open up’ strong regional networks, and to find local mobilisation in order to move local communities away from obsolete attitudes and knowledge and to foster access to resources outside the region” (IRE, 2007, p. 14).

It is therefore necessary to understand the arrangement, and the territorial arrangement of the firm-based innovation process, to understand the opportunities which regional and national policy-makers have to improve the innovation performance of firms increasingly embedded in these complex networks. At the same time, it is important not to overplay the territorial fixity of policy-makers. The ‘ideal type’ model for the regional strategy process developed by the

Commission included involvement of outside experts as a means of ensuring that the strategy was not purely inward looking (IRE, 2007). Likewise, there is a strong implicit external dimension to activities such as cluster-building and technology centres, helping innovation firms to access knowledge from outside the region.

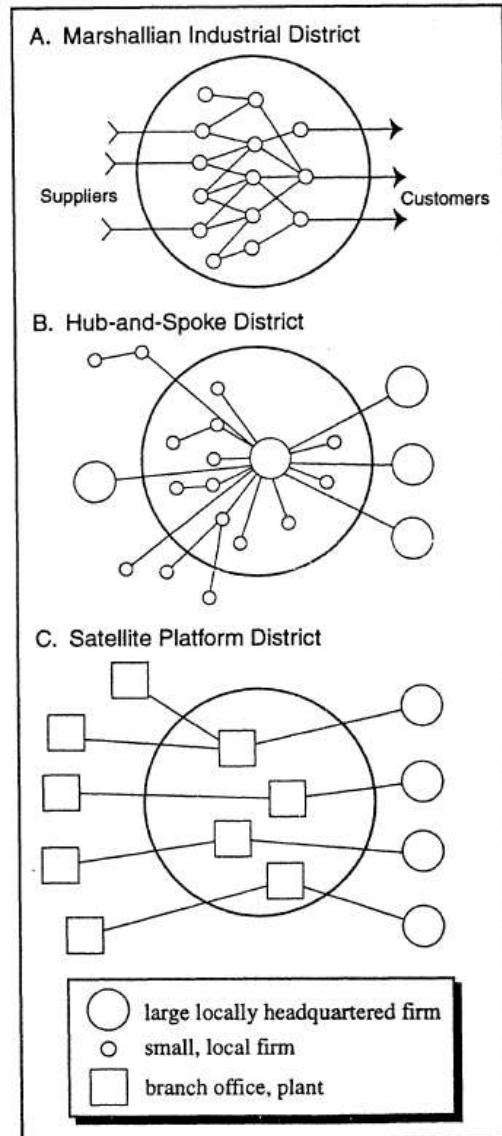
To understand this problem, a precondition for developing conceptual and practical solutions, it is first necessary to return to the idea of a regional innovation system. To simplify this global-local dimension, we propose three conditions which must be fulfilled to come up with regional innovation strategies that deal adequately with the global-regional issue:

- Regional strategies **highlight external connections**: “The key for regions and their policy is to find the local and regional networks that link to global networks and enhance their learning capacity, innovativeness, and competitiveness” (Lim, 2006, p. 19).
- Regional strategies **highlight internal connectivity**: “The capabilities that enable local firms to engage with global value chains and networks on terms that are as favourable as possible” (Cooke & Memmedovic, 2003, p. 12).
- Regional strategies **reflect local contexts**: “This creates tension between the global/national and local/ regional out of which different forms of RIS can emerge” (Nuur *et al.*, 2009, p. 125).
- Regional strategies **achieve wider recognition and legitimacy**: “The participation in national and European networks and associations may also be an effective strategy for regions to create their visibility in the European multi-level governance system” (IRE, 2007, p. 14).

Tensions in regional-global connections

There are a number of authors who attempt to make sense of the importance of external connections for systems whose capacity to generate innovation is seen as being dependent on primarily local knowledge circulation connections. Markusen (1996) first offered a typology for understanding regions on the basis of not only the kinds of firms they possessed in terms of technological cycles, but also the relationships of those firms to external actors. Her analysis of global-local connections is reproduced in Figure 4.

Figure 4. Firm size, connections and local versus non-local embeddedness



Source: Markusen, A. (1996), "Sticky Places in Slippery Space: A Typology of Industrial Districts", *Economic Geography*, 72, pp. 293–313.

Arguably, the most widely known is Bathelt *et al.*'s (2004) metaphor of global pipelines and local buzz, which describes a global knowledge economy in which lead firms are connected in long-term innovation projects, and through these lead firms connections with SME connections, they can create a local buzz. Oinas & Malecki (2002) argue for the importance of "local and distant connectors", individuals with strong interpersonal networks, and firms with supply chain and project-based networks, which help regional actors to maximise their benefits from participating in these wider "spatial innovation systems".

A number of actors note that in such circumstances, regions are negotiating between a set of tensions. Heidenreich (2004) stresses the tensions between pressures for localisation and interaction locally, which generates local benefits, and globalisation and external focus, which

helps particular firms to secure their profitability. Niosi & Zeghu (2005) see this as a tension between centripetal and centrifugal forces, between pressures to maximise innovation outcomes by clustering and to maximise production profits by locating manufacturing to least-cost locations. Wolfe (2009) sees the tension as between collective (association) interests and the private interests of individual firms, with an added factor being that increasing firm size correlates both with increasing access to global networks, and a decreasing reliance on locally-produced, collective knowledge assets.

At the same time, there have been very strong pressures for particular groups of actors to ignore these tensions, which have been reflected both in the literature, as well as the identified attempts to begin to move beyond those problems:

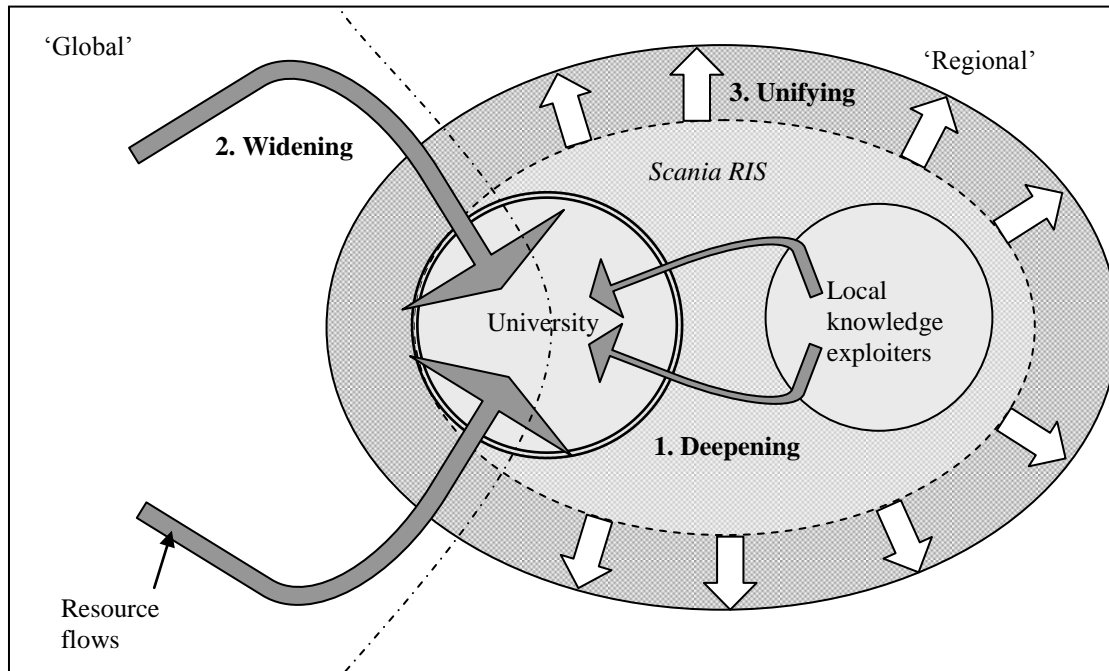
- A number of writers have pointed to the fact that much of the development of RIS concepts have been driven by regional actors, whose interests lie primarily in their own territory and what they can reasonably expect to influence, which is precisely those local dimensions (*inter alia* IRE, 2008).
- There has been a tendency to focus on supply and value chains within sectors, and not to consider knowledge transfer and stimulation between sectors within a region (*cf.* Bathelt, 2001)
- At the same time, these local-global connections are extremely difficult to grasp, forcing assumptions that co-operation and networking operates relatively smoothly, for example that hub firms do indeed help local SME networks to access global resources (Koschatzky, 2009).
- Describing a system as multi-scalar automatically creates a hierarchy between higher and lower scales, and in the context of studies looking at regions, dwelling on external factors can dis-empower those regional situations, which is unhelpful for those interested in the regional scale (the so-called Scalar envelope, Cooke, 2005).

This working paper begins from Oinas & Malecki's (2002) observation that it is **local and distant connectors** which are critical in understanding regional trajectories. These connectors influence both the way in which external pressures impact on the region, as well as to help to define the economic roles which firms within the region can play within global knowledge production networks and value chains. Oinas and Malecki argue that what these connectors do is to build purposive proximity between local and external actors i.e. proximity that facilitates the exchange of knowledge, and helps local actors to better access the necessary resources for innovation. Drawing on a typology of proximity later authoritatively published by Boschma (2005), they argue that within-region innovation systems rely on geographical proximity, whilst organisational, relations, institutional and strategic proximity can also facilitate building connections between local and external knowledge actors, which contribute to the emergence of epistemic communities, communities of practice and networks of practice (Haas 1992; Wenger, 1998; Benner, 2003).

Drawing on Benneworth *et al.* (2009), it can be argued that what Oinas and Malecki refer to as 'local-distant connectors' effectively play three strategic coupling roles in a RIS, in their case looking in particular at the role of Lund University on the development of the regional innovation system of Scania, in Southern Sweden. Firstly, they can help bind the networks within which they participate more tightly together, and help with the knowledge-transfer and knowledge-circulation activities locally. Secondly, they can 'widen the global pipelines', increasing the flow

of external knowledge into the region. Thirdly, they can help to stimulate a ‘local buzz’ effect, involving more actors in innovation, helping through complementary variety as well as supply chain management, and spreading the benefits of the innovation process throughout the region. This is depicted in Figure 5 below, which highlights the three processes by which these global-local hinges contribute to the regional innovation system.

Figure 5. The multiple impacts of university engagement on restructuring and strengthening the Scania RIS



Source: Benneworth, P., L. Coenen, J. Moodyson & B. Asheim (2009), “Exploring the Multiple Roles of Lund University in Strengthening the Scania Regional Innovation System: Towards Institutional Learning?”, *European Planning Studies*, 17(11), pp 1645 – 1664.

Christopherson & Clark (2007) note that this issue of ‘fit’ between these two different sub-systems is by no means guaranteed. Indeed, they observe that in the case where there is not a ‘fit’ between the capacity-augmenting sub-system of the CIS and the knowledge-exploitation sub-system of the RIS, then there can be real problems. The situation they have observed in the North Eastern USA was of powerful companies which lacked a real dependence on the regional knowledge-exploitation sub-system, and they were able to segment the labour market and create monopsonistic contracting systems in which there were very few regional benefits from their presence. It is possible to point to other companies which have failed to be able to adequately benefit from their regional presence and absorb knowledge from the regional network, something which the vogue for ‘open innovation’ (*qv*) suggests is potentially rather widespread.

It is clear that different types of knowledge exploiters provide different kinds of global-local connections, with headquarters of multinationals offering the greatest benefits, globally-connected clusters beneficial, with branch-plants and stand-alone activities the least connecting. But as Boucher *et al.* (2003) indicate, different kinds of knowledge producers also offer different kinds of global connectivity, partly depending on the constellation of local knowledge producers, and partly depending on the kinds of regions within which they are located. They distinguish four kinds of (university) connection roles:

- **Single-player universities in peripheral regions:** helping to build up local networks which can absorb technologies brought into the region from outside;
- **Multiplayer universities in peripheral regions:** mobilising the institutions into a ‘collective’ which can help promote the region to outside investors;
- **Traditional universities in core regions:** transferring knowledge to local businesses through consultancy and the development of new education programmes and tracks; and
- **Newer, technology-oriented universities in core regions:** contributing to the development of an open, internationally-oriented regional culture to facilitate local participation in wider networks.

This situation can have consequences for public policy interventions, and the limits of what can be achieved with existing actors. In situations where there are no local firms able to work with universities, policies need be sensitive to encouraging universities to contribute to the local knowledge economy. The university can incubate and encourage local businesses through spin-out programmes, creating new businesses to exploit university knowledge, as well as through graduate consultancy start-ups, creating businesses who can take responsibility for ‘pushing’ university knowledge into regional businesses. The TOP programme of the University of Twente in the Netherlands was specifically oriented towards creating engineering consultancy businesses to create both high-technology businesses as well as to increase regional demand for technical services. Likewise, for regions weakly served by regional knowledge producers, public policy can try to create new university-type institutions and co-locate those with public research laboratories and innovation centres; the University College of Seinäjoki in Finland was created as a partnership of five universities who together with the local authority created a new university college to serve west Finland.

The role of local-distant connectors in strengthening RISs

In their analysis of the automotive global production network, Coe *et al.* (2004) coined the phrase ‘strategic coupling’ to describe what can bind these elements together. Regions have an offer comprising their assets, and the extent to which they are sought after by global innovators influences the extent to which firms become dependent on that territory – the more unique the asset, and the greater the demand, the more a firm becomes strategically coupled to that territory. Regional institutions seek to transform those regional assets to maximise the strategic coupling, and regional innovation strategies specifically seek to shape regional assets (technology, territory and organisation) to the demands and wishes of global production networks.

Yeung also highlights the importance of understanding the embedding of regional innovation systems in wider networks, notably the connections between global firms and local counterparts. “In either strand of literature [global production networks and new regionalism], insufficient attention has been paid to the inter-connections between these external ‘global’ firms and their ‘local’ counterparts” (Yeung, 2006). He argues that there are three main processes which have – at least in the case of East Asian innovation systems – helped to build a co-dependence, and co-ordination, between corporate and regional innovation systems, what he refers to as the ‘strategic coupling mechanisms’. These are firstly diasporas and global community networks, secondly, the changing nature of global industrial organisation, and thirdly, development State institutions who can reduce unhelpful competition for firms seeking to locate in those places. These assets are certainly very particular to the case of a relatively limited

number of East Asian which begun their main techno-industrialisation processes in the last two decades, and pertain at least in some measure to countries, able to regulate markets.

“Strategic coupling is a time-space contingent convergence of interests and co-operation between two or more groups of actors who otherwise might not act in tandem for a common strategic objective” (Yeung, 2006, p. +14).

“The strategic coupling processes of these actors in different regions and locales constitute the central dynamic of regional development, as they bring together regions and GPNs in a recursive and cumulative process of growth and development” (Yeung, 2006, p. +18).

