FOSTERING THE INNOVATION AGENDA FOR SUSTAINABLE DEVELOPMENT IN RESOURCE REGIONS: A CENTRAL QUEENSLAND CASE STUDY

Abstract

The ability to identify and foster innovative solutions to complex challenges is critically important in regional Australia, and particularly so in 'resource regions'. This paper explores the role for innovation in delivering regional outcomes across the social, economic and environmental domains. It describes the value of regional innovation strategies in assessing regional assets, challenges and emerging opportunities, through a case study focus on Central Queensland. This region is one of Australia's key resource hubs, which benefits from the economic activity linked with extractive, transport and processing industries, but also experiences a range of adverse social and environmental effects. Awareness of innovation systems and innovative practices allows regional development practitioners, as well as the mining industry itself, to re-frame issues and opportunities beyond current drivers, development paradigms and planning horizons. The paper presents a set of innovation-based principles to consider when developing strategic responses to these challenges and opportunities. It also introduces the concept of 'innovation wedges' to strengthen regional capacity to adjust and adapt to the rapid and cumulative impacts of resource development activity.

1.   INTRODUCTION

1.1   Challenges in the development of resource regions

Australia features many landscapes that are rich in natural resources. The economic value of these is immense: estimates for Australian exports in resources and energy were placed at approximately $AU200 billion for 2011-12 (BREE, 2012). This high level of productivity is not a sole result of having available concentrations of mineral, ore and/or coal deposits; rather, the (economic) value is translated through the intensive extraction, processing and handling activities that are housed in Australia. Thus, 'resource regions' are usually characterised by multiple medium- to large-scale extraction and processing facilities, and typically include extensive road, rail and port infrastructure. Almost all resource-rich areas are located in regional parts of Australia, away from the densely populated state capital cities (Figure 1). In many cases, and particularly in Queensland, these minerals-based resource development sites also coexist with agricultural uses (Carrington and Pereira, 2011).

>>FIGURE ONE ABOUT HERE

Current expectations are for the ongoing growth of these resource regions in Australia, as well as the likely emergence of new areas of growth; with trend estimates for exploration expenditure rising by 3.1% to $AU1,056 million to the June quarter 2012, led principally by Western Australia (ABS, 2012a). Resource regions can therefore include both established communities (e.g., the Bowen Basin in Queensland; the Hunter Valley in New South Wales) as well as emerging nodes (e.g. the Surat and Galilee Basins in Queensland). In fact, the 'resource region' moniker is an impermanent one, because regional industry is fluid, capable of both expansion and contraction.

Regional Australia is a term used to describe the various non-metropolitan communities of Australia, including the inner and outer regional areas, as well as the remote and very remote areas. Most of regional Australia is represented by vast and sparsely populated rural and remote areas (Charters et al, 2011), and collectively, almost one-quarter of Australia's population resides outside of major urban areas (ABS, 2012b). The changes associated with large scale resource extraction hubs are a key issue for regional Australia. These activities bring with them complex challenges that manifest across the economic, social, environmental and governance domains: for example, this includes demographic and labour force shifts; regional governance; liveability, family and social wellbeing; cultural and civic aspects; housing; public health; workforce planning and education; transport and development infrastructure; water and energy; and environment and natural resource management (Kinnear, 2013).

Resource regions thus pose an important conundrum from both a government and community perspective: resource extraction provides significant economic return, but it does so by expending non-renewable assets. This presents a five-fold challenge. First, during rapid industrial development, resource regions are confronted by serious social issues including variable housing pressures, skilled labour shortages and lack of social ('soft') infrastructure: each of these issues have featured strongly in submissions to the current Australian House of

Representative's Enquiry (Commonwealth of Australia, 2013). Conversely, the appropriate levels of economic benefit from resource regions are not always retained locally. On the one hand, economic leakage often occurs through supply chain dynamics, as well as labour force mobility; and on the other, there is the issue of appropriate return of royalties to their source regions. The latter has been a trigger point for the introduction of state government 'royalties for regions' policies in both Western Australia and Queensland, though the suitability of these approaches continues to be debated (LGAQ, 2010).

Second, although having strong economies during peak demand, resource regions are very vulnerable to downturns in the global economy. There is a strong dependence on commodity prices, demand for the resource base, and the (low) value of the Australian dollar (BREE, 2012; QRC, 2012). Consequently, during slowdowns, these regions are likely to experience unemployment (including underemployment), instability and social dysfunction. For example, in the Illawarra region of New South Wales, market changes leading to the recent closure of BlueScope Steel has created a need for widespread structural adjustment. The Federal government has since acknowledged that innovation will be integral to transitioning the region to a sustainable future, with the creation of the Illawarra region innovation and investment fund (AusIndustry, 2012). Dependency on extractive industries can also leave regions overexposed to the considerable cost risks associated with key policy shifts, such as the introduction of the carbon tax (MCA, 2011) and mineral resource rent tax.

Third, resource regions may be so dependent on extractive activity that they lack business diversity and competitiveness, and thus the ability to meet the emerging global demand for 'greener' supply chains, manufacturing processes and consumer products. Mining growth in Australia has benefitted not only from its endowment of natural resources and its proximity to Asia, but also from the maturity of structural arrangements for investment and trade, political stability, access to technology, baseline infrastructure and sophistication of human capacity. This path dependency may be both a regional and national construct, reflecting terms of trade and structural adjustment initiatives, amongst other things (Cutler, 2008).

Fourth, the concentration of major industrial and mining activity into regional hubs creates serious environmental issues, including threats to water and air quality and biodiversity.

