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**Reframing the role of universities in the development of regional innovation systems**

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## **Abstract**

The role of universities in regional innovation has evolved over the last twenty years. This evolution has seen the emergence of a third role of universities that has re-shaped and transformed their two traditional functions of teaching and research. This paper proposes a conceptual framework for analysing variation in the roles performed by universities in the development of regional innovation systems. This framework is based on the triple helix model of university, industry, government relations, the literature on university engagement and the innovation systems literature, more generally. The framework is applied to a comparative study of three non core-metropolitan universities in Australia. A number of insights and issues are drawn in regard to conceptualising the role of universities in regional systems.

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## **Introduction**

The role of universities has evolved over the last 20 years. Where once largely focused on teaching and research within a universal community of knowledge creating institutions, universities are adopting a third role in regional economic development (Etzkowitz and Leydesdorff 1999). This role is recursive, re-shaping the two traditional roles undertaken by universities, and transformative, re-positioning universities as primary institutional spheres in economic regulation, alongside industry and the state (Etzkowitz and Leydesdorff 1997; Sutz 1997). This paper proposes a conceptual framework for analysing the third role of universities and for explaining variation in the roles that universities perform in different regional settings. This framework draws on two bodies of literature: the triple helix model of university, industry, government relations (Etzkowitz 2002a, 2002b; Etzkowitz and Leydesdorff 1999) and the literature on university engagement (Holland 2001, 1999; Chatterton and Goddard 2000). These bodies of literature point to two types of roles performed by universities, which I label generative and developmental, respectively. The literature also points to a number of factors that explain the roles that universities perform in regional systems. These factors, potentially, explain variation in the roles that universities perform in different regional settings.

The second section considers the major touchstones in the conceptualisation of the role that universities perform in regional systems, drawing on the innovation systems literature. The conceptual framework for analysing the role of universities in regional innovation systems is

then set out. This section introduces the two types of roles performed by universities, based on the triple helix and university engagement literatures; as well as the factors explaining the roles that universities perform. The third section applies this framework to a study of three non core-metropolitan universities in Australia. The final section draws out a number of implications of the study for conceptualising the role that universities perform in regional innovation systems.

### **Conceptual framework**

The conceptual framework consists of two parts that explore ‘what’ universities do and ‘why’ they do what they do. The literature has tended to focus on the first issue, but is weak in exploring the second. The role of universities in the development of regional innovation systems may be categorised using a duality spanning generative and developmental categories, based on the triple helix model and the literature on university engagement. These categories, which are not mutually exclusive, may be articulated with reference to four key elements of a regional system, as found in the literature on regional systems and on the new regionalism. These elements are: regional agglomeration, a proximate stock of (human) capital, an associative governance framework and cultural norms of openness to learning, trust and cooperation between firms. The second part of the framework consists of a number of factors, evident in the literature, that appear to explain the roles that universities perform. These factors involve characteristics of the university and of its proximate regional space, and they can also be used to explain variation in the roles performed by universities in different regional settings.

#### *(i) The role of universities*

Theorisation of the role of universities in regional innovation systems has evolved in the last twenty years, from the innovation systems approach, which highlighted the importance of knowledge spillovers from the educational and research activities performed by universities in regional knowledge spaces, towards the development of a third role performed by universities in animating regional economic and social development (Etzkowitz 2002a, 2002b; Etzkowitz and Leydesdorff 1999, 1997; Leydesdorff and Etzkowitz 1998; Holland 2001; Chatterton and Goddard 2000; Goddard and Chatterton 1999).

Universities have long been recognised as providers of basic scientific knowledge for industrial innovation through their research and related activities, where ‘industrial’ connoted the agricultural and manufacturing sectors (Guston 2000; Smith 1990; Hart 1988). Neoclassical economic theory explained the productive performance and competitive advantage of firms largely in terms of relative resource endowments (Hall 1994). The role of knowledge and of institutions involved in the creation of knowledge was seen as exogenous, though not unimportant, to the production system (Freeman 1995). The emergence of the national systems of innovation approach (Freeman 1991; Lundvall 1992) shifted this conceptualisation of the role of universities in economic production, bringing universities ‘inside the tent’. In regard to the role that universities perform in regional innovation systems, there are two dominant approaches to conceptualisation. These two approaches – the triple helix model of university, industry, government relations and the literature on the engaged university – overlap, but also manifest some important differences in emphasis. Both bodies of thought highlights that universities are increasingly linked to place but they offer different analyses of the driving forces shaping that relationship. Further, there are significant issues surrounding the assumptions made regarding institutional; norms and behaviours.

The triple helix model (Etzkowitz and Leydesdorff 1997) sharpened the focus on the role of universities in regional economies, pointing to the anticipation of hybrid university, industry, government relationships that involved the multiplication of resources and capital formation projects, such as real estate development in science parks and firm formation in incubator facilities (Etzkowitz 2002b: 14). This model conceptualised a non-linear, interactive approach to innovation as a recursive overlap of interactions and negotiations among universities, industry and government – the three helices conceptualised in the model (Etzkowitz and Leydesdorff 1997). A key insight offered by this model is the hybrid, recursive, cross-institutional nature of relations among the three helices. The institutional spheres of the state, the university and industry were formerly separate entities that interacted across strongly defended boundaries. Increasingly, individuals and organisations within the helices are taking other roles than were traditionally ascribed to them (Etzkowitz and Leydesdorff 1999: 113; Etzkowitz and Leydesdorff 1997; Sutz 1997).