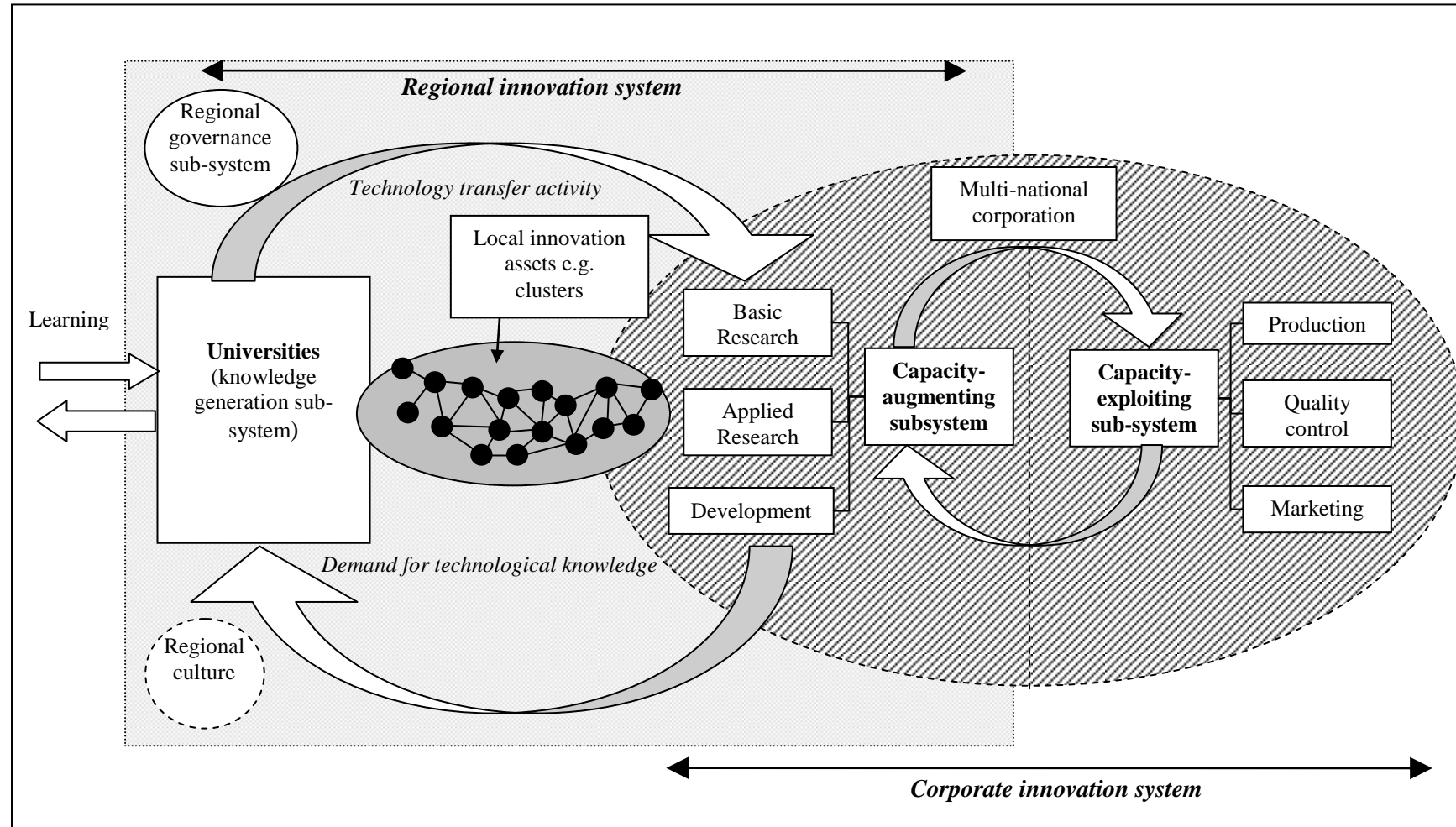
But the idea of strategic coupling at least helps to clarify the challenge for regional innovation policy in an age of innovation within global companies, namely to strategically couple corporate innovation systems to the region in ways that maximise the attendant regional benefits. Moreover, this suggests that the most effective form of maximisation is in building what Mattes calls heterogeneous co-operation (after Heidenreich, 2004) between (more) globalised corporations and (more) localised knowledge producers and suppliers. Mattes (*inter alia*) notes that one effect of strongly globalised corporations with strong innovation activities is that they tend to assemble constellations of suppliers around them in physical locations (*cf.* Markusen, 1994). The question becomes what is the role of regional innovation policy in such places where there are not such strong lead corporations able to build the concentrations of knowledge expertise and activity.

“When a state or region invests in infrastructure which is by definition geographically fixed (airports, roads, ports), it can certainly appropriate considerable benefits therefrom. But the other places to which the locality is not linked may also appropriate benefits, insofar as they both depend on efficient connections which permit specialisation and trade” (Storper, 1995, p. 901).

“The capability of the RIS is to be sought in the ability to deal with the contradictory challenges and dilemmas of regional concentrated innovation processes” (Heidenrich, 2004, p. 368).

This analysis suggests that there are three potential roles for regional innovation policy in stimulating global-regional interfaces, and using global pipelines to better drive regional buzz. The first is improving the co-ordination between the corporate and regional innovation systems, and in particular in ways that increase the dependency of the CIS on the RIS (see Figure 6). An example of this would be support for the development of local corporate competency centres which also fit with and draw their strengths from existing regional clusters. The second is in identifying the global orientations of firms within the region, and seeking to encourage even those capacity-exploiting activities to become more regionally focused. The third is in the attraction of novel activities to the region, changing the types of global production networks which flow through the region and hence altering the possibilities to create spill-over benefits.

Figure 6. The embeddedness of regional innovation systems in corporate innovation systems



Source: Authors' own design.

This model has analogues with Mahroum *et al.* (2008)'s model for conceptualising 'regional absorptive capacity', although with the inclusion of a better defined geographical dimension through expanding 'global knowledge' to sectoral innovation systems. Critical parts of the model are these local-global connectors, the points of contact between the local and the global knowledge production elements. A generic definition of what constitute these 'local and remote connectors' or 'global-local hinges', is offered by Oinas & Malecki:

"The actors ... are centrally individuals (entrepreneurs, managers, employees, individuals in governmental or semi-governmental bodies, researchers, etc.) with their interpersonal networks (face-to-face, virtual, or a combination of these) and firms (multi-locational/multinational) and their networks of various sorts: (advanced) customers, universities, research institutions, support organizations (such as chambers of commerce, knowledge centers, government bodies, and consultants) ... Innovation involving both local and distant relations often center on networks of these actors" (2002, p. 119).

We use four main criteria which emerge for distinguishing what kinds of actor can play this global-local hinge function. The first is that they are involved in multiple networks, regionally and internationally, and these have a visible regional manifestation (Markusen, 1994). The second is to make a distinction between those that can play a role and those that do, taking up Christopherson & Clark's (2007) point that global hub firms can easily play a very negative, corrosive effect on RISs. The third is that these hinges build proximity between local and remote actors, whether organisationally, institutionally, cognitively or socially (Oinas & Malecki, 2002; Boschma, 2005). Fourthly, there must be clear social relationships between local and external actors, mediated between the hinge institution (Wolfe *et al.*, 2005).

It is possible to distinguish a number of types of 'global-local hinges'. These are the organisations that build proximity between local actors and the remote actors in their own networks, that facilitate local actors accessing resources remotely, and hence strengthen the resource base and innovation capacity of locally-innovative firms. These include a number of distinct classes of actors:

- **Large-hub firm:** these are large "firms [which] have needs and loyalties which keep them anchored in the regions ...[whilst] also embedded in relationships external to the region, with customers, competitors and suppliers" (Markusen, 1994, p.483).
- **Related diversity (Jacobs externalities) firm activities:** Gray *et al.* (1996): a region hosts one or more industries each with one or a few dominant hub firms or non-profit institutions ... the hubs are likely to be embedded in far-flung relationships of exchange (and in some cases, co-operation) with branch-plants, suppliers, customers and competitors outside of the region" (p. 622); (*cf.* Storper, 1995; Panne, 2004; Uyarra, 2009).
- **Cluster-firm network-industrial district:** groupings of similar companies connected through local institutions and networks and with strongly-developed international connections connecting the cluster to global value chains (Gertler & Wolfe, 2006).
- **Relay centres:** institutions which encourage firms to behave more extrovertedly "policy in regions [lacking clusters] should therefore focus less on stimulating RISs, and more in linking regional firms to relevant knowledge resources outside their region,

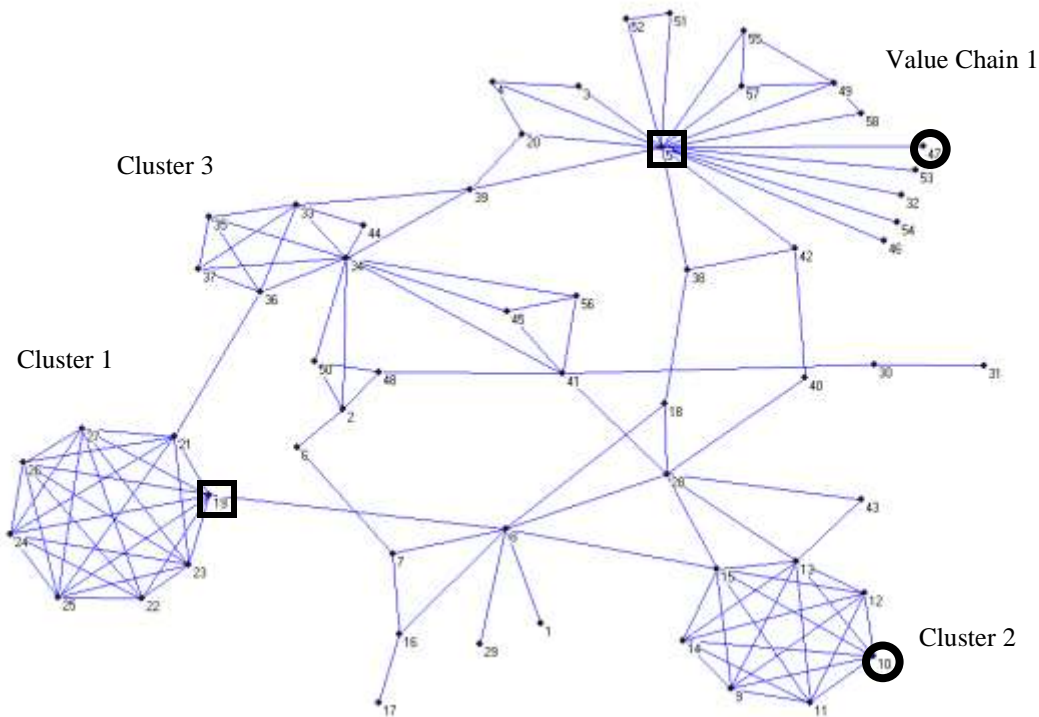
nationally or internationally” (Nuur *et al.*, 2009. Also see Uyarra, 2009 – Coupling effects).

- **Universities & public RTD infrastructure:** “Global research partnerships and knowledge exchanges are commonplace; these complement (rather than substitute for) strongly localised learning dynamics” (Gertler & Wolfe, 2006, p. 227). “If a national university in a particular region is relatively active in knowledge interactions with small local firms, it acts as a new entrant to the local market of public technical services” (Fukugawa, 2008, p. 162).
- **Infrastructure:** where the global connectivity of the infrastructure creates business opportunities which lead to business service clusters, and those business service clusters underpin the commercial viability of the infrastructure e.g. World-port city networks (Jacobs, 2009; see also Storper above).
- **Epistemic communities:** Cooke & Memedovic (2003) argue that sometimes external stimuli are important, and for new ideas to be introduced into a region, there must be some people in the region who already have an understanding of it; their example is of the role of UNIDO in transferring RIS ideas to less developed countries.

The increasing recognition of the importance of global-local connectors as key drivers of economic development has been paralleled by a recognition of the importance of the dynamics of the strategic coupling process. As previously noted, connectivity is critical for innovation by allowing innovators to more easily access knowledge, finance, expertise, market contacts and human capital, as part of efforts to create innovations. Previous regional development paradigms focused on regional networks, but in many cases fell short by failing to explicitly look at the network dimension. In seeking to understand how regional networks can be coupled to global knowledge chains, there is an increasing interest in understanding how individual connections build up between actors, and how this creates a structural capacity which improves the quality of the regional environment for (potentially) innovative actors.

Kallio *et al.* (2010) focus on the role of social capital in facilitating the operation of these networks in supporting regional innovation, and they conclude that general networking theory is of value in understanding how absorptive capacity builds up in those networks. Network theory provides a useful framework in helping to understand how policy can contribute to the building up, strengthening and consolidation of regional innovation networks. The base unit of analysis in a network is the actor – actors have connections which are underpinned by particular relationships – and in the case of an innovation network, a connection between two actors represents a willingness and ability for those two actors to exchange resources in pursuit of innovation. As well as purely financial considerations, in innovation the issue of proximity is also important, not necessarily purely spatial, but also cognitive, organisational, social and institutional as creating a basic framework within which actors can interact (Boschma, 2005). The overall set of relationships between actors therefore defines a network.

Figure 7. A global network of interconnected actors



Source: Dassen, A. (2010), *Networks: Structure and Action: Steering in and Steering by Policy Networks*, Center for Higher Education Policy Studies, University of Twente, Enschede, NL.

Figure 7 is useful for illustrating some of the important considerations for networks as applied to regional innovation policy. In the above network, there are three ‘clusters’ – networks of tightly connected firms – as well as one ‘value chain’. What regional innovation policy seeks to do is to build on existing relationships to create new connections that improve the functioning of the system. In terms of accessing innovation resources, this means reducing the number of connections through which actors have to progress in order to build a relationship with a new actor, and to be able to put their resources towards their own innovation effort. Consider that actor number 10 has resources that could support actor number 47 (both marked with circles).

As the network currently stands, this means building a connection through actors 13, 28, 40, 42 and 5 – making the actors 6 degrees removed. If one considers that a degree of remove is being put into contact with a colleague by an existing acquaintance, for example through a recommendation or both being at a meeting together, then each additional degree makes it correspondingly more time-consuming and harder to access the resources. If actors 13 and 5 were to develop a relationship between them, then this would reduce this network distance to two degrees of remove. So one policy intervention might be to bring actors 5 and 10 into contact with one another, and subsidise something that encourages them to work together – in one stroke, actors in cluster 2 and value chain 1 are much closer to one another, and can much more easily access each others’ innovation resources.

Using network theory, it is possible to calculate for particular interventions their overall effect on the network connectivity, and then to use this to compare particular interventions to better understand which is most valuable. In this intervention, for example, 17 actors each gain

four degrees of access to the actors in the other network area – a total of 576 degrees ‘gained’. Linking 28 to 5 would add just three degrees of access, making it one-quarter less effective. It is possible to make calculations at the level of the network as a whole, identifying which single intervention best improves the functioning of the network in terms of improving overall connectivity. This is of use in considering which policy intervention is most effective in improving the functioning of the innovation network.