Finally, the practice whereby physical assets are extracted without simultaneously developing legacy enterprises to fill the void has the potential to impoverish regional areas in the post-mine phase. This creates an enormous additional burden on the three tiers of Government as well as the exiting industries.

1.2   Regional innovation systems

Innovation has recently come to the fore as a key tool for enabling regional advantage (European Union, 2010); as well as being a regional advantage in its own right (Kinnear et al.,

2012). The Australian Government's *Powering Ideas: An Innovation Agenda for the 21st Century* defines innovation as the capacity for invention and discovery (DIISR, 2009). Often, this can lead to innovation being viewed through the lens of producing commercialisation outcomes, as a 'business activity'. On the other hand, Pangaro (2008) argues that innovation can be interpreted much more broadly: for example, as an insight that enables change leading to 'new value', be it economic or otherwise. Under this definition, awareness of innovation systems and innovative practices can allow regional development practitioners to re-frame issues and opportunities beyond current socio-economic drivers, development paradigms and planning horizons, thus considering a wider range of regional development possibilities.

In the context of regions, innovation is occurring constantly – in structured and unstructured, codified and uncodified ways. Traditionally, successful innovative regions have been shown to share a number of prerequisites:

- a critical mass of people and organisations to create leading edge knowledge transfer ('knowledge services') (Manning, 2012 in press);
- the presence of people and organisations who set the standard for industry, and who often cluster together for knowledge recombination (Moreno and Miguélez, 2012);
- the existence of pilot or demonstration projects, often (but not exclusively) those based on technological solutions to real-world problems (Madsen and Andersen, 2010); and
- a demonstrated, active participation and presence in the knowledge economy, especially through working with local universities (Youtie and Shapira, 2008).

These elements often coalesce in geographically bounded areas – regions where like-minded individuals and organisations share a similar resource base, climate, markets, and drivers and barriers for business growth: this is the core basis for 'cluster' or 'place-based' policy. Regions are now emerging as key functional areas by which innovation strategies can be defined and implemented: indeed, 'regional innovation systems' is now an academic discipline area in its own right. However, each region is different, and the particular nature of a given region is important in understanding the role and potential for innovation to help achieve sustainable development. Thus, whilst the European definition of 'regional' is rarely directly transferable to Australian contexts (Kinnear et al., 2012), the ability to identify and foster innovative solutions to complex challenges is still critically important in regional Australia, and especially so in growing 'resource regions'.

1.3   The need for systemic innovation in resource regions

Healy and Morgan (2012, p. 1048) have noted that "societies are increasingly asking themselves how innovation in the broadest sense – social as well as economic, public sector as well as private sector – can contribute to the pressing need for more sustainable forms of development". In rural development, the importance of social innovation in has been explored by Neumeier (2012), who concluded that that lack of innovation can constrain community vitality and development. Wear (2008) also linked innovation with community

strength in rural settings of Victoria; rural-regional innovation has also enjoyed some prominence in policy thinking in the United States, where the need for a better understanding and recognition of innovation has been identified (Dabson, 2011).

Globally, the potential value of innovation in accelerating social, economic and environmental outcomes has been acknowledged by, and then subsequently realised by, several regions. For example, dedicated regional-level innovation strategies (including 'cluster policies') have been adopted across the EU, North America and Asia (Camagni and Capello, 2013; CoC, 2005; OECD, 2013), although most of these are concentrated on the economic outcomes of innovation (e.g. higher productivity and competitiveness). Nevertheless, there are notable examples of regions where innovation has led to positive impact and outcomes, including benefits beyond simply economic prosperity. For example, these include case studies such as Manchester, where a commitment to 'open innovation' has led to urban regeneration (Carter, 2013); the Berlin-Brandenburg region, where SMEs involved in cluster and network-based innovation outperform those who do not (Seliger et al. 2008); and the Zhonggauncun Science Park in Beijing, which has been transformed into a highly competitive and successful high-tech region through a planned approach to economic development (Zhou, 2005).   Work by Aulua and Harmaakorpi (2008) on nine urban regions in Finland also demonstrated that regional innovation strategies can be successfully used to build regional reputation: this is beneficial in boosting population attraction, as well as increasing competitiveness.

Resource regions are traditionally places built on exploitation of resources - usually, physical resources. However, through careful planning to stimulate innovation, the mining industry and their host communities could also leverage their human and economic resources to better effect (Solomon et al., 2008). Innovation policy is also increasingly being used as an instrument for regional growth – to "help technologically leading regions to remain ahead and peripheral regions to catch up" (OECD, 2011, p. 16). Innovation and technological advances are key for productivity growth within the resources sector; they are also essential in combating overall resource depletion and the heightened extraction costs associated with deeper resource deposits (Syed et al. 2013). There are good examples of firm-level innovative practice, such as the development and deployment of simulation, automation and explosives technologies that play important roles in improving safety and efficiency (Syed et al., 2013). Cost innovations have seen the introduction of economies of scale such as the use of larger earthmoving and haul equipment. These have been important in boosting productivity, although the levels of returns associated with these approaches are finite, and so cost-saving curves quickly stagnate (Bartos, 2007). Innovation rates within mining companies appear broadly comparable to those of manufacturing firms, rather than with high-tech sectors; and that research and development investment in mining is relatively low (Bartos, 2007). Also, it seems that the key productivity advances associated with mining operations have not been sourced from within; rather, they have been introduced through the mining supply chain partners (i.e., third parties). Finally, there is a need for proponents to maintain a focus on innovation, as it has been shown that mining, in general, features "long period of no innovation, followed by bursts of revolutionary technology" (Bartos 2007, p. 151).