However, while authors within this body of thinking have pointed to limited examples of hybrid and overlapping roles (notably, MIT), it may be argued that the theoretical and empirical bases for limiting the presence of goal conflict, advocating equivalence of scale (and associated matters of capacity and power) across the institutional spheres and heightening the importance of a self-generating current of academic entrepreneurialism, is weak. At best, the empirical evidence underpinning the key assumptions underpinning institutional roles and behaviour interaction and independent entrepreneurial drive by university managers warrants further exploration. Nonetheless, the emphasis on academic entrepreneurialism in the triple helix model, centred on knowledge capitalisation and other

capital formation projects, may be regarded as conceptualising a generative role for universities, where these institutions drive development.

The literature on the engaged university (OECD 1999a; Holland 2001; Chatterton and Goddard 2000) also focuses on the third role of universities in regional development, but it differs from the triple helix model in its emphasis on adaptive responses by universities, which embed a stronger regional focus in their teaching and research missions. This approach does not eschew the development of hybrid, boundary-spanning mechanisms for external engagement; rather, it takes a broader, developmental focus that includes a range of mechanisms by which universities engage with their regions. Universities, through their resource base of people, skills and knowledge, increasingly, play a significant role in regional networking and institutional capacity building. Staff, either in formal or informal capacities, may act as “regional animators” (Chatterton and Goddard 2000: 481) through representation on outside bodies ranging from school governing boards and local authorities to local cultural organisations and development agencies. As such, universities make an indirect contribution to the social and cultural basis of effective regional governance.

The university engagement approach, therefore, points to a developmental role performed by universities in regional economic and social development that centres on the intersection of learning economies and the regionalisation of production and regulation. However, this body of thinking also appears to downplay differences in the missions of relevant institutions, as well as, arguably, oversimplifying the capacity and willingness of universities to adapt their functions in response to external signals.

These two bodies of literature point to a distinction between generative and developmental roles performed by universities in regional innovation systems. To explicate the nature of these roles further, they can be applied to four key elements of a regional system that are widely accepted in the literature. The four key elements are: the spatial agglomeration of firms and other organisations in a bounded geographical space, in a single industry, or complementary industries; the availability of a stock of proximate capital, particularly, human capital; an associative governance regime and the development of cultural norms of openness to learning, trust and cooperation between firms (Cooke 2002a; Niosi and Bas 2001; Morgan 1997; Florida 1995; Johnson and Lundvall 1994).

Table (i) draws together the two types of roles performed by universities in regional innovation systems and summarises the nature of these roles with reference to the four key elements of regional systems.

**Table (i) Analysing universities' contribution to the development of regional innovation systems**

<i>Key element of regional innovation system</i>	<i>Generative role</i>	<i>Developmental role</i>
Regional agglomeration, or clustering, of industry	<ul style="list-style-type: none"> <li>• Knowledge capitalisation and capital formation projects, centred on firm formation and co-location of new and existing firms near the University.</li> </ul>	<ul style="list-style-type: none"> <li>• Entrepreneurial activities, as well as regionally-focused teaching and research, not necessarily linked to capital formation projects.</li> </ul>
Human capital formation	<ul style="list-style-type: none"> <li>• Integration of education and knowledge capitalisation activities, specifically, firm formation, through teaching incubators.</li> <li>• Development of generic, advanced training programs to support firm formation and cross-institutional mobility by</li> </ul>	<ul style="list-style-type: none"> <li>• Stronger regional focus on student recruitment and graduate retention.</li> <li>• Education programs developed/adapted to meet regional skills needs.</li> <li>• Learning processes regionally-informed.</li> </ul>

	organisations and people.	
Associative governance	<ul style="list-style-type: none"> <li>• Driver of regional innovation strategy, centred on knowledge capitalisation and capital formation projects; by analysing strengths and weaknesses and bringing together industry and government to forge innovation strategy.</li> </ul>	<ul style="list-style-type: none"> <li>• Shaping regional networking and institutional capacity, through staff participation on external bodies; provision of information and analysis to support decision-making and brokering networking between national and international contacts and key regional actors.</li> </ul>
Regional cultural norms	<ul style="list-style-type: none"> <li>• Tradition of university/industry linkages, involving knowledge capitalisation.</li> </ul>	<ul style="list-style-type: none"> <li>• Tradition of university/industry linkages, involving knowledge capitalisation and other research collaborations.</li> </ul>

(ii) *Explaining variation in the roles of universities in regional innovation systems*

The second part of the conceptual framework addresses possible explanations of variation in the roles that universities perform in the development of regional innovation systems. A number of explanatory factors emerge from the triple helix and university engagement literature. These factors, which involve characteristics of the university and of the region, are listed in Table (ii) below.

**Table (ii) Summary of explanations of the roles that universities perform in the development of regional innovation systems**

<i>Explanatory factor</i>	<i>Definition</i>
University orientation to regional engagement	Nature of senior management commitment to regional engagement and mechanisms through which this is operationalised.
History of university-region linkages	Nature of historical linkages between a university and regional actors.
Complementarity of fields	Degree of alignment between the research strengths of a university and regional knowledge needs.

Champions	Presence and influence of university and regional advocates of university-region/industry linkages.
Nature of regional industry base	Types of industries and businesses in a region, and their demand for university knowledge linkages.
Political and economic conditions	Influence of specific government policies and/or practices directed to the region and the university. Influence of specific economic conditions in the region.

Table (ii) indicates that there are a number of institutional and economic factors that shape the role that universities perform in the development of regional innovation systems. The behaviour of these factors will vary between institutions and there may be additional factors that are peculiar to one or more institutions.