There are some general rules for what kinds of intervention are most effective in building network connectivity. Unconnected ‘islands’ of innovators are a significant problem, because they represent a huge forgone opportunity for effective innovation contacts. This indeed reflects Tödting & Tripp’s point (2005) concerning the problem of internal fragmentation undermining otherwise sound metropolitan innovation systems. The second issue, raised explicitly by Kallio *et al.* (2010) as well as Hansson *et al.* (2005) is the issue of ‘structural holes’. These are parts of the network which could be strongly inter-connected with a few additional relationships, but in which partners are kept remote from one another: in the diagram above there is a ‘structural hole’ between clusters 1 and 2 and value chain 1. Connecting 5 and 19 (both marked with squares) with 10 would result in much greater proximity between all actors in the innovation system.

There may be compelling reasons for policy-makers to work with particular actors even where it does not optimise the improvement to the network, depending on the regularity of the use of the contacts, and also the nature of the actors. If actor 5 is a Christopherson & Clark-type opportunistic multinational, and 57 is a more open large firm, it might be worth supporting the linkage of 57 and 10, because of the risk that 5 will try to monopolise its network position. The most efficient connections to target are those that bring already well-connected actors together effectively – as we show in section 2 – and this can mean nuancing particular interventions such as science parks in different ways to address these ‘structural holes’ in regional innovation systems.

A final consideration in the context of this paper is the issue of global actors. In the diagram above, it is assumed that all actors are based in the same region. Global-local connectivity is important for competitiveness and inserting firms and knowledge-producers into wider knowledge production networks, thereby anchoring those networks to the region. Although the networks themselves become more complicated when external actors are considered, the principle is the same, and it is indeed possible to evaluate which kinds of policy building which kinds of connections are most applicable to particular kinds of network configuration. Policy needs to be particularly sensitive to where structural holes exist between local actors and global value chains. In some cases, it can make sense to encourage local innovators to cluster together around existing globally well-connected actors, whilst in other cases it might make more sense to develop new external connections, for example through participating in international research programmes or joint selling at exhibitions.

2. Classifying regional styles of global interfacing

In section 1, the problem of global-local connectivity was set out as a failure to appreciate the need to create strategic coupling between local and external actors within the region, and consequently that promoting that coupling was an important task for regional innovation policies and their supporting strategies. The issue is that there is a huge gulf between a general recognition of the importance of understanding the global dimension, and a more systematic understanding of what can practically be achieved to improve the strategic coupling capacities of particular places. In this section, we undertake an experiment to explore what kinds of strategic coupling is

necessary in different kinds of regional innovation systems. We classify innovation systems using two kinds of variable, their internal networking and the number of external connectivity.

We develop a four-way classification of the global orientation of regional innovation systems, which provides a concrete means to explore the appropriateness of different policy mixes for different regional situations. On that basis, we explore what the implications of this are for place-sensitive regional innovation policies, and operationalise that into four 'global orientations' for regional innovation policy. These global orientations are different approaches to building connectivity within the same instrument (such as science parks) to be borne in mind by regional innovation coalitions in creating the most appropriate regional innovation strategies for their particular regional contexts.

Towards a dynamic account of changing regional innovation systems

The previous section has argued that a critical component of regional innovation capacity is the potential to anchor in those regions actors active in wider innovation networks, integrate them into the regional innovation system to stimulate local dynamism. The corollary of this from a strategy perspective is – as Coe *et al.* (2004) highlight – to optimise the regional coupling capacity, to react to the needs of these key global actors and ensure that they continue to contribute to the functioning of the RIS. But at the same time, it must be recognised that simply subsidising these key firms, or seeking to attract new globally-networked actors, creates a substantial problem of opportunism. Directly funding these businesses sees these firms dependent on the region for funding alone, and thereby reduces that firm's interest in working with regional networks, creating this local buzz. The question then becomes what smart mixes of policy instruments can be used to optimise this local anchoring process?

We argue here that the answer to this question is clearly dependent on the regional context, and there is not a one-size-fits-all approach to policy instruments. For regions who lack a strong position within global networks, policies to develop external relationships are important, and hence strategies may focus on helping increasing their actors' global mobility, funding attendance on study trips, conferences, and exhibitions with the intention of stimulating matchmaking. Regions strongly dependent on single firms or sectors may seek to stimulate diversification to reduce that dependence, and in particular encourage new firms to develop global linkages, through innovation vouchers, trans-regional or transnational RTDI programmes. Regions with strong firms that do not work together effectively may choose clustering programmes, to realise the potential for critical mass between related firms. Regions with several clusters may likewise seek to encourage co-operation between clusters to create new innovative domains and applications, and to create new market-leading positions in emerging (multi-disciplinary) technology areas.

For the purposes of this paper, we highlight three key dimensions emerging in the previous discussion which are salient for the classification of regions' global-local coupling capacity according to three dimensions:

- **Connectivity:** the extent to which there are innovation actors in the region who have relationships with external actors active in sectoral innovation systems;
- **Density:** the extent to which local actors are well networked and can effectively co-operate and collaborate in pursuit of innovation; and

- **Dependency:** the extent to which there are ‘gate-keeping’ actors who are able to regulate the access of local firms to global networks.

The dependency dimension is mostly salient where the particular actor acts as a gateway to the region, for example through a very strong OEM in a region like Seattle (Boeing) or a university in an otherwise thin RIS. In such cases, there is an added problem for the region to create global-local connections which are not mediated by this single actor, who then has opportunities to behave opportunistically, for example by demanding increased subsidies. It is then possible to characterise the global/local profile of regions on the basis of the two other dimensions, which we do in Figure 8.

Figure 8. A classification of the modes of connectivity of regional innovation systems

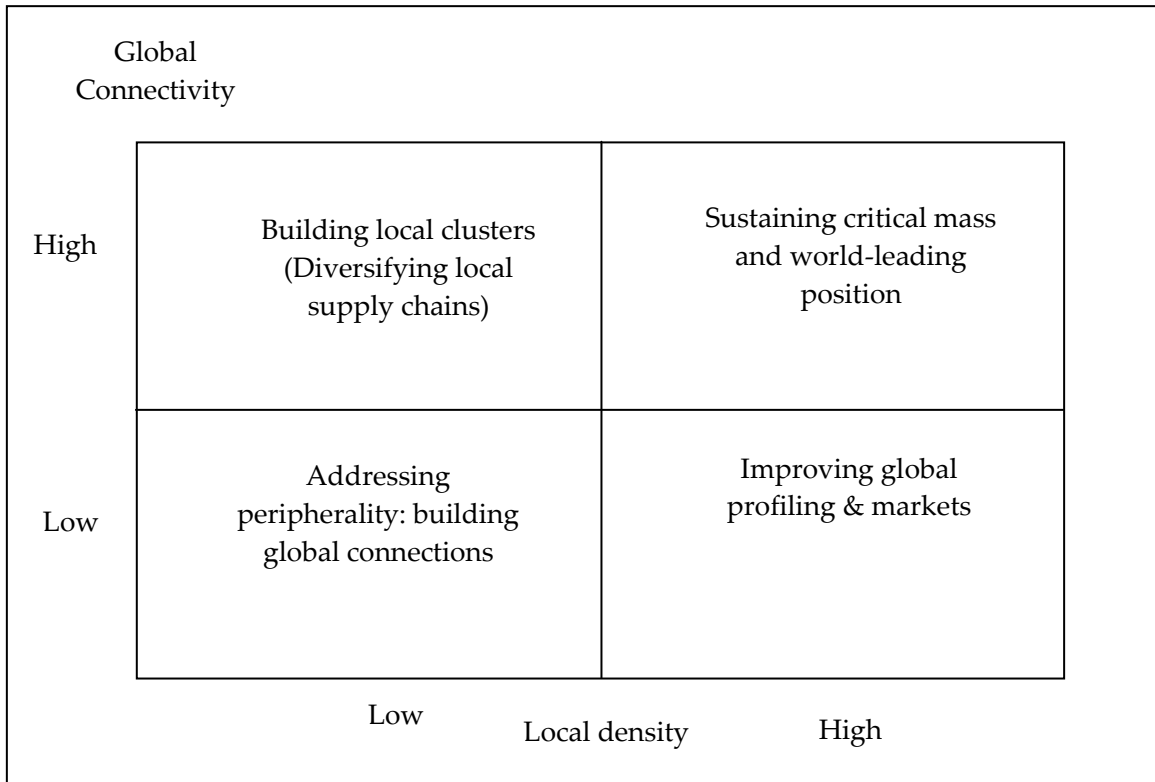


Figure 8 offers a classification of RISs' global networking needs based upon four classes which reflect the starting point of those regions. In two of these regional archetypes, the focus is on building new global connections, strengthening the 'global pipeline' elements of the RIS, but from a very different starting position, and hence with a very different policy emphasis. In those regions without hinges, the best approach is always to create global connectivity. In other types of region, where there are some regional networks but the risk of opportunism, then new global connections help to embed global actors' interests in the region, and guard against potential future opportunism, just as it makes sense to have two oil pipelines from the Caucasus to Europe.

In two other kinds of situations, it makes sense to focus on building local connections, ensuring that global connections help to stimulate local innovation and create local 'buzz', in the language of Bathelt *et al.* (2004). In highly centralised RISs with some existing external connections, improved local connectivity creates alternate network pathways, creating more opportunities for innovative outcomes within existing players. Where the region is highly fragmented, then the emphasis on building local connectivity is in creating novel regional networks which involve leadership or at least participation from those with connections globally, thereby expanding the scope of the cluster.

The four policy orientations correspond to different kinds of RISs with existing connectivity, as explained above. The first distinction is between those that will most benefit from building global connections and those that benefit from building local connections. For regions which benefit from building local connections, the other distinction to be made is on the basis of the density of the RIS, between dense/ centralised and sparse RISs. For regions which benefit from building global connections, there is a clear distinction between those without strong global connections, and those with global connections. On this basis, it is possible to discern four policy orientations for developing global-local connections:

- **Connecting globally:** Building a global pipeline: finding a point of connection from the region to key global actors;
- **Cluster-building:** Improving local networking to connect more local actors into the growing regional network;
- **Sustaining momentum:** Building up new regional hinges with connections to regional firms – building critical mass; and
- **Deepening pipelines:** extending hinge connectivity and networks around a hub.

Policy orientations for strengthening global-regional connectivity

The instruments by which particular regions can achieve these ends are not distinct from purely regional innovation instruments (IRE Working Group, 2008). There is an implicit global dimension within regional innovation policy, even if it has been considerably down-played in much of the policy discourse about RISs. Building and sustaining global linkages is something necessary for all regions seeking to sustain their regional competitiveness. This global-local dimension is something for all regions, and at the same time, it is already embedded implicitly within regional innovation activities and instruments. The issue is how to tease this out, without making an unnecessarily artificial distinction between global and local actors.

The issue can be considered as the fact that in different kinds of regional contexts, there is a need for different kinds of emphasis on the way global connections are built up. Our argument is that some of these are more salient in particular contexts than others. Figure 8 distinguished different kinds of policy orientations in different kinds of regions, and these apply to the way particular instruments are best implemented in different places. Science parks *as an intervention* has something to offer to all kinds of regions.¹ Sanz (2009) differentiates a number of roles which science and technology parks can play in practice:

- Privileged links to governments;
- Direct co-operation with universities;
- Hosting mature business communities;
- Focus on business incubation/creation; and
- Strong international dimension.

However, the way that science parks should be implemented in practise differs between different kinds of regions.

- In regions completely lacking global hinges, science parks should work as technology poles, **connecting** global-locally creating something for a global actor to plug into, potentially through ‘soft landing’ programmes for foreign based entrepreneurs or R&D FDI, along with means to connect that actor to regional ones (*cf.* Crete Innovation Pole, IRE, 2008).
- Where there are already good local network connections and some global connections, then the value of a science park is as a physical space for networking, building **critical mass** deepening relationships between actors (Van der Veen *et al.*, 2006).
- Science parks can stimulate **cluster-building**, acting as innovation promotion centres, like IDEON in Lund, helping to provide innovation services to local SMEs as well as providing physical connections to universities (Heydebreck *et al.*, 2000).
- Where there are already existing connections between regional actors, science parks can help in **consolidating** relationships between local firms helping to build the wider technological and innovation profile, and increasing external actor interest in the region (Wicksted, 2000).

One instrument can be oriented in four quite different ways, depending on the needs of the regions concerned. We therefore offer the idea of a ‘policy orientation’ as a means of thinking through how to optimise regional innovation strategies and instruments to improve global-local connectivity. The argument is that global-local is not a separate element of regional innovation strategies, but what is critical to optimise success is that regions are able to take a dispassionate look at their regional profiles, identify what are the key global-local challenges that they face, where to focus building these connections, and then to implement their wider regional strategy

1. This is not to say that every region needs or should have a science park, rather that in all kinds of regional conditions, science parks can be implemented in particular ways that give global-local connectivity the greatest boost.

mindful of the desired global-local policy orientation. Baier *et al.* (2007) offer their own typology of seven objectives underlying regional policy instruments. This will be used in section 3 to consider how different policy tools can be used to drive regional innovation strategies towards different global orientations:

- Improve innovation governance and strategic intelligence for policy-making;
- Foster an innovation friendly environment;
- Higher education / human capital development / gender issues;
- Development of research infrastructure;
- Strengthen innovation including the protection and commercialisation of intellectual property
 - Strengthen innovation in the SME sector
 - Industrial policy and strategic technology policy;
- Encourage technology and knowledge transfer to enterprises and development of innovation poles and clusters; and
- Promote and sustain the creation and growth of innovative enterprises.

Fitting real regions into the policy orientation approach

The key to effectively managing the global-regional interface lies in ensuring regional innovators are as well-coupled as possible to sectoral innovation systems, and that the region offers the best environment for strategically coupling outside actors to regional innovators. It is important to note that regions and their firms are not separate from sectoral innovation systems, and sectoral excellence can shape and reshape these systems if particular regions become home to path-breaking radical innovations. But, a good supply of expertise and innovation is not enough given the ubiquity of many kinds of knowledge, and the ability to insert into these global chains is vital. In most cases, the reality for regions is that they have to adapt (and help their firms adapt) to support the needs of actors who are primarily located outside the region, with very little direct interest in contributing to regional innovation systems.

The success of regional innovation policy lies in making regions more important within these particular sectoral innovation systems, and increasing the exposure to global value chains. It is these global chains which provide the pipelines through which resources can flow, and it is as important in principle to ensure that local buzz is also maximised in this process. The global-local issue can be understood as one of ‘global pipelines, local buzz’, and appropriate policy scenarios can be differentiated on whether to prioritise one or the other, and precisely how to prioritise those connections. This has profound consequence for the way in which particular policies are implemented, whether to improve local connections and build local micro-clusters, to embed external actors better in the region, or to diversify the regional innovative structure.

Although the models of ideal type RISs depict a set of nodes, it is important to remember that what these correspond to are the hinges that connect the RIS to the wider global value chains. These may be lead multinationals or local businesses, or a single university, but they are more

likely to be networks in their own right, such as clusters of firms, research centres and universities, communities of like-minded individuals, specific intermediary organisations other related organisations, or even pieces of infrastructure. The focus for these global orientations is how to work with existing hinges, or even to identify and realise potential hinges. The scope of the hinges will change over time, as new companies form or become networked, as researchers and intermediary organisations reflect new local demand, potentially increasing the scope of those hinges. The value of policy lies in maximising the scope of those hinges, to support private benefits through innovation in networks, but also to create public, place-specific benefits through related variety spill-over effects.