In resource regions in Australia, it could also be argued that current policy and institutional settings do too little to facilitate enduring growth; nor are they conducive to attracting private investment in social infrastructure or new and diversified business ventures. In turn, this creates (and perpetuates) regional environments that are driven by, and dependent on, the resource sector economy; instead of being stimulated by the window of economic prosperity that the resource sector provides. Clearly, the ability to identify and implement innovative solutions to these problems – as well as the opportunities – inherent in resource regions will be critically important in securing a future for regional Australia.

Here, it is important to note here that innovation for regional advancement is not simply constrained to innovation dealing with economic diversification. The ABS (2013) defines innovation as the introduction of a new or significantly improved good or service; operational process; organisational/managerial process; or marketing method. Using this interpretation, ABS data show that innovation activity is increasing through the business sector in Australia: recent figures indicate a 8% rise in the number of innovation-active businesses in the past year (ABS, 2013). However, of the seventeen sectors for which annual data are collected, the mining industry ranks only 12th in terms of the proportion of businesses which are innovation-active. The areas of social innovation (such as boosting partnerships with Indigenous peoples) and environmental innovation (such as reductions in carbon footprinting) are good examples of new value that can be created quite outside of economic imperatives, and which hold benefit for regions more generally. However, for these areas of new value to be realised, a planned approach that encourages more broad, as well as more systemic, innovation must be used.

1.4   Understanding Regional innovation: methods and metrics

Much has been written about research methods for urban and regional planning, but there is an acute lack of published literature that is specific for regional innovation 'planning'. Regional planning in the broader sense follows a well-recognised sequence including compiling an evidence base, community consultation, and a process by which regional issues and priorities can be identified and actioned. By contrast, approaching regional development through the lens of innovation is an emerging discipline that requires practitioners to strike the balance between adopting traditional regional planning approaches that are already familiar and tested, as well as providing a structure that ensures that innovation is firmly embedded in regional culture, and is the driving factor by which challenges are addressed, and new opportunities are identified and capitalised on. For example, the OECD (2011, p. 20) noted that regional innovation should be considered in three dimensions:

1. the institutional context – the 'room to manoeuvre' afforded to key regional innovation actors, in terms of the regional governance framework;
2. the whole-of-region innovation system – 'the strengths and weaknesses for innovation and the nature of local relationships and networks'; and
3. the 'strategic choices made by a region' – how it intends to transit towards new growth models.

An important point in any discussion about innovation within regional planning is also the distinction between 'writing an innovation plan', or 'undertaking to conduct regional planning in an innovative way'. Both these approaches offer value for regional innovation systems (and for regional development more broadly). However, a key difficulty in either of these approaches is that any planning exercise ought to be linked with measurable performance outcomes, and preferably, some sense of how likely a region is to succeed in reaching these. This introduces the extraordinarily tricky elements of not only measuring innovation, but also the ability to predict it.

The development of predictive methodologies for regional innovation systems is a nascent field. Most reports are focussed entirely on retrospective reporting of innovation performance (e.g., the European Innovation Scoreboard and the Global Innovation Index), rather than forward estimates of likely innovation activity. Nevertheless, a number of novel methodologies are emerging, such as the use of principal components analysis, where groups of innovation statistics are compared for their relative importance in influencing overall innovative activity (Wang et al., 2011). Other work has used an 'evolutionary economics' approach, which explores how regional innovation systems are influenced by cooperative behaviour, driven by the need to overcome fragmentation and/or low density of entrepreneurs, and vertical disintegration (production of intermediate goods) (Gunnarsson and Wallin, 2010). There have also been many attempts to 'map' innovation and identify likely trends in innovative activity (e.g., Naidoo, 2010; Rowley et al., 2011).

Clearly, the use of any of these types of tools first requires that appropriate regional innovation 'factors' must be identified. This, too, is a complex field; so much so that the OECD has prepared an entire manual (the 'Oslo manual') dedicated to collecting and interpreting technological innovation data (OECD, 2005). This document acknowledges that innovation can be different in nature and scale, and should therefore be examined at the firm, sectoral, regional and national level; as well as by type (e.g. process or technological innovation).

Even where studies are constrained to regional-level innovation systems, compiling a list of relevant indicators is no easy task: the pervasive nature of innovation means that indicators can be spread right across the spectrum of regional development, especially if including innovation enablers and barriers (CoC, 2005; OECD, 2009; European Union, 2010) (Table 1). Obtaining meaningful data for each of indicators can also be a challenge. Gössling and Rutten (2007) demonstrated that wealth, gross domestic product, cultural diversity, and the talent and density of a population were each influential variables in developing regional innovation systems. Indeed, all of these were positively linked with innovative activity, with the exception of GDP. More recent work, such as that by Li (2011), has divided regional innovation capability even further, into categories of the innovation environment (or 'habitat); the capacity for knowledge creation and knowledge acquisition; and economic performance; with each needing to be applied across the business, research and development and government sectors. Furthermore, a study by Bellandi and Caloffi (2010) also illustrated that regional innovation policy must be firmly based on an understanding not only of the structure of innovation systems, but also the relationships (synergies, interconnections) that can be

formed between them. A similar sentiment was given by Uyarra and Flanagan (2012), who encourage the move away from mechanistic evaluation of innovation to instead direct effort toward learning processes in response to public policy interventions.