### **Comparative analysis of three Australian universities**

The conceptual framework developed in the previous section was applied to a study of three non core-metropolitan universities in Australia. The case studies, which involved over a hundred semi-structured interviews and extensive document review, centred on a peri-urban university, located in a predominantly services-oriented regional economy; a provincial city university located in a region dominated by manufacturing, but in transition towards a services industry base; and a rural university located in an agricultural region. Each case study involved a number of semi-structured interviews, supplemented by detailed review of documents, including Annual Reports, Strategic Plans, Research and Research Training reports, government reports and internal papers and reports provided by the universities. In total, 102 interviews were undertaken, with senior university managers, academic staff, representatives of local authorities, government agencies, regional development bodies, other peak regional bodies, area consultative committees, peak business and industry bodies and private firms. The

range of actors canvassed provided a rich picture of the nature of each university’s engagement with its external environment and key characteristics and issues relating to the regional settings within which the universities operated. Table (iii) summarises the results of the study.

**Table (iii) Summary of the roles performed by the three non core-metropolitan universities in regional innovation systems**

<i>Key element of regional innovation system</i>	<i>Peri-urban university</i>	<i>Provincial city university</i>	<i>Rural university</i>
<i>Regional agglomeration</i>	• Developmental role.	• Emerging generative role.	• Developmental role.
<i>Human capital stock</i>	• Developmental role.	• Emerging generative role.	• Developmental role.
<i>Associative governance</i>	• Developmental role.	• Generative and developmental roles.	• Developmental role.
<i>Regional cultural norms</i>	• No evidence of significant role.	• No evidence of significant role.	• No evidence of significant role.

Table (iii) shows that the three universities tended to perform a developmental role in regional innovation systems, consistent with the university engagement literature. That is, the universities tended to focus on adapting their traditional roles in teaching and research to support regional needs, rather than re-positioning their roles relative to industry and the state in driving development, through knowledge capitalisation and other capital formation projects centring on academic entrepreneurialism. However, on the evidence reported in the study, it may also be argued that the behavioural change was rather less adaptive than reactive to perceived incentives. The exception to this general conclusion was the provincial city university, which was developing an emerging generative role across three of the four key elements of regional innovation systems considered in the study. Although not yet reaching full effect, the study highlighted an evolution in the development of this University’s knowledge

linkages with industry, from an emphasis on individual transactions towards capital formation projects involving groups of firms. However, there was a weakness in the University's ability to capture the commercial benefits of the knowledge bases that it had created, or co-created.

A number of explanations of these findings emerged from the study, as summarised in Table (iv).

<i>Explanatory factor</i>	<i>Peri-urban university</i>	<i>Provincial city university</i>	<i>Rural university</i>
<ul style="list-style-type: none"> <li>▪ University orientation to engagement</li> </ul>	<ul style="list-style-type: none"> <li>• Focus on community development and social justice. Operationalisation relatively recent, in 2000.</li> </ul>	<ul style="list-style-type: none"> <li>• Entrepreneurial focus as driver of regional economic growth.</li> </ul>	<ul style="list-style-type: none"> <li>• Limited focus on regional engagement, until recently. Operationalised in 2002/3. Ad hoc activities previously.</li> </ul>
<ul style="list-style-type: none"> <li>• History of university-region linkages</li> </ul>	<ul style="list-style-type: none"> <li>• Heritage steeped in education, as Colleges of Advanced Education.</li> <li>• Limited research role.</li> <li>• Limited community engagement role.</li> </ul>	<ul style="list-style-type: none"> <li>• History of university-industry knowledge-based linkages, in steel manufacturing and mining; extended to advanced manufacturing and IT&amp;T, as well as health.</li> <li>• History of engagement with regional governance.</li> </ul>	<ul style="list-style-type: none"> <li>• History steeped in agricultural education; later agricultural research.</li> <li>• Limited community engagement, other than, through education programs.</li> </ul>
<ul style="list-style-type: none"> <li>• Complementarity of fields</li> </ul>	<ul style="list-style-type: none"> <li>• Research strengths aligned with knowledge needs of public and non-profit agencies involved in regional governance.</li> <li>• Weak alignment with knowledge needs of private sector industries.</li> </ul>	<ul style="list-style-type: none"> <li>• Research strengths aligned with manufacturing, IT&amp;T and energy sector demands.</li> <li>• Weaker alignment with knowledge needs of services industry SMEs.</li> </ul>	<ul style="list-style-type: none"> <li>• Research strengths aligned with agricultural industries in region.</li> </ul>
<ul style="list-style-type: none"> <li>• Champions</li> </ul>	<ul style="list-style-type: none"> <li>• University champions shaped the policy on engagement, notably, the focus on community development and social justice; and role in shaping regional governance.</li> <li>• Limited evidence of a specific role performed by external champions.</li> </ul>	<ul style="list-style-type: none"> <li>• Champions, within the University and in the region, leveraged the development of linkages with key firms in manufacturing and IT&amp;T; technology precinct and the development of the Innovation Centre and Innovation Campus.</li> <li>• Regional champions maintained informal and</li> </ul>	<ul style="list-style-type: none"> <li>• Ad hoc role academic staff.</li> <li>• Limited role by champions at senior level, until recently.</li> </ul>