Hinge activities necessarily contribute to both building local connectivity as well as building global outward connectivity. However, in different circumstances there may be different attributes of those hinges that public policy wishes to stimulate. Where there is a large multinational firm acting as a regional hinge, and many non-innovative SMEs in related sectors, it makes more sense to stimulate those SMEs to work with the lead firm than encourage that lead firm to participate more actively in wider global innovation networks. In these circumstances, rather than providing R&D subsidies for the MNC, there will be a better payback to the RIS from public policy instruments which encourage clustering activity and knowledge sharing between the MNC and the SMEs. These various hinges and hinge activities are listed in Table 1.

Table 1. Hinge actors and support activities for public innovation policy to stimulate regional innovation systems

Type of hinge activity	Hinge activity stimulating local connectivity	Hinge activity stimulating global connectivity
Large-hub firm	Encouraging cluster-building and knowledge circles between MNC and SMEs	Subsidies for R&D with world-leading research activities elsewhere
Related diversity firm activities	Supporting cross-sectoral shared innovation projects and networking activities	Encouraging local firms in sourcing knowledge from world-leading institutes
Cluster-firm network-industrial district	Upgrading the innovation capacities of local businesses in the industrial district	Marketing the collective capacity of the local entity globally, building up a global industrial district brand
Relay centres	Innovation vouchers to help SMEs access knowledge located elsewhere	Mentoring schemes to help local firms to absorb knowledge created elsewhere
Universities & public RTD infrastructure	Technology transfer office helping local SMEs to identify knowledge needs and absorb university knowledge	Supporting participation in collaborative, multinational innovation and research projects pursuing global excellence
Physical infrastructure	Upgrading local/ regional accessibility and feeder infrastructure to support its wider role	Affirming the importance of the place as a centre of particular transport/ distribution networks with other public policies
Epistemic communities	Supporting post-qualification education for local agents on basis of external standards (e.g. MBA)	Overseas visits and delegations to build connections with people in similar situations elsewhere

Source: Authors' own design.

What is absent from the discussion so far, yet critical, is the relation between regional strategies, global orientations and national policy frameworks. In some cases, national policy frameworks can directly determine regional capacity to select their own policy orientation. England and Denmark's approach to clusters around 2000 forced regional policy-makers to take a primarily cluster-building approach, reducing the possibility to target developing those clusters' wider global connections. National policy frameworks also indirectly shape the possibility for regions' global orientation selection. A focus on flagship projects and prestige inwards

investments pushes regional partnerships strongly towards consolidation approaches rooted in developing growth poles.

However, higher levels of decision-making also influence what can be achieved by determining the practical availability of assets as well as the particular national governance paradigms. An important determinant of whether regions can pursue their own strategies is the extent to which they can persuade higher-level partners to support their regional strategies with complementary national investments within the regions. It is much easier to develop an effective regional innovation strategy for regions already designated as the national growth pole than if perceived nationally as a backward region, as the cases of Thessaloniki and Eindhoven bear out. But likewise, given a strong combination of assets, then it is under certain circumstances possible to choose an alternative strategy to the national, as Tampere region in Finland did in designating its own centres of excellence outside of the national programme.

The global orientations do not determine instrument selection, which is a matter primarily shaped by the existing regional innovation assets, political decisions taken by regional partners, and the totality of resources available to fund new activities. The point of an orientation is that it is a perspective with which to shape the configuration of particular instruments, and how to bring different instruments together to create a coherent support package for regional innovation which does not neglect the global dimension. This is precisely the point made with respect to science parks, that a science park can achieve different things for a region, and its outputs are maximised if they go with the grain of the necessary global orientation. It is this issue, of the configuration of instruments to the global orientation, which is explored in the concluding section.

One issue it is important to make clear here is the fact that each of the four policy orientations covers different types of regions, so the fact that different regions are in the same class of region does not suggest that they are similar kinds of regions as far as innovation goes. All that can be inferred from these regions being in the same class is the fact that there are similarities in the kinds of policy intervention which work best in these regions in terms of strengthening the connectivity of the region to global value chains in ways that strengthen the regional innovation system. These similar policy orientations come together in similar nuances taken to using particular instruments to achieve policy ends. They may also serve to help regions understand from which other regions they should seek to learn, thereby avoiding simplistic policy borrowing (*cf.* Legendijk & Cornford, 2000), and increasing the relevance of chosen policy approaches for their region.

The remainder of the report is structured as followed. In section 3, we consider for each of the policy orientations, which kinds of instrument work best to address that particular problem. However, given an increasing emphasis on a ‘smart policy mix’ for regional innovation (*cf.* OECD, 2009), it is also necessary to think at the level of the **strategy** how particular types of instrument can be brought together to best effect. This is the subject of section 4, which focuses primarily on the best strategic emphasis for the four global-local orientations.

Table 2. Policy orientations and innovation in regions: a summary of the policy orientation archetypes

	Connecting globally	Sustaining momentum	Cluster-building	Deepening pipelines
Archetype for region	Peripheral regions lacking strong research strengths and international connections	Regions with strong local cluster organisations well networked with policy actors	Small groupings of competitive businesses with limited local connectivity	Region dependent on limited number of global production networks/ value chains
Key weakness	Absence of connection to external actors – no external stimulus for innovation	Risk of hollowing out and being left behind by GPNs – maintaining global lead	Regional firms tend to look outwards – contagious local undervaluing of partners	Dominance by a single firm or chain that exploits not supports regional actors
Existing strengths	Latent innovative actors with potential to grow quickly and deliver change	Highly innovative, well networked clusters playing leading role globally	Industrial districts with competitive advantages and global profile	Industrial ecosystem supporting value chains with diversification opportunities
Key challenge	Building a global pipeline: finding connection point from region to key global actors	Building up new regional hinges connected to regional firms – building critical mass.	Improving local networking connecting more local actors to growing regional network	Extending hinge connectivity & networks around hub
Optimal solutions	Helping regional actors take the first steps in international co-operation (collectively?)	Bringing outside actors in, and helping to collectively shape future trends	Channelling innovation support to stimulate growth through regional clusters	Helping second-tier innovators become market leading and shaping
Example regions	Madeira, Portugal Tallinn, Tartu Estonia Attica, Greece Sardinia, Italy	Île-de-France, France Baden-Württemberg, Germany Flanders, Belgium Toronto, Canada	Skåne, Sweden Navarra, Spain Auckland, New Zealand Zuid-Holland, Netherlands Nord-Pas-de-Calais, France	Eindhoven, Netherlands Piemonte, Italy Limburg, Belgium Seattle, USA North East of England, UK

Source: Benneworth, P. & A. Dassen (2010), "Strengthening Global-Local Connectivity in Regional Innovation Strategies – A Theoretical and Policy Reflection", *Project Working Paper for OECD Regional Innovation Strategies Project*, CHEPS, University of Twente, Enschede, Netherlands.

3. Four policy orientations towards improving global-local connectivity

On the basis of the characterisation above, different styles of intervention are necessary to help improve the region's global connectivity. In this section, we develop the idea of 'styles of intervention' on the basis of these four policy scenarios, to consider the kinds of regions in which they might be appropriate, the kinds of interventions and nuances which can help to densify the RISs, and some of the problems which must be addressed if these changes are to improve global connectivity. The choice of appropriate scenario depends primarily on the existing regional situation, as well as the existence of regional assets which make the intervention possible. As Yeung notes:

“Regional authorities and government agencies should not be paying excessive attention to building regional capability without carefully assessing and understanding the kinds of GPNs with which the region can have a good chance of strategic capacity” (Yeung, 2006, p. 31).

It is clearly much easier to identify projects to tie global actors to dense but disconnected RISs than it is to sparse RISs, where there are far fewer regional knowledge networks into which external actors may wish to tap.

Connecting globally: building the first new global pipelines

In regions which do not have good global connectivity, then the appropriate policy focus is to build a global-local connection (“pipeline”) which taps most effectively into the existing regional assets. In supporting the creation of a global-local connection, policy-makers are seeking to create an activity that brings a global actor – that is important within a sectoral innovation system – to the region, and to maximise the benefits which local actors derive from them. A key determinant of what that hub might be is therefore dependent on the nature of local connectivity. The question is who ‘leads’ local networks, and who is in a position to ensure that as many local activities have the opportunity to benefit from the development of these wider connections. Related to this is the propensity of the leading actors towards opportunism, and the possibility to ensure that instruments do not create single firm benefits, but help develop the region towards a more networked culture.

In these situations, ‘building a global connection’ involves regional actors becoming more actively and centrally involved in existing sectoral innovation systems. The development involves a group of already connected local actors being able to use their regional connectivity as a means of actively participating in this wider innovation system. There will therefore be clear regional assets already in the sector – such as networks of firms with shared knowledge assets – as well as relationships with external actors. The regional problem in that sense is why is the potential in those assets to contribute to a wider sectoral innovation system not realised through firms actively participating in regional networks. Typical approaches which are necessary in such regions include:

- Identifying and verifying regional innovation strengths (real, potential and latent);
- Focusing on developing these sectors, aligning public resources behind these sectors;
- Inviting external partners to visit the region to develop linkages with local businesses;

- Using ‘innovation connectors’ – skilled and experienced mentors to link local businesses to appropriate knowledge sources;
- Attracting highly skilled people to the region through dedicated fellowships, research and placement positions;
- Developing a leading institute with global profile to create visibility and focus for the region; and
- Encouraging the wider use of innovation partnerships through innovation vouchers.

The most appropriate policy approach depends in a large measure through the mechanisms by which the local actors inter-relate, and hence how the global benefits can potentially diffuse through the region via the creation of a local hinge. The local networks might be have formal trading relationships or informal untraded activities, and relationships might be complementary-collaborating, or they might be competitive. Where there are strong vertical supply chain relationships within the region, then supporting a lead company to participate more effectively in global supply chains will provide an innovation stimulus to those companies feeding into the supply chain. This may involve helping those lead companies acquire new technologies, developing it within the local supply chain, and helping with marketing and project acquisition.

Box 1. Estonia: Building the linkage to Helsinki, creating high-technology Tartu

Estonia joined the EU in 2005, and despite proximity to neighbouring Finland, it remains one of the poorer European member states, comparable to Hungary, Poland and Croatia in terms of GDP per capita. Estonia was hard hit immediately following independence by the Russian economic crisis which also affected Finland, albeit slightly earlier, and bounced back to grow strongly in the decade following 1999. The first wave of innovation strategy developed followed accession negotiations with the development of a national innovation agency (2002), then an attempt to strengthen the regional innovation system (2004). Progress stalled in internationalising the innovation system in the mid 2000s, with emphasis being placed on creating home-grown high-technology companies alongside importing high-technology equipment to stimulate modernisation of firms. Neither have substantially overhauled Estonia’s technological base.

There are two interesting elements emerging in the internationalisation of Estonia’s innovation system. The first is exploring how the proximity to one of Europe’s leading innovation nations, Finland (40km from Tallinn by sea) can be used to drive forward innovation in Estonian firms. Innovation is coming to the fore of the Twin Cities Co-operative Arrangement, and agreement has been reached to develop a Twin-Region of Arts and Sciences bridging metaphorically, if not yet literally, across the Gulf of Finland and capitalise on the close cultural proximity between the two cities. At the same time, the neighbouring second city of Tartu is pursuing a strategy of science-based growth, capitalising on its ancient university comprising more than half Estonia’s HERD, and its more recent science park. The science park both hosts existing high-technology companies as well as stimulating entrepreneurship, drawing on the university’s research and infrastructure strengths in nanotechnology, biotechnology and healthy food. At the same time, the science park is active in a range of networking projects to help companies based in Tartu improve their global profiles and help strengthen the local cluster.

Where there is a university with global knowledge expertise and otherwise unconnected firms, then helping to diffuse new knowledge into those local businesses through partnership projects and exchange projects is also important, whilst at the same time encouraging universities and research laboratories to acquire new knowledge both through research activity, but also through recruitment of high quality staff. Where there are strongly competitive relations between companies, then the optimal policy intervention is the creation of a common broker which can

help the regional partners to acquire external contacts and then exploit them either individually or collectively.

Box 2. Hangzhou: building a Chinese high-technology cluster region

Although China has been very successful at attracting foreign investment in the last 15 years, there is evidence that this is not always translating into local development, with foreign-owned companies concentrating manufacturing rather than innovation activities in China. A number of Chinese administrations are seeking to use their strengths in global production networks to build up their innovation systems. Hangzhou, located in the Yangtze Delta, in the hinterland of Shanghai, is home to the (top-ranking) Zhejiang University, has sought to do that and create a cadre of local managers and entrepreneurs able to exploit these opportunities. The region has been able to align substantial resources behind industrial zones, including a (nationally-designated) Hi-tech Industrial Development Zone, backing it with a high-technology industrial development fund to support collaborative projects. Joint ventures and partnerships have been very important as a mechanism to anchor leading external companies to the region, including with Singapore for the development of the USD 700 million Singapore-Hangzhou Science and Technology Park. The Hangzhou Hi-tech Industrial Development Zone, established in 1990, has over 450 foreign investors who have invested a total of USD 11.75 billion in the last 20 years.

Deepening pipelines: local networking to support regional hinges

When there is a strongly centralised RIS with existing global connections, then the most appropriate set of interventions relate to increasing regional innovation capacity, and maximising the local ‘buzz’ from innovation. The biggest weakness of a centralised innovation system is its reliance on a single strong actor, and that can mean that the only opportunities which are exploited are those which are of interest to that large actor. This reduces the opportunities that other actors have to identify where there are opportunities for them to work together to effectively innovate in ways that other external partners find attractive. The issue is one of initiative and path-dependency; hub actors run the risk of being very path-dependent, and locking the region into particular development trajectories which can be very risky for that region. Creating new local linkages within creates opportunities for new combinations, stimulating innovation in different areas and permitting cross-sectoral spill-overs. The question is which connections to target regionally, to strengthen global connectivity?

The answer lies in building an alternative centre of critical mass outside the hub actors which nevertheless help to contribute to the competitiveness of the RIS as a whole. An important mechanism by which this is achieved is in reducing opportunism by the RIS actor by potentially challenging the idea that all regional support should be targeted at the already competitive and globally connected company. Although this will increase the regional connectivity, it does not address the problem of opportunism, and in particular in preventing regional enclaves from forming where individually competitive and innovative businesses do not contribute to the development of a competitive innovative milieu. This will typically involve the following mix of activities:

- Identifying potential latent clusters, firms & research centres with strong global and weak regional links;
- Emphasising a message of collaborative innovation, backed with substantial public resources;
- Targeting globally active actors, developing centres of excellence better linked to local SMEs;

- Developing physical spaces and activities bringing actors together to collectively innovate;
- Concentrating activities in particular locations and value chains;
- Stimulating intrapreneurship (corporate venturing) to encourage diversification; and
- Smart entrepreneurship programmes, creating well-networked, growth-ready high-technology SMEs.