>TABLE ONE ABOUT HERE

2. METHODOLOGY

2.1 Key research questions

This article aims to explore the innovation agenda in terms of the value it can bring to the resource regions of Australia, as well as how the agenda it might best be fostered. This is examined through a case study of the Central Queensland (CQ), focussing in particular on the development of a Central Queensland Regional Innovation Plan. Central Queensland has been recognised as one of ten federally-acknowledged 'regions of innovation', and this offers a unique opportunity and driver to pursue regional development in CQ via the innovation agenda.

This article responds to three key research questions relating to regional innovation planning:

1. In what ways do traditional regional planning documents and tools need to be adjusted such that the benefits of systemic regional innovation can be realised, particularly in resource regions?
2. What are the key data sources that are needed to inform actions designed to foster regional innovation, and how accessible and reliable are these metrics in resource regions?
3. What are the implications for Australian regional development policy, in terms of a greater focus on innovation to help achieve sustainable development in rapidly growing resource regions?

This research is of mixed (both qualitative and quantitative) nature. The approach taken was modelled on the original methodology described by Lesáková (2011), where regional innovation strategies can be divided into three phases: 1) building up consensus, 2) analysing regional innovation potential and 3) defining priorities and action plan.

2.2 A non-traditional approach: the regional innovation consensus

Community consultation is a key element of almost all regional plans: this is critical in ensuring that community values are reflected in the prioritisation of themes, and that the community has a sense of ownership around the plan. However, it is often the case that the planning process is well advanced before consultation is commenced; for example, with draft copies of the regional plan being made available for comment. By contrast, a novel aspect of this particular regional innovation exercise, was that prior to commencing the study, the Central Queensland region had travelled considerably towards a regional consensus on innovation, achieved through the signing of the CQ Innovation Accord. This Accord was

(and is) a regional agreement that was developed, negotiated and introduced by the Innovative Regions Centre during 2010/2011. It was created as an open-innovation framework that allows cross-sector inclusion in the innovation agenda by becoming a signatory to a series of principles around innovation (Table 2). The process of establishing the Accord is described elsewhere (Ogden, 2012) and so the results of the consensus-building phase will not be described here. The Accord remains a living document and will be valuable tool in garnering regional support for the innovation activities identified by the Innovation Plan.

>TABLE 2 ABOUT HERE

2.3   Data sources: mapping regional innovation potential

There is no clear method for analysing regional innovation milieu and potential in resource region, so preparing a comprehensive assessment of regional 'innovation' poses a difficult challenge. It has already been noted that regional clustering analyses performed on standard industrial and innovation data, including locational quotients, often fails because these data "do not capture the nature and strength of traded and untraded inter-firm linkages, knowledge spillovers, social networks, and institutional support structures" that are necessary for regional innovation (Junbo and Jackson, 2011, p. 121). The task is also made particularly difficult for the Central Queensland region (and other Australian resource regions) because of wide geographic span and geo-politics: there are a variety of jurisdictional boundaries to consider. In addition, 'performance measurement' for regional innovation is inherently difficult, as few data are available at the regional or sub-regional levels (as discussed above).

Appropriate profiling for innovation therefore required a mix of both subjective and objective information. For this study, the innovation 'habitat' in Central Queensland was described through a combination of regional intelligence, demographic and economic statistics, and traditional innovation metrics (where applicable), including:

- regional economic information compiled using REMPLAN v3.0 economic modelling software, including the use of key propulsive drivers, which reflects the key contributors to regional economic activity through a combination of value-added, employment, regional export and backward linkages data;
- publicly available data from the Australian Bureau of Statistics, IP Australia, the Queensland Office for Economic and Statistical Research and Planning Information and Forecasting Unit; and
- industry intelligence collected through informal discussions with regional stakeholders.

Some of the information presented in the findings of this article also draws on the results of a regional business survey, which has been presented more fully elsewhere (Kinnear et al., 2011).

2.4   Developing the Regional Innovation Strategy

Following the regional innovation analysis, a strategic CQ innovation document was prepared using a number of guiding principles and objectives, derived from the elements that are traditionally included in broader Australian regional planning practice (e.g., Collits, 2007). These included:

- assessing the region's existing innovation assets, challenges and emerging opportunities;
- identifying the key areas to that should be focused on in order to grow the regional innovation system of CQ (as well as spillovers to other regions nationally); and in particular, to widen the perspective and range of possibilities that might be facilitated in the region;
- articulating the key steps that might be taken to realise the latent potential for regional innovation in Central Queensland; and
- creating an implementation plan consisting of specific, actionable tasks and targets, each with identified timelines and the roles and responsibilities of CQ's innovation actors and other regional stakeholders.

The document was developed based on the six pre-existing theme areas that comprise the CQ Innovation Accord (Table 1). Within these six domains, it was determined that the high-value project areas are likely to be those that:

- are built on foundations of collaboration and connectedness across multiple regional innovation actors;
- are reflective of the current and emerging regional strengths;
- bring new value in at least one, but preferably all, areas of the 'quadruple bottom line';
- allows CQ to contribute to one or more national priority areas, whilst retaining regional-level value (a key theme of the Central Queensland Regional Roadmap prepared by Regional Development Australia (RDAFCW, 2011); and
- preferably, can be mapped at a level of detail that allows for progress in the short to medium term, and where resources are readily available or can be quickly sourced.

3.   FINDINGS

3.1   Compiling a regional innovation profile: analysis of available data

The Central Queensland region is formally comprised of the Fitzroy and Central West statistical divisions, an area of some 497,738 km^2. This is a large and diverse regional Australian network of geographically, socially, economically and eco-systemically linked communities. The Central Queensland region had 229,552 residents as at the 2011 Census,

with almost half of these living within the Rockhampton Regional Council area (OESR, 2012).