		formal linkages with senior University officers, seeking their input and guidance on regional strategies.	
<ul style="list-style-type: none"> <li>Nature of industry base</li> </ul>	<ul style="list-style-type: none"> <li>Services industries and public agencies; some manufacturing; IT and agriculture.</li> <li>Dominated by SMEs</li> </ul>	<ul style="list-style-type: none"> <li>Manufacturing, but in transition towards a stronger services base.</li> <li>Largely SMEs and a limited number of medium to large firms.</li> </ul>	<ul style="list-style-type: none"> <li>Agricultural and related industries – rice, viticulture, wine production.</li> <li>Dominated by SMEs</li> </ul>
<ul style="list-style-type: none"> <li>Political and economic conditions</li> </ul>	<ul style="list-style-type: none"> <li>General political support for role of the University.</li> </ul>	<ul style="list-style-type: none"> <li>Strong political support for development of the region and the role of the University.</li> </ul>	<ul style="list-style-type: none"> <li>General political support for role of University.</li> <li>Prolonged drought, which has depressed producer levies used to fund R&amp;D in agricultural industries.</li> </ul>
<ul style="list-style-type: none"> <li>Additional factors</li> </ul>	<ul style="list-style-type: none"> <li>Size/diversity of the region.</li> <li>Location of the University.</li> <li>Reluctance of SMEs to engage with universities.</li> <li>Individualistic business culture.</li> <li>Poor understanding of innovation.</li> <li>Staff reluctance to do regional work.</li> </ul>	<ul style="list-style-type: none"> <li>Funding pressures/lack of incentives for regional engagement.</li> <li>Reluctance of SMEs to engage with universities.</li> <li>Individualistic business culture.</li> <li>Poor understanding of innovation.</li> <li>Staff reluctance to do regional work.</li> </ul>	<ul style="list-style-type: none"> <li>Funding pressures/lack of incentives for regional engagement.</li> <li>Geographical isolation of region.</li> <li>Structure of R&amp;D system in the agricultural industries.</li> </ul>

**Table (iv) Factors explaining variation in the roles performed by universities in regional innovation systems**

Table (iv) compares the explanatory factors across the three universities as the basis for explaining variation in the roles that they performed in the development of regional innovation systems. Of the three universities, only the provincial city University had adopted an entrepreneurial orientation to regional engagement. Senior managers had sought to position the University as a key enabler of the region's future economic development. This was manifest in a number of ways, notably, in the development of a technology precinct and, more recently, an Innovation Campus, as the focal point of a regional IT&T hub; as well as the development of informal and formal relationships with a range of key actors in the regional governance institutional set-up, centred on leadership of a regional innovation strategy. The peri-urban university had adopted a different focus in its approach to regional engagement, driven by a concern for a broader contribution to community development and social justice. This was manifest in the nature of its engagement with agencies in the regional governance set-up, particularly, a range of collaborative research projects undertaken with public and non-profit agencies that held key responsibilities in regional governance and the provision of information and analysis of social issues facing the region.

The nature of the rural university's orientation to regional engagement was unclear, because formal statements of intention in its recently released Strategic Plan had yet to bear fruit. However, the signals emerging, for example, from the two Memorandums of Understanding developed with the local authority, which involved partnerships relating to technology transfer and social and cultural development, pointed to a broad-based orientation to engagement. But, at this point, the rhetoric outran reality. Table (iv) also points to significant variations in the depth of orientations to engagement, with the peri-urban university and the rural university implementing formal commitments to regional engagement only in recent years.

Table (iv) reveals similarities and differences in the nature of university-region linkages across the three universities. The provincial city university had had a deeper tradition of engagement with industry and with the regional governance set-up, although, until recent years, these linkages centred on individual transactions with a limited number of medium and large companies. These linkages had been developed through a number of trilateral research mechanisms and, more recently, capital formation projects. There were similarities in the history of university-region linkages between the peri-urban University and the rural University, because the heritage of both institutions was grounded in post-secondary, vocational education provision, as Colleges of Advanced Education. It is understandable, therefore, that these two universities performed a developmental role in human capital formation, compared to the provincial city University, which had a stronger tradition of education and research linkages with firms. Their heritage as education providers meant that limited scope existed, until relatively recently, for the development of broader knowledge-based linkages through research activities, with industry. Added to this, their activities in external engagement were, largely, allied to their educational programs.

It may be unreasonable to suggest that there is an unbreakable link between heritage and the role performed by a university in the development of a regional innovation system. Universities develop and mature over time, and the principal thrust of the third role of universities, as discussed in the triple helix and university engagement literatures, suggests this. However, there are lags in the operationalisation of change and it was evident that, at this point, the shifts towards a third role by the peri-urban university and the rural university were yet to take strong effect. Consequently, the footprint of their heritage as post-secondary education providers appeared to overshadow.

The provincial city University and the rural University demonstrated a close alignment between university research strengths and the knowledge needs of private sector organisations. The peri-urban University's research strengths were supportive of the knowledge needs of actors involved in regional governance, but were poorly aligned with the needs of private sector industries. This was evident in an analysis of collaborative research projects undertaken through trilateral research mechanisms. Collaborative research projects undertaken by this University were, predominantly, with public agencies in the region, whereas, the provincial city University tended to partner with private firms; albeit a limited number of medium and large firms in its primary regional context and in secondary regions. Similarly, the rural University's involvement in trilateral research mechanisms centred, predominantly, on research in the agricultural industries. The University's developmental role in human capital formation also reflected its research strengths. There were differences in alignment, therefore, between the research strengths of the universities and regional knowledge needs, which underpinned their role differences.