This involves bringing the local actors together with the leading regional hub actor and giving them reasons to work together in ways that do not exclusively benefit the hub organisation. Open innovation centres can be valuable in this regard by helping companies with interests similar to that of large, leading companies to meet with other similar businesses, creating a critical mass of activity in that area, with capacity to contribute to innovation beyond the region built upon the regional support from participating firms. Thought needs to be placed on the ways in which interventions can get beyond supporting individual firms to supporting co-operation, which is not always a straightforward or transparent process. There are no automatic reasons for firms to network even when co-located in regional innovation centres. Cluster organisations can play a role in such circumstances in helping these local mobilisations take place and developing critical mass independent from that of the hub.

Box 3. Energyville, Genk: filling in the high-technology triangle

The Belgian Province of Limburg was profoundly affected by the running down of the coal industry from the late 1960s onwards, the last mine closing its gates in 1992. Attempts to revitalise the region by attracting new inward investors encouraged the development of a branch-plant economy with limited endogenous innovation capacity. Since the 1990s, the region has attempted to capitalise on its regional innovation base, in particular from a strong public research infrastructure, a university, two polytechnics, a cross-border institution and a number of public laboratories. At the same time, the region has found itself at the centre of gravity of the increasingly flourishing ELAT – the Eindhoven-Leuven-Aachen Triangle, although with very few tangible connections to the high-technology activities driving these places. A new science park has been developed at the former Waterschei mining site, and as part of that, the Flemish Agency for Technology for Sustainable Development, the Province and the University of Leuven are investing in the Energyville project. As part of this, Energyville has successfully attracted a national demonstration centre for the InnoEnergy Knowledge and Innovation Community, part of the European Research Council programme for valorisation. This helps tie Waterschei and its energy research community closer to Eindhoven and Leuven universities, and helps to internationalise a science park that is also seeking at the same time to stimulate local entrepreneurship and innovation.

In these situations, what happens is that there is an increase in scale in the nature of the outputs produced within the region, so additional firms and knowledge producers are brought into the sectoral innovation system, and the region becomes more of a node or a stronger node within that innovation system. The relationships within that node help to stimulate knowledge based growth regionally. New firm formation is an important – if lagging – indicator of the extent to which this has been achieved, and new firms which draw on a mix of global and regional resources also help to strengthen regional networks, so in these situations, global-local entrepreneurship activities, such as supporting ‘born global’ start-ups within particular regional contexts can help to densify and diversify centralised RISs away from their (over-)reliance on a single hub actor, broadening the regional benefit into a wider network.

Box 4. Stimulating internationalisation within Piemonte

Piemonte region forms part of the industrial heart of Italy, the so-called “first Italy”, with strengths in IT, chemicals and the automotive sector. However, these sectors have come under increasing pressure recently from restructuring, and there is no certainty that the region’s past capacity to reinvent itself will continue into the future. Since 2005, the region has promoted a Regional Law for Research and Innovation which devotes around EUR 300 million to stimulate of regional innovation. At the heart of the resulting Innovation Strategy is a focus on Innovation Platforms, partnerships of firms, universities and public research organisations that come together, identify common research agendas, and then seek external (global) partners for their implementation. The first of those which has already been relatively successful is the Torino Wireless, which also has features of a cluster organisation, stimulating entrepreneurship as a means of creating new pathways for exploiting knowledge, as well as helping firms purely to participate in research programmes. The policy has highlighted a number of other sectors able to benefit from this approach, including aerospace and biotechnology, with more of these innovation platforms developing over time. Alongside this, there has been an attempt to streamline the provision of business support services so that it is possible for entrepreneurship to take place alongside collaborative research projects with an international dimension.

Sustaining momentum: embedding global actors in the region

There are a number of situations where good regional policy helps to expose existing external contacts to more, and different, regional innovation partners. On the one hand, this helps to embed those global actors more firmly within the region. On the other hand, it reduces the opportunities of individual local actors to behave opportunistically, and therefore increases the cultural influences which global actors can have. The more diverse the RIS already is, the greater the emphasis can be on embedding external actors within the region and using their external knowledge as a driver of the RIS. Conversely, the more concentrated the RIS is around a single actor, and the greater their willingness to act opportunistically, then the greater the emphasis on creating shared spaces where other local actors can: interact with these global actors; create solutions to their problems that sustain their interest in the regional innovative capacity of that region; and prevent a single partner from privately appropriating publicly funded benefits.

One ideal solution lies in attracting foreign direct investment in research, technology development and innovation to take place within the region to exploit the existing regional strengths. There needs to be a prior identification of where regional strengths lie before a rational choice can be made of how to build better linkages between regional networks and external actors. There are three main vectors which can help connect global partners more thoroughly to a region, through staff movements and contacts, shared R&D projects, and the provision of consultancy services. There are a range of policy tools which can be used to support these, including innovation vouchers, shared R&D projects, specialised immigration and recruitment policies, and international marketing activity including shared delegations to particular key actors. Typically, they will involve the following kinds of activity:

- Developing a strong understanding of the global dynamics of leading industrial sectors;
- ‘Disjoint foresighting’: understanding the opportunities for new combinations of knowledge, resources, talent to create new firms, sectors and value chains;
- Support for expansion, diversification and an increased innovation profile for firms already located in the region;

- Stimulating creativity and multi-disciplinarity in research and innovation activities: avoiding programmatic research and encouraging crafty curiosity;
- Encouraging risk-taking in businesses around new and emerging technologies e.g. venture funding for high-risk, disruptive technological trajectories; and
- Targeted support to encourage local businesses engage more fully with global clusters.

Box 5. Toronto: MaRS Discovery District

Toronto is one of the main growth centres in Canada, and host to the largest concentration of public-sector research in universities and laboratories, with a considerable cluster of related corporate R&D, notably in health and medical sciences. With increasing competition in these fields for the attraction of inward investment, Toronto City Council as well as the Province of Ontario and the Federal Government have come to invest in the MaRS Discovery District. This site, located in Toronto's downtown amongst the city's universities and research centres, supports cutting edge research and development, as well as stimulating collaboration between firms in Toronto through its Collaboration Centre which runs an active series of networking and learning activities. Because of Toronto's pivotal position in Canada's national innovation system, it is already a hub for a number of important research, development and innovation networks, and therefore the MaRS Centre provides a means to connect up global and national innovation networks, as well as creating an innovative boost for the city and province.

The key challenge in seeking to attract inward investment in R&D is that it is extremely lumpy, with few firms willing to agree to substantial R&D activities away from their main sites. The issue becomes one of upgrading, making key players in sectoral innovation systems more interested in the innovation offer of the region, which clearly depends both on existing local networks, but also existing global contacts and connections. The policy instrument here lies in generating a local coalition with some critical mass that is more attractive to outside partners, deepening their relationships, making one-off relationships more sustainable, and involving more partners in deeper relationships. Part of that is supporting local technological and organisational infrastructures to bring local partners together to build up that critical mass, as well as the global contacts of local partners. The infrastructure in turn contributes to the deepening of these relationships.

Box 6. Staying centre stage: Île-de-France and the global cluster conference

The Île-de-France is at the centre of the French national innovation system and represents around one-quarter of all expenditure on research, development and innovation. The region is host to a number of critical clusters as well as headquarters to firms leading innovative global production networks. There are a number of cluster organisations that seek to ensure that firms in the region maintain their competitive advantage in fields of social software systems, urban sustainability, aeronautics, digital technologies, finance, medicine and mobility. These clusters have come together in the last five years to organise the *Paris Region Innovation Tour*, an international cluster conference at which global cluster organisations come, benchmark, network, match-make and exchange interests, both in notions of clustering and industry innovation support, but also encouraging networking within value chains through the use of technology showcases. The event brings together French clusters from outside Paris as well as clusters from across America, Asia and Europe, and helps to cement Paris's role as a critical co-ordinating centre for industrial innovation in these thematic areas.

Cluster-building: bringing new local actors into regional networks

The fourth type of global-local orientation is in promoting regional cluster-building, that is to say supporting the development of additional firms, research centres and collective activities that draw local actors not already active in innovation into the sector. This has the effect of helping to join up the regional innovation system, both maximising the opportunities for new, creative activities supporting the sector, as well as maximising policy impacts by drawing many new actors into the policy space (*cf.* Nauwelaers & Wintjes, 2002). By stimulating innovation in regional networks involving actors outside the region, the intervention seeks to provide opportunities for regional actors to be drawn into innovative behaviour as well as providing immediate returns for that effort.

Cluster-building is in practice very difficult to effectively stimulate, because it involves changing the behaviour of non-innovating companies, and encouraging companies to consider activities outside of the sectors with which they are comfortable. Both Lovering (1999) and Lagendijk (1999) point on the strong pressures to cluster-building activities to default to being glorified quality circles and benchmarking clubs raising quality but not innovation in manufacturing supply chains of large multinational corporations. Rutten (2002) points to the thin regional dimension of micro-clusters established by the Océ imaging technology company in North Brabant in the Netherlands, groupings of companies in the region, rather than creating untraded interdependencies and other growth factors identified by Storper (1995). The kinds of research instruments which can help encourage this kind of activity include:

- Cluster-building programmes, bringing companies together and stimulating collective action at least partly aiming to create a collective cluster identity;
- Increasing proximity between actors by encouraging routine encounters such as seminars, workshops, match-making, and collective bidding;
- Developing shared research infrastructure that brings businesses to solveing business problems;
- Helping SMEs to fit into large firm supply networks, develop more local linkages and stimulate local innovation;
- Business support focused on networking activities, ensuring that these networks stimulate innovation rather than routine market activities; and
- Support for innovation resources, assisting with finance, intellectual property (IP), skills, management training.

Box 7. Regio Skåne: Building an innovative food cluster

The Skåne region in the south of Sweden is one of the country's traditional agricultural areas, but since accession to the European Union in 1995, and increasing globalisation in the food sector, agriculture has come under considerable pressure to develop higher-value products, and to compete through innovation. From 2000, the Regional Council encouraged its food companies to work together more closely, and in 2003, they bid for and won national funding through the VINNOVA programme for ten years of support for the food innovation system in Skåne. This region is closely linked across the Öresund Bridge with the Danish Jutland Innovation System, which includes a number of firms, research institutions and venture capital firms which add to regional critical mass, and the Skåne Food Innovation Network is also active in the Öresund Food Network, which specifically seeks to stimulate and expand interaction between firms, research organisations, and business support services, on both sides of the Öresund Strait. The focus of the Food Innovation Network has, and continues to be, on densifying the local RIS, supporting innovative collaborative projects between partners often active in their own global networks, but with limited experience of local collaborations. To extend international co-operation and interaction, the Food Innovation Network has played a leading role in the development of the Baltic Sea Region food cluster ('Baltfood').

This is further complicated by the fact that regional innovation is highly uncertain, making it extremely difficult for regional policy-makers to stipulate to businesses what precisely they should undertake in their collaborative activities. From a network perspective, the role of local collaboration in these circumstances is to create more indirect connections between local and global actors, densifying the regional innovation system, and making it easier for external firms to receive the benefits of those regional clusters. A number of regions have experimented with cluster-building, such as the region of Twente, where funding after 2000 was made available for micro-clusters such as the Twente Initiative for Medical Products (TIMP, *cf.* Klein Woolthuis, 1999; Benneworth & Hospers, 2007). The problem remains on determining the extent to which cluster-building policy drives the emergence of the cluster, and to what extent the firms and universities would have collaborated and developed in the absence of the policy intervention.

Box 8. Brainport Eindhoven & the High-Technology Campus

The region of North Brabant in the Netherlands prospered in the post-war period as the light-bulb company Philips transformed itself into a consumer electronics, health and hygiene business, investing heavily in the *Natuurkundig Laboratorium* (Physics Laboratory or NatLab). Although the region's development appeared to stall in the 1990s with increasing overseas competition affecting Philips' success, this trend has recently been reversed following the embrace by the Philips NatLab of the Open Innovation concept and its transformation into the High-Technology Campus. NatLab had previously been a highly secretive development centre for Philips, but in 2000, the Laboratory formally opened its doors to outside companies to establish themselves in the park, and access Philips facilities, including clean rooms, materials testing and electronic prototyping. A shared laboratory space, Miplaza, was also established, and currently more than 90 companies employ more than 8 000 researchers. This has helped in particular to bring local companies more closely into Philips' network and develop their own relationships with the large companies with which Philips is itself working. This is illustrated by one project within the High-Technology Campus, the Holst Centre, established as a "Open Innovation Centre for Wireless Autonomous Microsystems and Systems-in-Foil". This has been founded by IMEC, the Flemish Centre for Micro-Electronics and TNO, the Dutch Applied Research organisation as a means of creating a coherent research programme and assembling research teams to bring the ideas close to market. The Holst Centre co-ordinates research involving market leaders globally, as well as local SMEs, and helps to integrate new local businesses effectively into this wider value chain.

The challenge with cluster-building is getting genuinely new actors involved and delivering genuinely novel programmes and activities and joining them up with what is happening elsewhere in the region. There is a risk with regional innovation strategies in that they identify a

cohort of target actors as being innovative, and create an implicit criticism of the other group, as a means for treating them differently, often around eligibility for subsidies. The issue with cluster-building involves taking small groups of firms and their partners who are not necessarily globally connected, and connecting them to other groups of firms and partners who are globally connected. Given the issue of trust as highlighted by Klein Woolthuis, there can be problems in building a common culture and indeed trust between these different groups which can then provide the foundation for them to work together on the delivery of substantive innovation activities that helps to position the micro-cluster overall better within sectoral innovation systems.

4. Global orientations to regional innovation strategies

Orientations, instrument bundles and co-ordination mechanisms

In this final section, we begin to operationalise from a policy perspective how the different global orientations could be implemented within particular regional contexts. At the same time, there is a need to acknowledge that the instruments which particular regions will choose to deploy will vary considerably with their own regional circumstances. There are no magic-bullet global-local policies: as they involve giving outside agents a desire to work with regional partners, they also involve a degree of exclusively local strengthening, regardless of whether global partners can be persuaded of the value of that expertise to them. In this section, we conclude by setting out how a range of different instruments could be configured within different regional settings to maximise the global connectivity benefits that they bring.

Take for example the French policy *les pôles de compétitivité*, where groupings of firms and universities came together to be funded to promote localised innovation activities which in turn help to reinforce or diversify an existing global strength or competence. These policies do not have to be eye-catching or based on flagships, but involve stimulating regional networks, creating focused career services around universities as well as tailored courses, and linking outlying innovators to centrally located services, such as through branches of innovation agencies in rural areas. The French competitive poles programme in fact distinguishes three types of pole, global clusters, globally-oriented clusters and competitive clusters, each representing different approaches.