CQ is a productive region, and one with a diverse industry base. A wide range of large-scale industry projects have been planned for the region, ranging from the opening of new coal mines, or expansion of existing ones, to upgraded rail and ports facilities and major gas pipeline works. As one example, the emerging LNG sector in Gladstone has $AU30 billion in committed or under-construction projects, and this clearly has important ramifications for the development of the Gladstone community in the coming years. An analysis of the key propulsive drivers in the Central Queensland region indicates that the construction and manufacturing sectors are the most significant in terms of economic contribution to the region (Table 3). However, a different picture emerges when locational quotients analysis is used. Locational quotients are a measure used to describe the overall frequency or performance of regional economic sectors, compared with a base or reference case (for example, the national average). For CQ, locational quotient analysis suggest that the key economic sectors for the region are mining; electricity, gas and water supply; agriculture fisheries and forestry; construction; and transport and storage (Table 4).

> TABLES 3, 4 ABOUT HERE

There are relatively few useful datasets that can be used to describe the innovation activity that is occurring in Central Queensland. Partly, this results from the generic use of metrics that are not applicable or available at the regional scale (for example, the dollar value of formal research and development investment by regional business). Nevertheless, existing information indicates that the coastal centres are providing greater innovation outcomes (with respect to patent registrations) compared with the less populated rural shires, where no patents have been lodged (Figure 2). The Central Queensland region generally contributes less than 3% of the Queensland-based patents each year, and this contribution has been steady since 1994. With respect to the commercialisation of innovation, in recent years, patent activity has been driven in the population centres of Rockhampton (4700, 4702 postcodes), Emerald (4720) and Gladstone (4680). There has been no patenting activity in the Central West in recent years. The 2012 *State of the Regions* report has indicated that some 6,595 people are employed by hi-tech firms in the CQ region, representing around 5.3% of all employment (ALGA and National Economics, 2011). An important note in describing the regional innovation activity is that there are no particular values or metrics that are specific to innovation related to resource-sector activity. Neither is there a clear way to ascribe particular types of innovation activity to the presence of the resource sector, compared with other sectors in the region. This is an important barrier in trying to understand, and then exploit, the actual or potential innovation that may be realized from the resource sector, both for the benefit of resource companies, as well as the broader region that supports the resource development activity.

>FIGURE 2 ABOUT HERE

With respect to intelligence on much broader types of regional innovation, commentary was provided on items such as relevant infrastructure and resources; sector status; the key issues, drivers and/or constraints; emerging opportunities and projects, as well as any known information about forward planning or aspirational goals. Some of the key themes in this analysis included the constraints placed on the region by the severe flooding of 2010-11; skills shortages, the lack of appropriate digital infrastructure, access to venture capital, poor uptake of government assistance programs to small-to-medium enterprises (SMEs), and competition from overseas providers (e.g. for modular construction components).

Many industries already have a focus on production/efficiency gains, including the ability to adapt to and mitigate climate change. However, there are further opportunities for diversification and value-adding, particularly through greater linkages to the knowledge economy through education, research, professional services and improved communication. A range of social innovation issues were also raised, particularly around service provision for the high Indigenous population in the region. Overall, a growing awareness of the importance of 'liveability' as a key component of regional sustainability and prosperity has led to planning and advocacy agendas having particular focus on social infrastructure.

In regard to whole-of-region issues, some of the key areas identified included the need to better understand the regional SME profile; the need for SMEs and CQUniversity (the regional university presence) to engage more productively; and the demand for an innovation 'clearing house' for good ideas, ideally combined with a physical demonstration and business incubation site, as well as a formal governance structure.

Finally, although an extensive set of regional planning documents have already been prepared within the CQ region, none have specifically discussed the key ingredients for regional innovation – the leading innovation actors, the networks between them, and their individual and collective culture in terms of understanding innovation and what it has to offer Central Queensland. This is a critical gap that can be addressed through the preparation of a dedicated innovation strategy, or at least, by explicitly noting the role of innovation in other regional instruments.

3.2   Regional innovation as a competitive advantage for the mining industry

Resource-regions are likely to benefit particularly well from innovation, challenged as they are by complex problems of rapid economic growth, community liveability and natural resource management (see section 1.1). Resource regions may also be particularly well suited to innovation because of the emphasis on linking regions with global value chains (Chaminade and Vang, 2008): resource companies are typically multinational corporations, and this provides an opportunity to globalise the region through what are often the 'key employers in town'. Recent work by the Bureau of Resources and Energy Economics (Syed et al. 2013) has noted that 'as Australian resources become progressively more difficult to mine, mining companies will need to continue to innovate to remain competitive' (p. 34), yet it appears that 'step-change innovations are not forthcoming rapidly' (p. 33).

Despite this, it would appear that mining is not an inherently innovative industry, and that neither are resource regions inherently innovative in Australia. Partly, this might be related to the risk-averse industry base; so too it may be that the rural basis from which many resource-regions have begun has contributed to overly conservative and traditional thinking amongst the region's key stakeholders. Alternatively, it may also be that a structural failure exists; and that innovation could be quickly accelerated in resource-regions if their regional innovation systems were better understood and supported.