Table (iv) highlights the differences in the depth of influence of champions in the three universities. This is evident in comparing the peri-urban University and the provincial city University. The role of champions in the peri-urban University had been an important determinant of the policy orientation of that university to regional engagement; but this had not been matched by specific roles performed by champions in the region. Although there were regional champions of the role performed by the University, in a general sense, there were few examples of specific advocacy by regional actors. On the other hand, in the provincial city University, there was evidence of a more pervasive role performed by internal and external champions, through informal and formal channels, which had led to specific

developments, such as the Innovation Campus, the development of a cooperative research centre and the co-location of a major international telecommunications company with the University.

Table (iv) further points to significant variation in the nature of the industry bases in the three regions studied; although, a common characteristic was the dominance of SMEs, which is typical of non-metropolitan regions in Australia (DISR 2001). The peri-urban region was dominated by SMEs in services industries and a range of public agencies that were embedded in the governance institutional set-up. These sectors are not, typically, regarded as exhibiting a strong demand for horizontal knowledge sources as innovation impulses (DISR 2002; Basri 2001). On the other hand, the industry bases of the provincial region and the rural region were predominantly science-based, although there was evidence of a shift underway towards a services economy in the provincial region. The firms and industries with which the provincial city University had tended to develop knowledge linkages did not have strong local supply chains and had tended to rely on knowledge linkages with a number of universities, nationally and globally. In regard to the rural region, although the agricultural industries were science-based in nature, agglomeration economies were more sensitive to factors other than the availability of proximate knowledge sources from universities; for example, climate and commodity prices.

There were also marked differences in the nature of political and economic conditions shaping the three regions and their universities. Although there was general political support for the role performed by the peri-urban University and the rural University, especially, in education, there was stronger support evident in the provincial region and its university, in particular. This was manifest in the injection of capital by the State government to support the

development of the Innovation Campus, which built on the declaration of the region as a Centre of Excellence in IT&T. But, there was limited evidence of the direct influence of economic conditions, with the exception of the rural region, which had suffered prolonged drought in recent years. This had begun to have an adverse impact on the level of funding available for R&D in the agricultural industries.

Table (iv) indicates that a number of the additional explanatory factors identified in the case studies applied to at least two of the three universities; notably, funding pressures; reluctance of SMEs to engage with universities; individualistic business cultures in the regions; a poor understanding of innovation by business managers and staff reluctance to do regional work. That a number of these factors did not emerge in the rural University study may be explained by the structure of the R&D system in the agricultural industries, where peak industry bodies and government agencies control the development of research priorities, the allocation of funding and technology transfer, drawing on revenue from statutorily-mandated producer levies. Funding pressures were raised as a key explanatory factor in the provincial city university and the rural university. This issue related to the tension between the need to raise private funding for research and the limited availability of funding in the proximate regional settings of the universities, particularly from SMEs. This explained the observation by academic staff and University senior managers that there was a lack of incentive for regional engagement.

The peri-urban University and the rural University faced a number of peculiar factors relating to the nature of their regions. The former was set amidst a large, diverse region that had porous boundaries with a core-metropolitan centre that included four major universities. The rural university was located in an isolated region that was approximately 500 kilometres from

the nearest major metropolitan centre, and this had created opportunities and challenges for regional engagement. The structure of trilateral research mechanisms in the agricultural industries was also an opportunity and an obstacle. On the one hand, the University did not have to deal with a fragmented industry base in seeking access to research funding; but, the degree of control exercised by peak industry bodies and government agencies meant that there were limited opportunities for academic entrepreneurialism and the development of a stronger third role.

There were marked differences and similarities, therefore, in the nature of the explanatory factors across the three universities and their regions. The orientation to regional engagement in the provincial city University had an entrepreneurial character, while the peri-urban University tended towards community development and social justice. The rural University appeared to straddle these two positions. The history of university-region linkages had a pervasive influence across the three universities. There were significant differences between the teaching-oriented heritage of the peri-urban University and the rural University, on the one hand, and the teaching- and research-based industry linkages developed by the provincial city University from its earliest years. The complementarity of research strengths and regional knowledge needs supported the knowledge needs of private sector industries in the provincial city University and rural University, but were weaker, in this respect, in the peri-urban University, which was better aligned with the knowledge needs of public agencies in the governance set-up of the region. Champions performed an important role across the three universities, but had a broader and deeper influence in respect of the provincial city University than in the other universities. There were differences in the nature of the regional industry bases across the three cases, although it was clear that the provincial region and the rural region were dominated by science-based industries that, typically, exhibit a stronger

demand for horizontal knowledge linkages. All three regions were dominated by SMEs. Political and economic conditions also had a differential impact in the three regions and their universities. It was clear that, of the three universities, the provincial region and its University, in particular, enjoyed stronger political support. On the other hand, the prolonged drought in the rural region was beginning to have an adverse effect on the flow of R&D funding from the peak agricultural industry R&D bodies.

Finally, a number of additional factors were identified in the studies, some of which were applicable in at least two of the three cases. These factors were: funding pressures and a lack of incentive for regional engagement; the unwillingness of SMEs to engage with universities; individualistic regional business cultures; a poor understanding of innovation and negative staff perceptions of the value of regional work. However, distinctive, in regard to the peri-urban university and the rural University, were the size, diversity and location of the peri-urban region; the geographical isolation of the rural region and the orientation of trilateral research mechanisms in the agricultural industries.