- Global clusters include, for example, the ICT cluster organisation in Paris (Saclay) which is forming part of the Saclay research campus and will eventually account for around 10% of France's entire public R&D expenditure.
- Globally-oriented clusters support innovation in sectors which are globally connected, as well as encourage innovation and entrepreneurship amongst existing regional businesses, such as *Toulon Var Technologie*, stimulating the marine cluster in Toulon.
- Competitive clusters: groupings of large firms, SMEs, research institutes, universities, chambers of commerce, centres of excellence and regional partnership bodies targeted on particular sectors, creating a shared focus for collaborative research programmes (e.g. Lyon Bus & Truck, involving Renault Truck as well as the local university in developing five research themes for a co-ordinated region programme).

This recognises the fact that different regional constellations have different needs, so a world-class cluster can build critical mass (e.g. ICT around Paris), globally active clusters can provide cluster leadership and help with consolidation (e.g. around Toulon), whilst competitive clusters can help promotion both clustering and connecting, stimulating innovative activities in weaker regional innovation systems.

The first element of this analysis is to identify a range of policy instruments which could potentially be of value. To ensure broad coverage, we use Baier *et al.*'s characterisation of the regional innovation policy toolbox. They argue that regional policies have basically seven aims, and that those aims demand very different kinds of policy. On the basis of their seven-fold classification, we highlight how different ways of configuring these into strategic bundles appropriate to the regional situation (*cf.* Heydebreck *et al.* 2000). The full set of potential interventions is listed in Table 7 at the end of this section. For each of the four global-local connectivity orientations, we consider which of the various types of policy instrument domains (drawn from the Fraunhofer classification, *cf.* Kozchatzky, 2009) function best in terms of offering four key characteristics of policy effectiveness:

- **Easy to deliver:** the policy can be effectively implemented within the local environment;
- **Greatest impact:** the policy constitutes a substantive solution to problems identified;
- **Lowest Cost:** the policy will not incur disproportionate costs in its delivery; and
- **Locally popular:** there will be support from local actors for these policy interventions.

Connecting globally: building a visible external profile

In these kinds of regions, the emphasis lies on building an external profile, that is to say identifying where there is potential for existing actors or groups of actors to build enduring innovation relationships with outside partners. There is an influence on the nature of existing intra-regional relations, whether formally through the supply chain, informally through associations and personal contacts, or semi-informally through clubs and cluster groupings. The challenge overall is in being dispassionate in where regional potential lies, and dissociating identification of potential from politics or favouritism. There is then a need for a degree of commitment to building an external profile around this regional asset, and using it to stimulate outside investment and relationship building. This has been used very successfully in a number of formerly emerging but now mature markets such as Korea and Singapore.

At the scale of the region, what is necessary is the generation of dispassionate, and ideally independent and externally verified, information about comparative regional potentials across the economic structure. Alongside this, there is a need to identify potentially excellent innovation actors, and to begin developing the profile outside the region. As part of this, it is also important to improve connectivity within the region and to create a set of brokers within the region with good knowledge about how innovation works. There needs to be an intense dialogue between those developing strategies and those implementing support services and undertaking innovation to ensure that the 'strategy' is informed by regional potential as well as ambition, tying strategic choices into existing regional assets.

The role for the investment in infrastructure lies in building something up with sufficient plausibility as a world-class research asset, attractive to outside investors. The role for universities within this is developing an international research profile, as well as gateways, bringing in faculty and young talent with the potential to be later embedded. For regions in this phase, it is clear that developing infrastructure has a clear physical dimension, creating new spaces where the global meets the local, as Flanders did with the IMEC (the Mechatronics Centre of Excellence) in 1984, creating something visible and eye-catching, and signalling partners' serious commitment to the idea of innovation in these places.

Box 9. Navarre: accelerated building of regional networks

The region of Navarre (Spain) is a relatively strong European region, with a per capita income at around the same level as Emilia-Romagna (Italy). It is already heavily internationalised, and performs relatively well in terms of R&D performance, with GERD on GDP of 1.9%, far above the Spanish average. However, in the course of two regional technology plans (2002-04 and 2005-07), the relatively poor connectivity of firms in Navarre was noted and connections drawn to moderate innovation performance. The response was the Third Innovation Plan, which has focused itself around building four kinds of networks, locally, between both firms and business support organisations, as well as with similar regions elsewhere and global innovation networks. The region is using a mix of Competitiveness Poles and European Network building to build critical mass locally and encourage better competition for innovation funding at the European scale. Although a relatively recent project, and substantially resourced, there have been some early results.

- Navarra is participating in the Council of European Bioregions, a network of biotechnology support professionals that serve their local biocommunity through direct services including networking, incubation, partnering and cluster promotion.
- Universities have joined 3 networks, 5 companies have joined 4 networks, and 3 research centres have joined 4 networks.
- AH Asociados (a local Architecture SME) is participating in the European Construction Technological Platform.

The case study highlights the fact that it is possible to focus on both local and global dimensions simultaneously, creating elements to stimulate visibility of innovation activity externally as well as to help link local innovators into these globally-networked flagship facilities.

Business support in such regions involves supporting innovation that exploits these infrastructure developments in some way. Attracting new foreign direct investment (FDI) in RTDI activities is one role, as is supporting shared services between universities and businesses in these new locations. Firms can help to populate an innovation pole, just as the science park that built up around IMEC following its creation became a concentration of new innovative businesses, and contributed to the place-making and profiling of the innovation pole. In this phase, the reality is that resources are concentrated into a limited number of flagship projects, and other activities gravitate to these projects to create a local innovation system with sufficient gravitas to offer potential knowledge resources for external-global partners.

Table 3. Innovation policy instrument choice in connecting globally regions

	Easy to deliver	Greatest impact	Lowest cost	Locally popular
Identifying and verifying regional innovation strengths (real, potential and latent)			✓	✓
Focusing on developing these sectors, aligning public resources behind these sectors	×	✓	×	
Inviting external partners to visit the region to develop linkages with local businesses	✓	×		✓
Using 'innovation connectors' to link local businesses to appropriate knowledge sources	×	✓		
Attracting highly skilled to region via dedicated fellowships, research and placement positions	×	✓	×	×
Developing leading institute with a global profile to create visibility and focus for the region		×	×	✓
Encouraging the wider use of innovation partnerships through innovation vouchers	✓		✓	

Note: ✓= Policy strength in connecting globally region

×= Policy weakness in connecting globally region

Deepening pipelines: creating a dynamic regional network

The challenge for those regions is increasing the scale of the regional hinge, so drawing more firms into the part of the RIS which has the closest contacts with outside innovation actors. This helps to strengthen the region as a node within the sectoral innovation system. Therefore, what is important in these situations are those activities which help increase the scale of the hinge, such as creating and attracting new firms, for example. The best firms to create are those that already have global linkages, the so-called born global firms. The other important element is in stimulating existing actors to do things differently, so creating new mini-networks within the RIS, as well as creating a sense of urgency for the need for innovation through things like external benchmarking and foresighting, and creating a collective regional profile in particular sectoral areas which can then be marketed via city- or region-marketing to increase the attractiveness of the region.

Box 10. Flanders: building the image of high-technology Flanders through the Third Industrial Revolution

Flanders in the 1980s used innovation policy as a central plank of its regional strategy. A central component of its approach was Flanders Technology International, a technology festival held every two years, bringing in outside businesses with local guests. The explanation for this was that Flanders' regional strategy was explicitly a search to demonstrate that the Flemish Government could implement successful policies, and to legitimate the regional government vis-à-vis the Belgian layer. As innovation policy was not reserved to the centre, the Flemish government explicitly pursued an internationalising strategy to legitimate further regional powers for it. This is not unique: while innovation strategies may be drawn up at the regional tier, it is certainly untrue to suggest that they limit their ambitions strictly to their regional boundaries.

The main strategic interest in these kinds of regions is in stimulating new groupings of activity within the region, to exploit existing knowledge in new and innovative ways, and to create a demand for external knowledge sources which in turn lead firms to develop new external relationships, thereby increasing the overall regional diversity. In these kinds of regions, there are often one or a few actors that capture the regional policy 'imagination' and are able to configure regional strategies for their own benefits. In the North East of England, for example, the five universities were able to do this after 2003 given the absence of large private-sector R&D activities. In Flanders, in its second wave of regional policy, it encouraged small groupings of firms to approach it directly to create alternative regional innovation opportunities building on the success of the first wave of innovation policy (*cf.* Flanders Technology International). This helps to avoid the risk of existing strong actors overly determining regional innovation policy too closely to their own needs.

Box 11. Regional science policy & renewable energy in the North East of England

The North East of England has made several attempts to build innovative manufacturing strengths around new and renewable energy in the last decade. The engineering history of the region, including supply chains associated with offshore engineering, power generation and electrical dairy vehicles, potentially positioned the region to benefit from these new industries. In 2003, the regional development agency created five centres of excellence regionally, including two with the mission to focus on energy from chemical and electrical engineering perspectives respectively. The idea behind this strategy was to create a focus within the region on high-technology development and innovation, and in particular to reverse perceptions that the region was technologically underperforming. GBP 200 million was invested in these centres of excellence and associated research programmes over a five year period. There were hopes that this would lead to considerable new investment in manufacturing of fuel cells and wind turbines, which did not occur. Over a medium-term period, these areas have developed networks which are more strongly focused on a number of market opportunities, linking science to the market. In the field of wind power, the North East has consolidated its status as a place-to-be for blade research, and in early 2010 announced two substantial private investments, one in blade manufacturing for a nearby offshore turbine array and the other in turbine manufacturing, both high-value added elements of wind turbine value chains. In the field of fuel cells, the focus appeared to have been justified in mid 2009 when Nissan announced plans to develop a GBP 200 million battery manufacturing facility for electric vehicles (creating 350 jobs), and in 2010 plans for its first wave of electrical cars in the Wearside plant as part of a EUR 470 million investment potentially creating 3,000 jobs, highlighting the importance of the Sunderland site globally. The policy lesson is the long-term and step-wise nature of building up a cluster, with important elements being laid over a 15-year period prior to the successes in manufacturing employment generation being delivered.

The key instruments as far as firms are concerned are those that supply knowledge exchange and knowledge transfer between firms. The precise instruments are heavily dependent on the legal context, and in particular anti-competitiveness agreements. Mechanisms encouraging placements, secondments and associateships can be used to link businesses and to build experience and stimulate learning in collective collaboration for competition. Supporting ‘intrapreneurship’, creating new businesses from lead firms and universities can help to open up technology avenues which firms deliberately downplay in their own interest of competition. Co-entrepreneurship – joint ventures with multiple local businesses creating new joint ventures – are also important for creating corporate vehicles which have the opportunity to combine new knowledge creatively and allow them to be dynamically exploited.

Table 4. Innovation policy instrument choice in deepening pipelines regions

	Easy to deliver	Greatest impact	Lowest cost	Locally popular
Identifying latent clusters, firms & research centres with strong global, weak regional links	✓		✓	✗
Emphasising collaborative innovation, backed with substantial public resources	✗	✓		
Targeting globally active actors better linked to local SMEs		✓	✗	
Developing physical spaces and activities bringing actors together to collectively innovate	✓		✗	✓
Concentrating activities in particular locations and value chains	✗	✓		✗
Stimulating intrapreneurship (corporate venturing) to encourage diversification		✗		
Smart enterprise programmes, well-networked, growth-ready high-technology SMEs	✓		✓	✓

Note: ✓= Policy strength in deepening pipelines region

✗= Policy weakness in deepening pipelines region

Sustaining momentum: innovation at the boundaries attracting outside attention

Regions with existing critical mass are those which have strong localised innovation structures that nevertheless perform below expectations within sectoral innovation systems. Typically these might be Italian industrial districts, which cover a full supply chain, or at least provide finished products with little relation to knowledge and innovation activities elsewhere. The focus for these regions is on the one hand developing their external connections, but on the other hand also exploiting their intensely dense inter-regional connections to create new unique knowledge and innovations which attract the interest of outside parties. These regions have the potential to be highly innovative and to create radical innovations from new combinations of existing knowledge. At the same time, they also run the chance of suffering from the ‘weakness of strong ties’, becoming locked in to old habits and patterns of behaviour. The overall innovation orientation for these regions is therefore stimulating experimentation and innovation, and selling its allure to outside innovation actors.

From a strategic point of view, what is absolutely critical is to understand the relationship between the local networks and industrial districts, and the sectoral innovation systems of which they have the chance to form a part. The essence to success is radical innovation, not necessarily in terms of being paradigm breaking, but at least involving different kinds of actors creating new types of products, processes and services. The focus is on stimulating creativity and innovation between different sectors, and therefore creating the kinds of spaces where innovators – whether knowledge producers or exploiters – who would not normally co-associate – have both the opportunity and the reason to work together. Creative quarters and open innovation campuses are typically the kinds of instruments which can help to promote these inter-relations.

Box 12. Preserving leading market position: building the cluster narrative in Baden-Württemberg

The Region of Baden-Württemberg in South West Germany has long been acknowledged as one of the leading European technological regions with a very strong regional innovation system underpinning consistent long-term innovation performance. This is backed by a continuing strength in the German science system, which has seen for example the region perform the best of all the *Länder* in terms of its universities’ participations in the EUR 1 billion *Exzellenzinitiative*. The challenge for the region is to sustain this performance by ensuring the continuing growth and development of the regional innovation system.

Part of the strength of this collaboration is its orientation toward the SME sector, and the strategic focus of innovation policy in recent years has been on strengthening a set of regional clusters. Support for innovation has been directed at these clusters, including through 400 Steinbeis Foundation centres at regional universities, linking it to the Federal policies for Innovative Regions, Clusters and Competence Centres, and in stimulating an awareness of BW’s ongoing strengths. Steinbeis also operates a set of centres responsible for facilitating participation in Europe-wide research and innovation projects.

In 2008, the *Land* published its Regional Cluster atlas, mapping geographically and institutionally the clusters located in its 12 regions, as well as the key innovation support institutions focusing on those regions. These activities together have helped to reinvigorate regional innovation policy, and help to integrate policies between the two regional Ministries responsible. The success of this innovation approach is highlighted by the fact that Karlsruhe is leading the EU’s InnoEnergy Knowledge and Innovation Community (q_v), one of three strategic transnational projects seeking to promote valorisation at the European scale.

Knowledge producers have to become more open, so on the one hand this involves concentrating and encouraging universities and research laboratories to become more active in international collaborative R&D. On the other hand, this involves efforts to bring external partners to the region to stimulate responses from local businesses. This might be by bringing in

delegations or undertaking joint benchmarking work, or by recruiting selected inward investors to establish experimental laboratories together with local business. Unlike in those regions where the need is to improve connectivity between regional firms, these kinds of regions should not aim for a single site that is the ‘shop window’ for the region. In reality, firms will be spread across the region, and there is a need to make innovation support available across the region and not to restrict access to resources to particular flagship locations. Open innovation becomes a mentality and not a laboratory.