A guided workshop session on Innovation in Resource Regions was undertaken at a mining industry conference held in Mount Isa in 2012. A number of key messages arose from this session. For example, it was acknowledge that heterogeneity of mining proponents exists: the smaller players ('junior miners') are those that feature high levels of innovation, but little capacity to explore it because of the need to focus on core business during their high-risk start-up phase. By contrast, large, multinational players have the greater capacity for innovation, but less propensity to pursue it. Secondly, innovation is largely viewed in the context of driving productivity, but there is a recognition that innovation extends beyond technological advances. Within the mining industry itself, many senior staff have expertise in the business of mining, and its technological aspects, but scant subject matter expertise in innovation and how it might simultaneously increase business and regional sustainability. Perhaps as a result, many of the delegates expressed a reluctance to lead initiatives around regional innovation planning, although they accepted that corporate social responsibility and sustainable development were necessary and valuable. Overall, it was apparent that there is a need to draw the mining industry into innovation planning, particularly in cases where there are strong dependencies between the proponent and the township (e.g., 'company towns'). However, the 'transient' nature of corporate mining staff (with a highly mobile workforce and expertise) may make this difficult.

3.2   Drafting the Central Queensland regional innovation strategy

The CQ regional innovation strategy was built firmly on the foundation that innovation should not be relied upon to occur organically, even where there are favourable conditions and drivers. Rather, innovation is something that should be actively cultivated and managed throughout a region. Thus, a fundamental element of the document is that whilst project-based activity should be supported and facilitated, it is strategy-based actions that are more likely to deliver best return on innovation investment, given the size and diversity of the region and the limits on resourcing innovation initiatives. Given this, there was a recognised need to work strategically for whole-of-region innovation across Central Queensland, by:

1.   undertaking innovation 'husbandry' – to promote, embrace and grow innovation across the region; especially through the use of leadership organisations and individuals

2.   understanding and influencing relevant policy initiatives and regional planning;

3.   profiling, positioning and exploiting key regional innovation actors;

4.   resourcing 'collaboration and connectedness' for all types of innovation;

5.   'projectising' key areas of strength, interest and opportunity;

6.   removing barriers to business, industry and community entrepreneurship;

7.   embedding innovation from the ground up, especially through the use of skilling and education programs;

8.   better understanding the region's innovation and competitive, comparative and constructed advantage;

9.   celebrating and rewarding successes; and cooperating and sharing resources on innovation; and

10.   planning for a future beyond the current economic, social and environmental paradigms.

In this context, the action framework of the CQ Regional Innovation Plan (CQRIP) was divided into a series of thematic areas that were distilled as the critical acceleration points for region innovation (Table 5). The full Plan also included a matrix identifying key impact areas, lead change agents, a statement of the strategic approach, and specified projects for 2011-2015 for each domain.

>TABLE 5 ABOUT HERE

A particularly novel approach used in the CQRIP was also to view each action area as a 'regional innovation wedge'. This acknowledges that, if properly supported and actioned, each activity can act as a wedge to stabilise and strengthen the regional innovation system. This is a variation of the wedge theory that has already been applied to wicked problems, and where is it recognised that a series of smaller, planned actions can collectively contribute to a step-change in outcomes. The original example is this is mitigation of climate change achieved through the development of a series of alternative energy sources (Pacala and Socolow, 2004). Here, each 'wedge' helps to bridge the gap between the status quo and the preferred future scenario; thus stabilising the system. For regional innovation systems, however, wedge theory becomes somewhat blurred, because each domain area is not discrete or mutually exclusive. In the CQRIP, for example, there would be considerable overlap across 'wedges': this implies synergistic outcomes, rather than the additive effects that are implied in the original wedge theory.

4.   DISCUSSION

4.1   Regional innovation planning for Central Queensland

The CQ region is nationally and internationally recognised as an important resource-intensive area: a large proportion of its economic activity is either directly or indirectly related to, or impacted by, the extractive, transport and processing industries. From the perspective of the regional innovation agenda, this poses a risk of developing (and sustaining) a mono-cultural, insular approach to investment that is almost exclusive to resources-based activity. This can manifest in a variety of ways, including skewing knowledge creation and transfer towards specialisation for an industries that is known to encounter cyclic and cumulative impacts.

The development of a strategic regional innovation plan is very useful way that the CQ region can conceptualise and plan for activities that will deliver best value on innovation effort across the social, economic and environmental realms. The CQ Innovation Plan provides for a set of innovation-based principles for regional governance bodies to consider when developing strategic responses to these challenges and opportunities. Here, it is useful to note that the key challenges that face the region are in fact the same areas that offer best innovation opportunities, in terms of technologies, skilling and exports. For example, one of the key challenges facing the CQ region is the economic management of climate change, with a profile of highly emissions-intensive trade exposed industries. Recent work by Greer et al. (2011), focussed on the Gladstone sub-region, noted that there was strong community support for new industry initiatives in the areas of carbon emissions technologies and strategies, especially where this can offer support for the development of Indigenous business initiatives.

In Central Queensland, the key barriers to innovation in CQ revolve around the generally poor understanding of the innovation agenda, as well as problems of size and scale. There is little clarity around what is, should or could be achieved, and the potential markets for innovation in CQ. There is also poor integration of the innovation agenda with other regional development themes: most linkages are applied *ad hoc* when opportunities for funding and resourcing emerge, rather than being strategic. The region, like many in Australia, has a mix of decision-makers, combined with fragmented communication, cooperation and coordination amongst key regional organisations, and redundancies in regional planning processes. There also exists a lack of boundary spanning, with no cohesive structural approach; a deficit of devoted regional innovation infrastructure (both hard and soft); no visible, publicly accessible flagship space for regional entrepreneurial development; and no effective platform for broad ideas generation, capture and application/action from (and for) the community.