There were, therefore, a number of key explanations of variation in the roles performed by the three universities that emerged from the study. However, overarching all, was the impact of the competitive funding environment facing universities. For each of the universities studied, the increasing impetus to obtain funding from the private sector, often, on a competitive basis, was placing pressure on regional engagement. The limited capacity of regional firms to fund collaborative research, even where they could see benefits, meant that universities were increasingly seeking to develop knowledge linkages with firms and other organisations outside their primary regions. This was already evident in the provincial city University. On the other hand, the stronger linkages that the peri-urban University had developed with the

public and non-profit sectors in its region, to some degree, cushioned it from this pressure. But senior managers pointed out that the University was seeking to position itself more firmly on national and international stages to manage growing funding pressures. The lack of specific incentives for regional engagement, therefore, was raised consistently as a key factor that was distorting the priority that should be accorded to regionally-focused programs. The provincial city University was responding to these pressures by adopting an entrepreneurial focus in its engagement orientation.

### **Implications of the study for conceptualising the role of universities in the development of regional innovation systems**

The case studies raised a number of implications regarding the developmental and generative categorisations of the contribution that universities make to regional innovation systems. It was argued above that, while the nature of the developmental and generative roles performed by universities in regional innovation systems overlapped, there were differences in emphasis that warranted a distinction being drawn between these categories. The study confirmed this view, highlighting a number of differences in the initiatives that pointed to either developmental or generative roles performed by the universities. For example, while all three of the universities were undertaking knowledge creation activities that were directed to industry needs, the institutional forms within which the (emerging) generative role performed by the provincial city University were manifest (that is, the technology precinct and science park, as well as strategy leadership and the integration of teaching and research, which were embedded in capital formation projects) was qualitatively different from the other two cases.

Secondly, the nature of the roles performed by the universities was path dependent. Thus, the key developmental roles performed by the peri-urban University and the rural University in

human capital formation was shaped by their heritage as Colleges of Advanced Education, with limited involvement in research. On the other hand, the provincial city University, since its creation, had developed strong research and education linkages with key firms in the steel manufacturing, mining, IT&T and energy sectors in its region, which represented a platform from which its emerging generative roles in agglomeration and human capital formation were built.

However, the study also indicated that the developmental and generative roles did not appear to sit on a continuum. The institutional and historical antecedents of the emerging generative role performed by the provincial city University in regional agglomeration and human capital formation were distinctive, unmatched in the other two sites. Although the University had had limited success in knowledge capitalisation through its historical linkages with key firms in its region, there was a discernible line of development in the nature of its relationship with industry that pointed to an emerging generative role. This line of development was underpinned by the orientation of the University to regional engagement, wherein it was positioned as a central actor in the past and in the future of the proximate region. On the other hand, there was no material evidence to suggest that the developmental roles performed by the peri-urban University and the rural University were moving towards a generative role. Thus, the nature of the role performed by a university, as between developmental and generative, is not necessarily evolutionary, but, perhaps, is mediated by unique sets of historical, institutional and cultural factors. This is consistent with the literature on the academic entrepreneurial role of universities, which highlights the importance of historical and cultural factors that shape this role.

The study does not suggest that one or other role, that is, developmental or generative, is a 'better' result. A key finding of the study, as discussed earlier, was that the three universities tended to perform developmental roles in shaping the regional innovation systems in their primary regional contexts. While there were clearly prospects for improvement in the depth and breadth of their contributions, it cannot be said, based on the data, that this necessarily implied a shift toward a stronger generative emphasis. For example, there was room for the peri-urban University to strengthen the emerging emphasis on knowledge creation involving groups of firms. Such a move, according to interviewees, would yield benefits for innovation in the region, whether or not part of University-controlled entrepreneurial initiatives. A shift towards a stronger entrepreneurial orientation would benefit the sustainability and confidence of the University itself. But, arguably, this is not the most important ingredient in strengthening its role in the development of the regional innovation system. In other words, the data suggested that stronger innovation-focused knowledge creation by universities, whether direct or indirect, was the highest priority.

## **Conclusion**

This paper has proposed a conceptual framework for analysing variation in the roles performed by universities in the development of regional innovation systems. The framework consisted of two parts, which explored 'what' universities do and 'why', drawing on the triple helix model of university, industry, government relations, the literature on university engagement and the innovation systems literature more generally. A comparative study of three non core-metropolitan universities was undertaken to apply the conceptual framework. This study showed that the categorisation of universities as performing generative and developmental roles, highlights both strengths and weaknesses in the two primary bodies of

thinking regarding the role that universities perform in shaping the development of regional innovation systems. Firstly, there was evidence that the senior managers in the universities studied were modifying the positioning and core behaviours of their institutions to better align with regional needs. However, it was less clear whether this was an adaptive response or a reactive one, essentially, in response to changed demand conditions and other environmental factors. The university engagement literature suggests that universities are active in adaptation, persuaded by progressive thinking that ‘sees the writing on the wall’. There was some evidence, for example, in regard to the peri-urban University, that it was seeking to be more relevant to its constituents. But, whether the initiatives reported in the study are reasonably considered to be adaptive or reactive is debatable.

Secondly, although there was weak evidence of a generative role performed by the universities, the study indicated that, on the whole, the willingness and capacity of the universities to behave like industry and the state was weak. Even in the case of the provincial city university, which was experimenting with entrepreneurial initiatives and playing a key leadership role in regional governance, the study found that the realisation of commercial benefits by the university was poor and, for the present, the rhetoric appeared to outrun reality. It was also evidence that injections of capital and symbolic political support by the State government, in no small way, underpinned the nascent knowledge capitalisation ventures. This points to weakness in the assumptions underpinning the triple helix model, as outlined earlier.