For firms, the challenge is in stimulating diversification and changes of direction of otherwise successful innovative activities. This may involve raising the human capital of businesses, exposing them to new practices, and bringing in outside delegations to inspire regional actors as well as to help build up a set of contacts. Part of the strength lies in the capacity of firms already to work together, and this should neither be taken for granted nor ignored. The issue is supporting the kinds of activities in which existing firms work together on relatively radical innovations. Their willingness to do so will in turn influence the extent to which ‘honest brokers’ are necessary for the identification and provision of collective services which in turn help to raise the competence and profile of the industrial district.

Table 5. Innovation policy instrument choice in sustaining momentum regions

	Easy to deliver	Greatest impact	Lowest cost	Locally popular
Developing a strong understanding of the global dynamics of leading industrial sectors	✓		✓	✗
‘Disjoint foresighting’: new combinations of knowledge, resources, talent		✗	✓	
Support for expansion, diversification and increased innovation profile for regional firms	✗		✗	✓
Stimulating creativity and multi-disciplinarity in research and innovation activities	✗	✓	✗	
Encouraging risk-taking in businesses around new and emerging technologies		✓	✗	✓
Targeted support to encourage local businesses to engage more fully with global clusters	✓		✓	

Note: ✓= Policy strength in sustaining momentum region

✗= Policy weakness in sustaining momentum region

Cluster-building: breaking down barriers; unlocking regional potential

In fragmented regions, the challenge is that identified by Nauwelaers & Wintjes, that is to create a policy framework that supports many firms in a light touch way, in a region when innovative firms need intensive and costly support to improve their innovation processes. Part of this is the fact that much of the growth in innovation performance comes from firms that either do not exist yet, or are not active within regional innovation networks, and these kinds of problems are relatively intractable. The innovation strengths in such regions lie in disconnected pockets of excellence which may or may not in turn be connected to global actors. The challenge is in creating a rationale for more of these businesses to work together collectively and increase the density and strength of the regional innovation network, and to help increase the overall availability of knowledge resources through these networks.

The key strategic requirement in these circumstances is to understand what are the real economic opportunities in terms of innovation for the region. Where there are fragmented regional bases, there may also be fragmented representation for these sectors, and the most important strategic outcome to avoid is where support is channelled to articulate rather than high

potential micro-networks. This means that the regional strategy process needs a degree of external input, from both dispassionate local experts as well as external experts. Although this is good practice within all regional innovation strategies, the risks of a politicisation of the strategy process and a failure to create meaningful priorities are the highest for this kind of region. To deal with these uncertainties, alongside external advice and expertise, it is not possible to substitute for learning by doing. It is important to ensure that there are experimental activities providing reasons for different constellations of innovators to work together and thereby to get a sense for the real opportunities that exist for building up local micro-clusters.

Box 13. Tampere: facilitating co-operation and bottom-up clustering

The region of Tampere in the Netherlands was profoundly affected by the deep recession which hit Finland following the collapse of the Soviet Union in 1991. Prior to this crisis, the region had built up a strong coalition of regional actors working together effectively to promote the conversion of its textiles and forestry industries into an increasingly higher-technology knowledge economy. Tampere had attracted a new university as well as a technological university, and in the 1980s, a science park had been created with a much higher degree of independence from the university than usual at that time in Finland. In attempting to overcome this crisis, in which Finland's GDP fell by around 40%, Tampere was forced to be extremely creative with its innovation policy, and took the approach of being extremely flexible in supporting small groups working to stimulate innovation rather than adopting a one-size-fits-all approach to innovation policy. The universities provided the anchors for the development of the high-technology clusters, and the science park the capacity to develop the industrial/ exploitation side. This meant that the various industrial clusters had developed in an entirely idiosyncratic manner, not readily amenable to policy interventions. The city developed a number of cluster organisations to support business development, and when the national government organised a Centre of Expertise programme, nationally accrediting regional clusters; Tampere proposed four of its clusters (mechanical engineering/ automation, healthcare technology, digital media, and knowledge-intensive business services) to the national competition (1998). When the national government refused to accredit Tampere's knowledge-intensive business services cluster, regional actors had sufficient self-confidence to support the cluster out of their own resources, and this cluster has indeed been important in providing complementarity and supporting services for high-technology business. Since that date, the Centres of Expertise programme has become a co-ordinating mechanism for innovation support in the Tampere region managed by the Hermia company on behalf of the city and regional authorities.

The research base has a potentially strong role to play in this process, by acting as a nucleus around which innovation activities can cluster, and providing personnel with skills and knowledge to aid with the potential commercialisation of technology. At the same time, building contacts between universities (and of course other knowledge producers) and firms helps to increase the networking within the RIS, and identify opportunities for brokers, intermediaries and formal supporting institutions. It is important to create the spaces and opportunities for cluster-building, which might be shared facilities, technology clubs, proof-of-concept seed funding, and the research base. It is important to involve firms and universities – the eventual users of this infrastructure – in its development. This is not to suggest that in such situations universities should become purely regional institutions, because they can provide an important conduit to outside knowledge and contacts, but at the same time, in situations where there is a mismatch between university expertise and local knowledge demands, strategy needs to come some way to bridge those gaps without placing undue pressure on the university; technology or competency centres are a good way of achieving this.

Policy for firms is focused on helping more firms to innovate, and critically, to innovate by actively participating in (and hence also contributing to) the regional knowledge pool. Much of this activity necessary is the classic 'new regionalism' espoused by Morgan (1997) and promoted through regional technology policies, with two clear caveats. The first is that that networking activity has to help local businesses to fit into a wider innovation system, which involves both

supporting quality standards and technology circles, as well as innovative activity in those businesses which does not necessarily fit with the needs of the group as a whole. Thus technology circles are not the exclusive locus for innovation activity, as that raises the possibility of lead actors behaving opportunistically. The other element is that it involves creating more actors in the RIS, such as supporting high technology (or innovative) entrepreneurship achievable in the regional context, providing resources for entrepreneurship (finance, patenting, skills), and support for innovation, brokerage, match-making.

Table 6. Innovation policy instrument choice in cluster-building regions

	Easy to deliver	Greatest impact	Lowest cost	Locally popular
Cluster-building programmes stimulating collective action to create cluster identity	x		✓	✓
Encouraging routine encounters via seminars, workshops, match-making, collective bidding	✓	x	✓	✓
Developing shared research infrastructure that brings businesses through solving problems.		✓	x	
Helping SMEs access large firm supply networks, develop local linkages, and improve innovation	x	✓		
Business support focused on networking activities stimulating innovation	✓	x	✓	
Support for innovation resources, assisting with finance, IP, skills, management training			✓	

Note: ✓= Policy strength in cluster building region

x= Policy weakness in cluster building region

Table 7. The relationship between global orientations and use of innovation policy toolbox

	Connecting globally	Deepening pipelines	Sustaining momentum	Cluster-building
1. Improve innovation governance and strategic intelligence for policy-making	Identifying regional strengths in SISs Identifying potential lead partners locally Bringing the 'outside in' – exhibitions, etc.	Identifying potential local micro-clusters with existing global links Building support for encouraging high-growth local businesses	Identifying the role of the local industrial district in sectoral innovation systems. Mapping & understanding local industrial districts	Identifying regional pockets of excellence Identifying opportunities for related-variety spill-over effects
2. Foster an innovation friendly environment	Building connectors to attract potential future investors Support for match-making Mentoring and building up local links Highly skilled gatekeepers and brokers with outside knowledge	Stimulating co-operation between regional partners Benchmarking & foresighting: creating external stimulus for innovation Generating a substantial external profile – marketing to firms	Encouraging <i>radical</i> experimentation within the network, challenging lock-in Encouraging related variety innovations – multi-disciplinary innovation projects Promoting open-innovation & creative campuses	Encouraging local co-operation to build mutual trust -practical innovative activities encouraging relationship building Seminars and workshops from lead companies to diffuse knowledge & expertise
3. Higher education / human capital development / gender issues	Establishing global research profile Attracting 'talent & technology' to the region Bringing new innovation partners to the research to stimulate growth	University/ PRO-based centres of excellence raising global research profile Local networking activities around CoEs Creating local labour market connections via careers service Regionally tailored courses	Stimulating HEIs & firms to participate in international research programmes/ activities Exploiting existing partners, bringing them to region temporarily → permanently Creating brokerage for knowledge flow	Universities leading micro-clusters as honest brokers Supporting market research, technology analysis of cluster shared needs Creating entrepreneurial labour market with business experience, technology clubs etc.
4. Development of research infrastructure	High profile sites visible for potential outside partners Places for the global and local to meet within the region e.g. Science City	Creating central knowledge districts Linking outlying innovators to central knowledge services, e.g. High Technology Campus, Eindhoven	Acknowledging network's diffuse nature, not restricting participation in regional networks Augmenting existing activities and making more accessible physically/ organisationally	Shared R&D facilities Use of university/ PRO/ Technology Centre as broker Stimulating informal knowledge exchange – small tenders/ awards for shared working
5. a) Strengthen innovation in the SME sector	Providing resources to allow local firms to directly access external knowledge in the innovation process Courses & training in innovation process in SMEs, also for strategy-makers	Supporting entrepreneurship – spin-off mechanisms in the supply chain Providing knowledge exchange mechanisms – placements, secondments, internships, around lead actors	Challenging complacency: delegations and visits to world-class locations Helping generate more external contacts and bringing external knowledge into the region for SME benefit	Signposting services to reduce effort necessary for SMEs to access innovation resources. - career services, innovation advice, finance, MBAs, training

Table 7. The relationship between global orientations and use of innovation policy toolbox (cont.)

	Connecting globally	Deepening pipelines	Sustaining momentum	Cluster-building
5. b) Industrial policy and strategic technology policy	Signalling long-term commitment to the area to encourage private matched investment Attracting outside investors and partners (Singapore model) Creating a flagship as anchor to fill in sparse innovation system	Building spaces for other companies to come together around lead actors Supporting for networking and clustering locally building on lead actors Supporting knowledge transfer 'on legs' between firms	Strategic technology policy supporting industrial district competitive advantage Supporting valorisation & diversification by existing firms Upskilling within local businesses to encourage radical innovation	Helping local businesses to fit into supply chains – ISO9001, industry standards – new products into existing markets Supporting innovation projects proving collaborative concepts
6. Encourage enterprise tech transfer, develop innovation poles and clusters	Supporting lead cluster actors as anchor for regional innovation activity Designating an innovation pole to highlight local competency and long-term future orientation	Facilitating technology transfer and problem solving Corporate 'intrapreneurship' from lead actors to get core capacity in innovation networks	Creating shared capacity for mutual global profiling activity Collective networking organisation building external linkages; 'honest broker' developing collective programme	Brokerage: match-making, introductions, sign-posting, creating regional knowledge database Industrial knowledge circles – technology clubs with lead actors involved.
7. Promote and sustain creation and growth of innovative enterprises	Attracting and embedding R&D services via FDI Supporting co-operation with local businesses and universities – shared research and innovation seedcorn – small-scale but intensive	Support for 'born global' companies linked to external finance, knowledge sources Co-entrepreneurship (joint ventures) between regional companies to experiment with new technologies and markets	Funding for business succession, university spin-offs and corporate intrapreneurship Supporting serial entrepreneurship Mentoring new entrepreneurs with serial entrepreneurs	Creating supportive spaces for new high-technology businesses Support in accessing external knowledge sources Ready provision of high-technology entrepreneurship resources (finance, IP, skills)

Source: Policy-toolbox segmentation based on Baier *et al.* (2007); authors' own design.

Conclusions

Towards a framework for global-local RISs

The issues emerging in sections 3 and 4 present an interesting challenge for regional innovation strategies. On the one hand, there is a need for these strategies to have a clearly identified approach to internationalisation, to ensure that the activities equip innovators to compete efficiently within global innovation networks. At the same time, there is the need to ensure that this clearly identified approach does not operate as an add-on to the main strategy, but rather permeates the various instruments, methodologies and strategies chosen.

- Navarre Euroinnova project appears to be an interesting example of this approach, focusing on building networks at a range of scales, and ensuring that there was a degree of overlap and interaction between these various networks.
- Brainport Eindhoven is clearly articulated as a global-pipeline/ local hub strategy for the Netherlands, North Brabant and the Eindhoven city-region, creating a strong cluster rooted around Philips, a company strongly linked to other key innovative centres e.g. Leuven, Aachen.
- Tampere chose a Centres of Expertise approach, finding ways to support world-class clusters of local businesses already well-connected to the university and with their own strong global connections, promoting interaction and collective activity.
- Piemonte's 2005 Regional Law on Research and Innovation has placed a strong emphasis on internationalisation, devoting a substantial share of resources to internationalising the regional system of research and innovation (e.g. EUR 20 million for human mobility measures).

This in turn suggests a concrete methodology for the application of a global-local perspective in practice to regional innovation strategies. The purpose of the strategy is to configure regional assets to make the region more attractive as a location for innovation to outside partners, and to encourage greater knowledge sharing and critical mass-building within the region by RIS actors. This involves a number of separate components in terms of ensuring that the globalisation orientation is integral to the regional innovation strategy.

- Identification of the regional orientation
- Mapping the use of instruments
- Creating an appropriate global-local strategic orientation

Applying the idea of the global-local orientation in practice

Identification of regional orientation

The first element in applying a global-local orientation to regional innovation policy is the identification of the regional orientation in the particular regional context, that is to say what are those regional assets and to which global networks are they connected. There are a number of data-driven regional classifications which already exist for identifying both strengths of regional clusters as well as global connectivity, for example using regional co-patenting data. Simultaneously, an influence on the regional orientation is the wider global structure and dynamics of the key knowledge production networks of salience in which regional actors participate. Therefore, in parallel there is a need to understand what

opportunities exist in this structure for regional actors and strategies to create valued assets which can attract external partners to contribute to the innovation activities.

The key focus of this stage is that this is a learning exercise for partners within the region to determine where their regional strengths and weaknesses lie, and on the basis of their overall global-local connectivity, what kinds of approaches and instruments they may wish to choose. For less experienced regional innovation animateurs, the key challenge is one of imperfect information, and having insufficient knowledge about the region and its strengths to realistically evaluate what instruments could make the greatest difference. This stage is similar to a regional visioning stage of a more general regional innovation strategy in determining what the vision for the region is, and in particular, what the next realistic stage for the region is in terms of increasing the accessibility of its local firms to global innovation networks to strengthen regional competitiveness.

The main challenge in this stage is in being robust and objective. This means the smart use of quantitative data where it is available, although there is the risk that economic and innovation data do not adequately capture the real regional performance. Benchmarking with other comparable regions, as is already undertaken in Europe in a number of scoreboard and benchmarking exercises, can in part get around this problem. But what is important for regions to draw out from these exercises is to 'learn by inference' from other regions. By identifying how other similarly scoring regions have understood their global-local position, lessons can be drawn as to the kinds of problems and barriers in the way of improved regional performance. In these cases, policy examples should not be followed blindly but rather the understanding of the problematic applied.

An example is for regions which, like Navarre, are already heavily internationalised, and performing relatively well in terms of R&D performance, with GERD on GDP of 1.9%. The lesson to be learned is that in some regions, there can be a problem from the existence of a number of innovation networks which do not overlap. In Navarre, they chose to try to mobilise new networks and integrate them effectively in wider innovation networks through a comprehensive networking approach. For other regions this might not be appropriate, but the idea of integrating networks which do not yet overlap may form the foundation for another approach, for example through an Innovation Platform to bring representatives of these various networks into a common forum and produce common solutions.