The region's large size is likely to be a barrier in forming strong human interactions, since social networks and collaborations tend to work better where people, ideas and resources are in close proximity with each other. The sub-regional differences in priority industries and the competition between the key service hubs (particularly Rockhampton and Gladstone) also creates tension. However, the knowledge base of CQ is already decentralised across the hubs of Rockhampton, Gladstone and Emerald, and there are several organisations with large footprints (e.g., CQUniversity, the CQ Local Government Association, Agforce and the Queensland Resources Council) that can be used to initiate whole-of-region conversations and initiatives. There are also lots of innovation activities that could be operated effectively at the sub-regional level; reflecting the particular needs and strengths of those communities.

Lastly, for Central Queensland, the challenge for driving innovation in a large and decentralised resource region is the collective responsibility of all regional stakeholders, including the three tiers of government. For local government, a key challenge is managing the lag in social infrastructure that inevitably follows rapid resource activity; so too is the ability for Councils to build strong relationships with the key firms responsible for resource extraction (LGAQ, 2010). Whilst industry is often willing to recognise that they have an important role in contributing to solutions, the current mechanisms for collaborative action in resource regions rarely allows their investment to be strategic at the whole-of-region level. In this setting, innovation built on 'collaboration and connectedness' (DIISR, 2009) would assist in identifying and actioning projects for mutual benefit of all stakeholders.

4.2   The broader value of innovation planning in resource regions

Resource regions share a number of characteristics that give them a propensity to benefit from the innovation agenda, as well as to succeed in being innovative. Whilst the role of the innovation agenda in resource regions has been explored elsewhere, such as Alaska (Kresge et al., 1984), this is the first research to examine the value of innovation to resource regions in the Australian context. Australian resource regions are, by their nature, areas of highly disruptive activity, with disturbances often happening in rapid succession and on a considerable scale. Innovation – particularly radical innovation – breeds well in disruptive environments. Thus, within such environments, a focus on innovative responses (as opposed to business as usual), can help to ensure maximum new value is drawn from these chaotic (=changeable) environments.

Second, resource regions face a range of complex and often cumulative challenges, as already mentioned above. These 'wicked' problems require solutions that will be beyond current paradigms in terms of regional functionality, norms, behaviours and culture: there is a clear need for innovation.

Third, many of Australia's resource regions are indeed, in regional areas. Hence, they face the development challenges associated with isolation and small markets (Cutler, 2008).

Fourth, resource extraction is heavily driven by regulatory compliance as well as the continual pursuit of higher productivity and efficiency. Each of these can be strong drivers for innovation (e.g., Blind 2012). Equally, however, the cluttered regulatory landscape can be a disincentive for risk-taking and new business development: in particular, environmental legislation and the requirements around 'major project' status may be quite restrictive.

Fifth, research by Evans and Sawyer (2009) indicates that small-to-medium enterprises (SMEs) – a key cohort of interest for innovation work – face a number of challenges during 'mining booms'. These include difficulties in attraction and retention due to lost social services and unaffordable housing, skills shortages, and salary competition from the 'big end of town' (Miles & Kinnear, 2008; Petkova-Timmer et al., 2009). Thus, whilst SMEs are often encouraged to 'capitalise on the wealth of the mining boom', this is out of reach for many

regional businesses unless innovative practices in staff attraction, sophisticated product development, and customer services are in place (Evans and Sawyer, 2009).

Finally, resource regions display features on which strong innovation systems can be based. For example, higher levels of engagement and collaboration could be driven by compliance imperatives, as well as by the ecologically – and increasingly socially – sensitive nature of resource extraction. This could involve working with other firms, with state bodies, research partners and organised community groups in order to satisfy the range of risks associated with resource extraction. The existence of a collective of firms in geographical proximity, a (potentially) shared asset base, a common purpose, and common corporate motivation for improved outcomes (be those economic, social or environmental) suggests that resource regions may be ripe for the development of clusters which drive innovation (Porter, 2011).

The findings presented in this paper are concentrated on a single case study of Central Queensland, however the expectation is that these would be broadly similar across many other resource-rich regions in Australia. Certainly, the share of economic activity from resource-industries in regional Queensland is similar to, or in some cases, more modest that the values reported from other Australian states (Duc Pham et al., 2013). Australian regions also share many of the same development challenges as are reported from other areas, including the 'Dutch disease' phenomenon and concerns about negative social and environmental outcomes (Commonwealth of Australia, 2013). Internationally, these same issues are also echoed in nations such as Canada (Papyrakis and Raveh, 2013 in press) and appear also to be emerging in Mongolia (Reeves, 2011). It seems reasonable to conclude that the Central Queensland experience is broadly instructive of what may be occurring elsewhere, perhaps excepting cases where governance structures are dramatically different (for example, such as Mongolia).

4.3   Limitations of the method

One of the problems that will be faced in embedding 'regional innovation planning' into current practice is the need to navigate various uses of the term 'regional': much of the existing innovation literature is of European or American origin, where 'regional' is applied to quite different geographies – for example, at the state, national, or multi-national level. By contrast, the Australian context for 'regional' is usually applied at a much smaller level (e.g. that of statistical division); which introduces concerns over forming critical mass, as well as the availability of useful datasets on innovation indicators.

Secondly, the lack of accessible, current, and rigorous datasets about regional innovation performance is a critical barrier in allowing encouraging regional development practitioners to embed innovation into regional planning. For example, some fifty innovation indicators are used by the Global Innovation Index to determine innovation performance on a country-by-country scale (ISEAD, 2011); but less than one-fifth of these are likely to be available at the regional (=statistical division) level. This is a critical knowledge gap, given that Slaper et al.