In some respects, the study indicated that the key difference in emphasis between the two bodies of thinking – that is, the relative importance of academic entrepreneurialism, as distinguished from adaptive behaviour in an indirect sense – may be a moot point. In other

words, it may be argued that the most important insight provided by the study is the array of pathways through which universities are making a difference in their proximate localities. Whether this is driven by self-capitalisation of knowledge or shared capitalisation arrangements or no direct commercial spin off at all, is a second order issue. From a policy perspective, however, there may well be heightened interest in how university engagement at a regional level can provide a basis for the sustainable operation of universities themselves. In this regard, the distinctions highlighted by the triple helix model and the university engagement literatures are material.

Although the empirical material was confined to Australia, the conceptual framework proposed in this paper is a systemic one that has broader application for analysing the contributions of universities to regional innovation. The Australian evidence also contains insights that may resonate in other settings. In this regard, there is some scope for extension of the framework for cross-national analysis.

## References

- Bade, F & Nerlinger, EA 2000, 'The spatial distribution of new technology-based firms: Empirical results for West-Germany', *Papers in Regional Science*, vol. 79, pp. 155-76.
- Bagchi-Sen, S, Hall, L & Petryshyn, L 2001, 'A study of university-industry linkages in the biotechnology industry: perspectives from Canada', *International Journal of Biotechnology*, vol. 3, no. 3/4, pp. 390-409.
- Braczyk, H, Cooke, P & Heidenreich, M (eds) 1998, *Regional Innovation Systems: The role of governance in a globalized world*, UCL Press, London.
- Camagni, R (ed.) 1991, *Innovation Networks: Spatial Perspectives*, Belhaven, London.
- Castells, M & Hall, P 1994, *Technopolis of the World - The Making of Twenty-First Century Industrial Complexes*, Routledge, London.
- Chatterton, P & Goddard, J 2000, 'The Response of Higher Education Institutions to Regional Needs', *European Journal of Education*, vol. 35, no. 4, pp. 475-96.
- Cooke, P 1992, 'Regional innovation systems: competitive regulation in the new Europe', *Geoforum*, vol. 23, pp. 365-82.
- 2002a, 'Biotechnology Clusters As Regional, Sectoral Innovation Systems', *International Regional Science Review*, vol. 25, no. 1, pp. 8-37.
- Cooke, P & Morgan, K 1998, *The Associational Economy: Firms, Regions and Innovation*, Oxford University Press, Oxford.
- Edquist, C (ed.) 1997a, *Systems of Innovation: Technologies, Institutions and Organizations*, Pinter, London.
- 1997b, 'Systems of innovation approaches - their emergence and characteristics', in C Edquist (ed.), *Systems of Innovation: Technologies, Institutions and Organizations*, Pinter, London and Washington DC.
- Etzkowitz, H 2002a, 'Incubation of incubators: innovation as a triple helix of university-industry-government networks', *Science and Public Policy*, vol. 29, no. 2, pp. 115-28.
- 2002b, *MIT and the Rise of Entrepreneurial Science*, Routledge, London.
- Etzkowitz, H & Leydesdorff, L 1997, 'Introduction: Universities in the Global Knowledge Economy', in H Etzkowitz & L Leydesdorff (eds), *Universities and the Global Knowledge Economy: a Triple Helix of University-Industry-Government Relations*, Pinter, London and Washington, pp. 1-8.
- 1999, 'The Future Location of Research and Technology Transfer', *Journal of Technology Transfer*, vol. 24, pp. 111-23.
- Feldman, M & Desrochers, P 2003, 'Research universities and local economic development: Lessons from the history of the Johns Hopkins University', *Industry and Innovation*, vol. 10, no. 1, pp. 5-24.
- Florida, R 1995, 'Toward the Learning Region', *Futures*, vol. 27, no. 5, pp. 527-36.
- Farrant, R 2001, 'Pulling Together in Lowell: The University and the Regional Development Process', *European Planning Studies*, vol. 9, no. 5, pp. 613-28.
- Freeman, C 1995, 'The National System of Innovation in Historical Perspective', *Cambridge Journal of Economics*, vol. 19, pp. 5-24.
- Freeman, C & Soete, L 2000, *The Economics of Industrial Innovation*, 3rd edn, Continuum, New York.
- Garlick, S 1998, 'Creative Associations in Special Places': *Enhancing the Partnership Role of Universities in Building Competitive Regional Economies*, Department of Employment, Education, Training and Youth Affairs, Canberra.
- Goddard, J 1999, 'Universities and Regional Development: An Overview', in Z Klich (ed.), *Universities and Regional Engagement*, Southern Cross University Press, Lismore, pp. 33-46.

