Universities and innovation in informal settings: evidence from case studies in South Africa

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ABSTRACT

Technological and economic development benefits a minority of the global population, challenging universities to consider how a transformative framework of innovation for inclusive development can inform an expanded understanding of their 'third mission'. However, there is little conceptually and empirically informed research available, a gap that stimulated exploratory qualitative research to open up the field, through four case studies of emergent practices in South Africa. The paper aims to identify conditions that facilitate and constrain interaction and knowledge flows between universities and marginalised communities around livelihoods in informal settings. Analysis highlights how actors are driven to interact with one another, to learn and develop new competences. Conditions in the national and local policy environment intersect with organisational conditions within universities and communities, and within the interaction itself, to shape outcomes that impact on livelihoods and development. The conclusion reflects how working concepts may be refined to inform further research.

Key words: universities, innovation, informal settings, inclusive development, South Africa

INTRODUCTION

Technological and economic development has benefitted but a minority of the global population, and the majority remains in economically fragile and technologically excluded positions (Castells 1998). There is growing evidence to support the argument that techo-economic growth and equality operate in tension rather than in tandem, deepening the marginalisation of the most vulnerable in rural areas and at the periphery of urban settlements, particularly, but not only, in African, Latin American and Asian contexts (Cassiolato et al 2003; Dalum et al 2010). In such contexts, economic activity typically remains small-scale, informal and largely outside the knowledge, innovation and technology flows generated by higher education institutions and public research institutes.

Universities in these contexts are increasingly challenged to redefine their 'third mission' (Goranson et al 2010; Gregersen et al 2010) towards social inclusion, to harness science and technology to the benefit of the poor and marginalised (Fressoli et al 2011). Recent research reflects on shifting conceptions of the third mission in a more nuanced manner, and on how university research contributes to society (Loi and DiGuardo 2015; Trencher et al 2014; Penuela et al 2014). Understanding how universities interact with marginalized actors and communities in informal settings can add another dimension to the debate. How do universities extend their knowledge activities to include innovation by and for actors in informal settings - whether these are subsistence farmers, cooperatives, social enterprises, communities or individual households and citizens - in addition to, or in alignment with, their interaction with firms and formal sector actors, in a national system of innovation?

Interaction and networks with actors in informal settings are likely to be characterised by significant inequalities in knowledge structures and levels, resources and power, and may require new interface structures and mechanisms (Pohl et al 2010, Cullen et al 2014). This poses challenges for academics and university managers, who traditionally focus on formal academic reputation-building activities (Krucken et al 2009, Clark 2004, Whitley 2003). There is little conceptually and empirically informed research on the dynamics of university involvement in innovation to enhance livelihoods in informal settings available, however. Such a gap stimulated exploratory empirical qualitative research using a system of innovation framework, to open up the field through an examination of emergent practices of interaction, knowledge flows, gaps and bottlenecks.

South Africa provides a good context for such research, as socio-economic conditions throw the tensions between knowledge, growth, equality and inclusive development in stark relief. Universities must respond to the demands of a large informal economy and high rates of unemployment, in one of the most unequal middle income societies in the world. The informal economy in South Africa is heterogenous, inter-linked with the formal economy, and growing, estimated to contribute around R157bn, primarily in trade, community and social services (Devey et al 2006). However, much informal activity is marginal and takes survivalist forms at the household level (Ndabeni and Maharaj, 2013), creating little value-add or opportunity to link informal enterprises to formal sectors and value chains, or to create sustainable livelihoods.

The paper thus aims to identify conditions that may facilitate and constrain interaction and knowledge flows between universities and actors in informal settings, to contribute to the debates on articulating and balancing the roles of the university in contributing to inclusive development. It does so by reflecting on four in-depth case studies of networks between universities and marginalised communities, focused on innovation to support livelihoods. A review of the literature and the framework for these case studies is outlined in section one, and section two briefly describes the case study methodology used for the empirical research. Section three introduces the cases, describing how academics and universities, government agencies at various levels, community-based and co-operative actors, have been driven to interact with one another, to learn, innovate and develop new competences. Section four analyses how conditions in the national and local policy environment intersect with organisational conditions within universities and within groupings of actors in communities, to enable or constrain interaction. The final section reflects on what the conceptual and empirical analysis contributes, and how research can be refined and supplemented going forward.

1. A BRIEF REVIEW OF THE LITERATURES

This section first discusses the emerging literature on innovation for inclusive development within which we locate our research. It then sets out the working concepts of innovation, informal settings and inclusive development used to guide the empirical research and the selection of cases. Third, it elaborates the conceptual distinctions drawn from the literature on university-industry interaction in developing country contexts, in order to analyse the conditions facilitating or constraining interaction with marginalized communities.

The emerging literature on innovation for inclusive development

A new concern with the poor in innovation studies

The paper is situated within the 'transformation' (Anonymous 2015) [1] strand of an emergent literature on 'innovation and inclusive development'- or as it is variously termed, innovation for social inclusion (Arocena and Sutz 2012), inclusive innovation (Chataway et al 2013) or grassroots innovation (Gupta 2007). Until recently, the poor hardly featured in innovation studies (Lorentzen and Mohamed 2010), but Heeks et al (2014) illustrate the rapid growth of interest in "inclusive innovation", reflected in an increase of publications, starting from 2006. A recent review (Anonymous 2015) argues that although it is very difficult to categorise the differing perspectives emerging in the literatures on inclusive growth, development and innovation neatly, three competing trends or notions of development are evident: business as usual (typical in bottom of the pyramid approaches, Pralahad 2005), reform (OECD 2012, Foster and Heeks 2013), and transformation, the latter comprising a very small group of studies that question prevailing models. Thus, for example, a demand to extend the boundaries of innovation studies to include the demands, perspectives and knowledge bases of poor and marginalised communities is emerging in Latin America (Fressoli et al 2011, Arond et al 2011). Studies in this 'transformation' strand have in common that they

[1] I have blind reviewed this useful paper and awaiting full publication details, including author.

experiment with and explore the boundaries of innovation system concepts in relation to the prevailing issues of exclusion, marginalization and inequality in low income or highly unequal middle income economies (Cozzens and Thakur 2014; Crespi and Dutrenit 2014; Vessuri 2012; Swaans et al 2014).