The biggest risks at this stage of the process are that the analysis exercise becomes politicised. This creates problems at a variety of levels which are very difficult to rectify without having to abandon the whole approach. Firstly, where there are particular favoured sectors within a region, they can have a vested interest in blocking the emergence of new innovation policy if it threatens their privileged position, or from the recognition of new/ alternative sectors if these would dilute the privilege of established actors. Regional politicians might also have more interest in starting a process that produces a stream of positive stories about the region and about the governing institution than actually effecting real regional change. Likewise, this can lead to an identification of the project with a particular regional grouping, which in turn can lead to the strategy falling out of favour after changing political complexions of particular governance arrangements.

The likely problems, and suitable solutions to these problems, also vary by the type of region, and in particular the experience that these regions have in developing innovation policies, understanding their existing innovation capacity, and deciding objectively what solutions might work and contribute to the improved global integration of their regional innovation systems.

- **Connecting globally:** in these regions, the difficulty lies in understanding which latent and potentially externally-networked actors have the potential to be worth supporting as the basis for a better connected knowledge economy.

- **Cluster-building:** the greatest issue here is in distinguishing between the different global connectivities of the latent and actual micro-clusters that exist in the region, and in particular in identifying which clusters are to be prioritised.
- **Sustaining momentum:** the greatest issue in these regions is in addressing complacency and creating a sense of urgency; it is easy to have a politically desirable strategy and to describe it as a global-local perspective than to challenge the existing order.
- **Deepening pipelines:** the clear difficulty here is in getting round the existing lead partners who dominate regional discussions and are able to configure strategy and policy outcomes to their own benefit.

Mapping of use of instruments and global-local orientation

Following the decision and adopting of a global-local orientation for a potential regional innovation strategy, the next step in the process is then in deciding what instruments can be used. Important in this step is in calibrating the instruments that are working well in the region to ensure that they maximise local actors' resources to useful innovation resources globally and locally. Just as it is a beginner's mistake in the development of regional innovation policies to set unrealistic goals and targets, what a region can hope to achieve in terms of its global-local integration is limited by its existing capacity and opportunities. The principle in maximising the global-local connectivity is to initiate a constructive process whereby existing conduits help support existing businesses, new conduits are created, and new businesses are created and attracted with a more global-oriented profile in parallel with good local connectivity. However, the risk in this domain area is in adopting new and untested policies that have worked impressively elsewhere without understanding how they relate to the connectivity problems, limitations and bottlenecks of the region in question.

What much of the research has shown is that there is a strong implicit global-local dimension in many of the innovation institutions in the policy-makers' toolkit. The issue here is to marry up two dimensions, the first are those policies which work well in the region in question, and the other is how to encourage in those regions the right kind of connectivity-building activities. The question for policy-makers is then how to migrate the currently successful policy instrument to the ideal-type connectivity solution without undermining the success of the policy and the knowledge and connectivity of actors involved.

In a region with a university as main innovation actor with a strong science park, the challenge is to decide where the balance should lie between supporting innovation in existing businesses, encouraging high-technology start-ups, and attracting new research-intensive businesses. Where that balance lies in part depends on the capacity of local firms to absorb regional knowledge, and also on the attractiveness of the region and the university for potential external businesses. These are not simple judgements to make, but are necessary in order to be able to strategically anchor actors in the regions and create clusters of knowledge development which help reinforce the global-local connectivity.

One issue which is seldom addressed is the issue of the attraction of human capital to a region, in part because it is a very tricky issue to address, and in particular, regions that are not necessarily well globally-connected are often those that have challenges in attracting high-quality human capital. In parallel with that, it is often easier for the university sector to attract high quality workers because of the culture of academic mobility in the sector, and if universities are not the region's main hinge actors, then fellowship and research programmes can be a very expensive way to encourage local clustering process activities that might be better promoted via other mechanisms. This issue is not the same as brain-drain: graduate entrepreneurship and placement programmes can help regions with universities to attract high-quality

talent. the problem arises because regions lack individuals with the talent and connections to operate in global knowledge environments.

The practical solution for this has regularly been the creation of a global vision into which many partners are able to buy, which is both sufficiently abstract to encompass the novel search activities necessary but also sufficiently practical to build upon the strengths of the region. The vision is enacted through a series of concrete activities, such as the idea of the 'Third Industrial Revolution Flanders' being operationalised through Flemish Technology International, in turn inspired by a international technology fair in France, that sought both to expose Flemish companies to global innovation networks but also to sensitise local residents to the importance of innovation to competitive success. Oosterlynck (2007) characterises this as being more akin to a 'movement' rather than to being a strategy or project, reposition Flanders more positively globally. The idea of a movement captures both the broader vision but the range of activities that are also implemented under their name.

This phase is characterised by uncertainty amongst actors who have to make judgement calls in environments within which they may have very little good information. The risk in these situations for less experienced actors is that the need to take decisions leads to those decisions being taking using other kinds of reasoning and decision-rules than what makes sense in terms of global connectivity. The decisions may revert to an underlying logic, which may be clientelism, protectionism/ discrimination, favouritism or even choosing something because of its implausibility. Policies may be adopted from successful regions without looking at the underlying changes the policies drove and the context sensitivity of the solution. In more experienced regions, there is the converse risk of complacency, and failing to explore *potential* new connections and opportunities, instead favouring existing connections producing a kind of path-dependency, lock in and opportunity costs, all producing deadweight from a policy perspective.

- **Connecting globally:** in these regions, the challenge is in creating tangible global connections; a global vision is easy to articulate, but it is much harder to convert that vision into concrete actions which embody that vision.
- **Cluster-building:** in these regions, with pre-existing global connections, it is hard to encourage vulnerable micro-clusters to engage with other local companies with the potential to benefit from them, at the risk or cost of undermining the survival of the overall cluster.
- **Sustaining momentum:** these regions typically already have a strong infrastructure of activities such as exhibitions and festivals that create global connectivity; the biggest risk is that their success excludes potential beneficiaries that may be too big and commercial for local firms to access, or they may reflect the interests of a limited local group.
- **Deepening pipelines:** the challenge in these regions is that as global connections lie in the hand of a few hub actors, they will use the approach to further their private global interests at the expense of local actors.

Developing the global-local narrative within the regional innovation strategy

The development of a global perspective has many of the characteristics of a regional innovation strategy process, but it is not a process and it must be kept distinct from that strategy process. Certainly, it has a similar dynamic, requiring information-gathering, decision-making, consensus-building, piloting, expansion and mainstreaming. Those involved will also go through the same peaks and troughs of energy and enthusiasm in developing visions, projects, movements and activities. But developing a global perspective is an end in itself, and the third stage of the development of that perspective is anchoring it effectively back in the key strategies by which regions prosecute their regional innovation. In some

regions, these will be documents with the title of ‘regional innovation strategy’, but for others, particularly for those with complex multi-level governance arrangements or a strong degree of centralisation, they may also be embedded in national strategy documents for science, economic development and physical planning, and even in annexes setting out how those national policies apply in particular regional (sub-national) contexts.

In the second phase, with the realisation of the global innovation perspective, a set of activities are developed which support the development of a particular orientation which fits with the region’s particular global connectivity. This demonstrates that a particular approach to building connectivity can work - in this third phase, that orientation is ‘mainstreamed’ and made operational for regional innovation policy as a whole. This is done by aligning the activities within the global vision with other regional innovation activities, and helping to transfer the momentum and dynamism of these novel activities towards helping to rebuild a deeper, and more connected network. However, this reconnection task is certainly not trivial, particularly in situations where two different groups of people are responsible for a global perspective on the one hand, and regional innovation policy on the other. Certainly what helped Flanders succeed in developing its perspective was the fact that the same people (not institutions, but the politicians and administrators) had responsibility for, and interest in, both activities.

The nature of the challenge at this stage is in connecting two separate development processes with their own timetables, tempos and logics. In particular, the challenge lies in learning from one activity, the global perspective development, to influence the other, whilst at the same time, ensuring that the global perspective best reflects developing regional capacities and endowments. Each of these two processes have moments when participants are prepared to be open and to learn from one another, moments where partners are very focused on delivering particular tasks, and other moments where they are exhausted and emphasis must lie on consolidation. If these phases in the two processes are out of step, then it becomes very difficult to ensure that there are the mutual learning processes and knowledge exchange which can help to embed the global perspective in all of the activities of the regional innovation strategy.

This **is** a non-trivial problem to achieve and there are no simplistic solutions, because the nature of the processes will also vary in different regions. But regional innovation strategy capacity does not simply map across to the archetype regions already developed, with the exception of the cluster-building regions where there is likely to have been relatively little prior strategic activity. Strong internal connectivity is not dependent on the existence of regional strategies, although where it does not exist, it is likely to be a target for regional strategies.

Where there is strong regional innovation strategy capacity, and a community associated with developing and maintaining that strategy, the reality is that globalisation actions are likely to be seen as a challenge to existing partnerships, relationships, activities and interest. The challenge there is in ensuring that key regional innovation partners are able to understand the benefits of the globalisation activities, and to feel a sense of ownership of them in being able to contribute constructively to their development. Where there is no strong regional innovation capacity, the opposite is likely to be the case, and the global perspective becomes the default innovation strategy, and that runs the risk of excluding all those local activities which are not immediately globalising, but which can nevertheless through their local innovation and knowledge-based development activities contribute to developing more comprehensive and productive regional knowledge economies.

- **Connecting globally:** the issue for these regions is in tailoring other activities to supporting the hub activity, and ensuring the hub is well-connected to other local actors, as well as increasing its connectivity, for example through building incubators, open innovation spaces and start-up centres around science parks.

- **Cluster-building:** in these regions there is a need to build agreement on which are the clusters and sectors which will be supported into the future, and in developing instruments which help local firms participate most effectively in these wider clusters.
- **Sustaining momentum:** in these regions there will typically be very strong interest communities representing successful and well-networked sectors; their interests must be considered alongside those of firms and actors who have not directly benefited from the globalisation process, to ensure that the region's global hubs do not disembed.
- **Deepening pipelines:** in these regions, typically flagship innovation projects will build up such as science city-type projects, and there is the risk that these projects are seen as the end-point rather than as a means to an end, and over time, the globalising dimension is lost in favouring of servicing the interests of the key hinge actors.

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APPENDIX 1

Figure 9. The possible configurations of regional innovation systems based on internal connections and external hinges

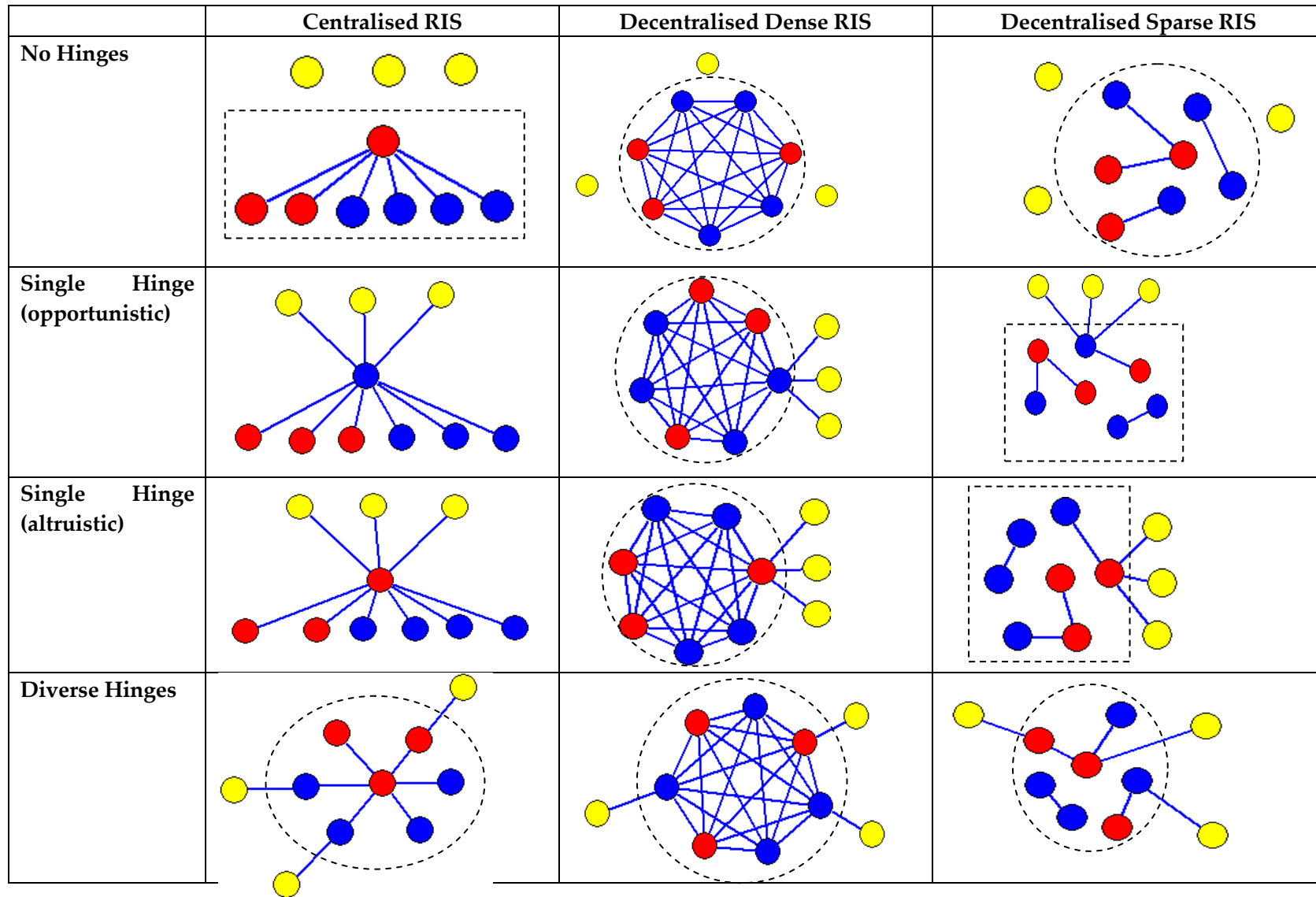


Table 8. The optimum operations for building local connections given RIS internal and external connectivity

	No Hinges	Single Hinge (opportunistic)	Single Hinge (altruistic)	Diverse Hinges
	Building Global Connections	Reducing Opportunism	Optimizing System	Optimizing System
Centralised RIS	Build hinge through hub	Increase local networking/Reduce opportunistic behaviour	Build global connections	Local networking
Decentralised Dense RIS	Find external connection/get a global perspective	Build global connections	Build global connections	Anchor global firms locally
Decentralised Sparse RIS	Change system/path-breaking grand project	Increase local networking/reduce opportunistic behaviour	Increase local networking/build global connections	Increase local networking/prepare for global linkages