- Goddard, J & Chatterton, P 1999, 'Regional Development Agencies and the knowledge economy: harnessing the potential of universities', *Environment and Planning C Government and Policy*, vol. 17, pp. 685-99.
- Guston, DH 2000, 'Retiring the social contract for science', *Issues in Science and Technology*, vol. 16, no. 4, pp. 32-6.
- Hagen, R 2002, 'Globalization, university transformation and economic regeneration: A UK case study of public/private sector partnership', *International Journal of Public Sector Management*, vol. 15, no. 3, pp. 205-19.
- Hall, P 1994, *Innovation, Economics and Evolution*, Harvester Sheaf, New York.
- Hansen, N 1992, 'Competition, Trust, and Reciprocity in the Development of Innovative Regional Milieux', *Papers in Regional Science*, vol. 71, no. 2, pp. 95-105.
- Hart, DM 1988, *Forged Consensus: Science, Technology and Economic Policy in the United States, 1921-1953*, Princeton University Press, Princeton.
- Hassink, R 2001, 'Towards regionally embedded innovation support systems in South Korea? Case studies from Kyongbuk-Taegu and Kyonggi', *Urban Studies*, vol. 38, pp. 1373-95.
- 2002, 'Regional Innovation support systems: Recent Trends in Germany and East Asia', *European Planning Studies*, vol. 10, no. 2, pp. 153-64.
- Holland, BA 1999, 'From Murky to Meaningful: The Role of Mission in Institutional Change', in RG Bringle, R Games & EA Malloy (eds), *Colleges and Universities as Citizens*, Allyn and Bacon, Boston, pp. 48-73.
- 2001, 'Toward a definition and characterization of the engaged university', *Metropolitan Universities*, vol. 2, no. 3, pp. 20-9.
- Kanter, RM 1995, *World Class: Thriving Locally in the Global Economy*, Simon and Schuster, New York.
- Keeble, D, Lawson, C, Moore, B & Wilkinson, F 1999, 'Collective Learning Processes, Networking and 'Institutional Thickness' in the Cambridge Region', *Regional Studies*, vol. 33, no. 4, pp. 319-32.
- Klofsten, M, Jones-Evans, D & Scharberg, C 1999, 'Growing the Linkoping Technopole - a Longitudinal Study of Triple Helix Development in Sewden', *Journal of Technology Transfer*, vol. 24, pp. 125-38.
- Krugman, P 1997, 'Good news from Ireland: A geographical perspective', in A Gray (ed.), *International Perspectives on the Irish Economy*, Indecon, Dublin.
- Lawton Smith, H, Keeble, D, Lawson, C, Moore, B & Wilkinson, F 1998, 'Contrasting Regional Innovation Systems in Oxford and Cambridge', in J De La Mothe & G Pacquet (eds), *Local and Regional systems of Innovation*, Kluwer, Boston/Dordrecht/London.
- 2001, 'University-Business Interaction in the Oxford and Cambridge Regions', *Tijdschrift voor Economische en Sociale Geografie*, vol. 92, no. 1, pp. 88-99.
- Lawson, C 1997, *Territorial clustering and high technology innovation: from industrial districts to innovative milieux*, Working Paper 54, ESRC Centre for Business Research, University of Cambridge, Cambridge.
- Lawson, C & Lorenz, E 1999, 'Collective Learning, Tacit Knowledge and Regional Innovative Capacity', *Regional Studies*, vol. 33, no. 4.
- Lundvall, B 1992, 'Introduction', in B Lundvall (ed.), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter, London.
- Lundvall, B & Johnson, B 1994, 'The Learning Economy', *Journal of Industry Studies*, vol. 1, no. 2, pp. 23-42.
- Lundvall, BA, Johnson, B, Andersen.E.S. & Dalum, B 2001, *National systems of production, innovation, and competence building*, DRUID, viewed 28 August 2002, <www.druid.dk>.
- Morgan, K 1997, 'The Learning Region: Institutions, Innovation and Regional Renewal', *Regional Studies*, vol. 31, pp. 491-503.

- Morgan, K & Nauwelaers, C 1999, 'A Regional Perspective on Innovation: From Theory to Strategy', in K Morgan & C Nauwelaers (eds), *Regional Innovation Strategies: The Challenge for Less-Favoured Regions*, The Stationery Office, London, pp. 1-18.
- OECD (Organisation for Economic Cooperation and Development) 1997, *National Systems of Innovation*, OECD, Paris.
- 1999a, *The Response of Higher Education Institutions to Regional Needs. Centre for Educational Research and Innovation (CERI/IMHE/DG(96)10/REVI)*, OECD, Paris.
- 1999b, *Boosting Innovation: The Cluster Approach*, OECD, Paris.
- 2000d, *A New Economy: The Changing Role of Innovation and Information Technology in Growth*, OECD, Paris.
- 2001b, *Cities and Regions in the New Learning Economy*, OECD, Paris.
- 2002a, *OECD Science, Technology and Industry Outlook*, OECD, Paris.
- Piergiovanni, R & Santarelli, E 2001, 'Patents and the Geographic Localization of R&D Spillovers in French Manufacturing', *Regional Studies*, vol. 35.8, pp. 697-702.
- Porter, ME 1990, *The Competitive Advantage of Nations*, Macmillan, London and Basingstoke.
- Putnam, R 1993, 'The Prosperous Community: Social Capital and Public Life', *American Prospect*, vol. 13, pp. 35-42.
- Santoro, MD & Chakrabarti, AK 2002, 'Firm size and technology centrality in industry-university interactions', *Research Policy*, vol. 31, pp. 1163-80.
- Saxenian, A 1990, 'Regional networks and the resurgence of Silicon Valley', *California Management Review*, vol. 33, pp. 89-112.
- 1994, *Regional advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA.
- Smith, BLR 1990, *American Science Policy Since World War II*, The Brookings Institution, Washington, D.C.
- Sternberg, R 2000a, 'University-Industry Relationships in Germany and Their Regional Consequences', in Z Acs (ed.), *Regional Innovation, Knowledge and Global Change*, Pinter, London and New York, pp. 89-122.
- Sutz, J 1997, 'The New Role of the University in the Productive Sector', in H Etzkowitz & L Leydesdorff (eds), *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*, Pinter, London and Washington, pp. 11-20.
- Van Looy, B, Debackere, K & Andries, P 2003, 'Policies to stimulate regional innovation capabilities via university-industry collaboration: an analysis and an assessment', *R&D Management*, vol. 33, no. 2, pp. 209-29.
- Wever, E & Stam, E 1999, 'Clusters of High Technology SMEs: The Dutch Case', *Regional Studies*, vol. 33, no. 4, pp. 391-400.