(2011) have shown that the strength of influences on innovation can vary according to the size of a region; as well as the nature of a region as urban or rural. In the United States, Porter (2011) recently prepared a snapshot summary of economic performance by state and cluster, with indicators based on prosperity, productivity, labour mobilisation, innovation, cluster strength, and an identification of the leading economic clusters for each region. By comparison, in Australia, many datasets are routinely collected by the ABS and reported in the Australian Innovation System Report (DIISR, 2011); but most are not available at the regional level, and ground-truthing (that is, attempting to find hard evidence from the field, to support or argue against broad statistical assumptions) has proved exceptionally difficult. Other methods use soft indicators with no easy way of measurement (consider, for example, quantifying the 'level of regional leadership'), or else require a combination of both objective and subjective information. This problem was clearly acknowledged by Gössling and Rutten (2007, p. 266), who noted that "few comparable data can be used as valid indicators … particularly with regard to the 'soft' factors".

Thirdly, a truly comprehensive plan would need to explore not only the necessary elements of innovation, but also the key drivers for innovation, and how innovation might be predicted in the future. For example, in resource regions systems, this might include key sustainability pressures (regional greenhouse gas emissions, energy and water use per capita, waste creation per capita), as well as market conditions. Again, many of these data are not traditionally captured at the statistical division level; few are revised on an annual basis; and no published studies appear to have linked these specifically with innovation outputs

Finally, there is room for an argument that innovation, by its nature, is non-linear and thus 'unpredictable'. Certainly, there are some aspects of innovation that cannot be planned for or facilitated, such as raw inspiration, the pressures created by global economic shifts, and the ways in which markets will response to new technologies. However, responding to these elements can be supported – for example, by ensuring that the appropriate mechanisms are available to capture and refine ideas, by strengthening regional economies to ensure resilience to global economic shocks, and by providing venture capital finance and access to research expertise to bring new technologies to market.

Given these challenges, it does not seem practicable to build a predictive tool for (Australian) regional innovation systems – mostly because of the lack of existing and available datasets. Rather, the more appropriate course of action appears to be to develop a tool planning framework that can increase the propensity of innovative activity in regions; since this would be best for informing and supporting decision-making about targeted intervention strategies by business support agencies, as well as regional development organisations more broadly.

4.4   Policy implications

The OECD (2011) has noted a danger for regional innovation policies to suffer from a limited view of innovation. In avoiding this, it seems that innovation needs to be explored beyond the firm-level and into the wider socio-technical regimes (Healy and Morgan, 2012), such as those in which resource extraction occurs. The policy implications for regional innovation

systems in Australia have already been discussed (Perrem, 2012; Kinnear and Charters, 2012), but this work has not focussed specifically on regional innovation planning, nor for application in resource regions. One criticism has been that innovation policy has 'lacked conceptual rigour' (Cutler, 2008, p. 6), but this is perhaps understandable for regions, where even basic innovation profiling data is difficult (or impossible) to access. This clearly points to an area for further study in Australian regional innovation systems. The OECD (2011) has already noted that regions need to invest in mapping the types of innovations that are most relevant for their vision, including those not necessarily measured by standard indicators. The field of regional development is now moving towards more evidence-based policy development and evaluation. This will require the collection and analysis of rigorous and meaningful datasets for innovation, applicable at regional (and even subregional) levels.

Finally, at the broader national level, constructing strong regional coordination and governance frameworks are critical in actioning the twin agendas of innovation and sustainable regional development. For example, recent work on the so-called 'resource curse' has explored the possibility that that this situation exists not because of the dysfunctionality of mining proponents, but instead, because of lacking governance and institutional arrangements (Hajkowicz et al., 2011). Similarly, the introduction of Regional Development Australia (RDA) committees to 55 regions across Australia was originally intended to provide for effective, collaborative leadership that would begin tackling some of these issues; yet it appears that this has not come to pass under their current structure (Buultjens et al., 2012). It seems likely that the use of innovation, particularly those dealing with cohesive futures, activation of capital, and collaboration and connectedness, could do much in strengthening regional governance systems.

5.   CONCLUSIONS

In pursuing a preferred future for resource regions, it is of note that resource activity is, by its nature, often at odds with sustainable regional development. That is, under the Brundtland definition of sustainability, the practice of drawdown on natural assets, often combined with environmental degradation, is not in keeping with intergenerational equity. It is beyond the scope of this paper to explore this tension; rather the focus has been on the role of the innovation agenda in helping resource-based regions transition to a more sustainable future.

Resource regions are especially important areas for innovation: as Morgan (2012 in press, unpaginated) notes, that "the forces of path dependency are most pronounced in the areas where new trajectories are most needed". However, this is not to say that innovation will ultimately direct resource regions away from growth in the mining sector. The innovation agenda is a vehicle by which resource regions can grow global competitiveness, enjoy more cohesive and liveable communities, and become more environmentally sustainable. Awareness of innovation systems and innovative practices allows regional development practitioners to re-frame issues and opportunities beyond current socio-economic drivers, development paradigms and planning horizons, thus considering a wider range of regional development possibilities. Whilst it is realistic to expect to be able to 'plan for innovation', creating an awareness of innovation, acting strategically to support and grow regional

innovation systems, and injecting innovation into regional planning will help to diversify economies, as well as discover opportunities to do better in the socio-cultural, environmental and governance realms. Resource extraction in rural Australian societies is a changing landscape – one that is shaped by economic, regulatory, and socio-cultural imperatives. The innovation agenda will be critical in helping shape the future of resource regions, for industry and regional benefits, as well as to create national value. However, ongoing research will be required, particularly in the area of holistic regional innovation metrics and predictive tools for regional innovation outcomes, if there is to be sound evidence base for regional development practitioners to use in formulating new regional innovation plans.

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