A research agenda to investigate Innovation for Inclusive Development

Most directly influential in shaping the approach for this paper was a transformative research agenda articulated by Cozzens and Sutz (2014), to investigate the dynamics of 'innovation for inclusive development' (IID), promoted through an online network, GRIID. IID is broadly defined as "innovation that aims to reduce poverty and enables as many groups of people, especially the poor and marginalized, to participate in decision-making, create and actualize opportunities, and share the benefits of development" (IDRC 2011). The aim is to align the insights of innovation studies with those of development studies. Cozzens and Sutz drew on a stream in development studies focused on how to promote sustainable livelihoods to reduce poverty, which stresses the significance of agency, participatory processes, collective action and understanding the values and institutions of communities, as well as the potentially significant role to be played by formal university and research institute actors (see for example, Kokkrankikal and Morrison 2011; Meinzen-Dick et al 2009; Wellard et al 2013). These insights were fertile for extending the concepts of innovation studies for analysis in informal settings. In turn, the value of an innovation systems approach with its emphasis on actors, interaction and learning is increasingly recognized by some scholars in development studies, particularly in relation to agricultural innovation and rural livelihoods (Roling 2011; Nyamwena-Mukonza 2013; Sanginga et al 2012). The IID research agenda was taken up by innovation scholars in various ways, focusing analysis on both formal and informal economic activities (Joseph 2014; Arza and Van Zwanenberg 2014; Natera and Pansera 2013).

We did not find much emphasis in this strand of the literature that could inform research on the changing mission and role of universities directly. Thus, to conceptualise the study on which this paper draws, we too were exploring and experimenting, framed by the broad IID research agenda but adding yet a further layer of complexity – a focus on the interaction and knowledge flows between universities and actors in informal settings.

Working concepts to investigate innovation in informal settings

The informal economy is reported to be growing globally, but provides between 50% and 75% of employment in developing countries (Chen 2004) and around 18% in developed countries (Schneider 2002). Santiago (2014) highlighted the research imperative to better understand innovation in informal settings:

> Understanding the learning, innovation and competence-building systems in informal settings, along with the pathways to strengthen the links between informal and formal economic activities, could enable innovation in the informal sector to be more sustainable, with wider impacts on productivity, livelihoods and welfare of the marginalized populations (IDRC 2011).

For purposes of empirical focus, we isolated a specific category of the informal sector that reflects the predominance of survivalist activities in South Africa: livelihood activities

located in informal settings. The informal economy is defined as those economic activities that fall outside government regulation, including both the informal sector and informal employment in the formal sector (Devey et al 2006). Marginalised communities and households can earn a living in both spheres (Kraemer-Mbula and Wamae 2010). Informal sector activities are typically owned by households and individuals, and provide livelihoods and subsistence for the poor (Ahmad 2015). We adopted a definition of 'informal settings' that refers to 'a set of places where people live, namely, marginalised households and communities, as well as a set of places where they work, namely, the informal economy' (Cozzens & Sutz 2014: 5).

'Innovation' is typically defined as the development of new products, processes and organisational structures. For our empirical analysis we had to adopt these definitions loosely, and extend their boundaries. Rather than 'new to the world', 'the country' or 'the firm', the level of novelty was likely to be largely 'new to the community' or 'new to the informal livelihood setting'. It is likely to involve diffusion, adaptation or imitation of an existing technology to the specific conditions, cultures or values of the marginalised community.

The empirical focus required a shift in the unit of analysis, from the national level to the local or regional levels. Key to understanding the nature of innovation activity is analysis of the local actors in a system and the relationships between them, mapping and evaluating channels for knowledge flows at the local level. We substantially broadened the typical innovation actor set to include significant local actors such as non-governmental organisations, community groups, local government, traditional leaders and indigenous knowledge producers, alongside cooperatives, households, social enterprises and subsistence farmers.

The problem remained how to conceptualise the factors and conditions that facilitate or constrain university interaction, and for this purpose, we turned to the literature on university-industry interaction, in order to appropriate concepts.

Conceptualising interaction between universities and marginalised communities

Researching flows of knowledge and capabilities

The work of Cohen, Nelson & Walsh (2002) on the links between and impact of universities on firm R&D in the United States was influential in shaping a body of research in developing countries. Cohen et al's (2002) aim was to identify flows of knowledge and capabilities, and the advantages of and constraints on building interactive relationships. Hence, their research emphasised the knowledge fields and economic sectors, the channels and types of relationships, and the outcomes and benefits to firms, of interaction with universities. This approach was adapted to study the nature and patterns of firms' interaction with universities, and universities interaction with firms, in selected sectors in twelve developing countries in Latin America, Asia and Africa (Albuquerque et al 2015; Adeoti & Odekunle 2010, Dutrénit et al. 2010, Eom & Lee 2009, Fernandes et al. 2010, Intarakumnerd & Schiller 2009, Joseph & Abraham 2009, Kruss et al 2011; Orozco & Ruiz 2010).

Drivers and strategies

We extended an emphasis in this literature, which interprets the 'drivers', channels and outcomes of university-firm interaction, to encompass actors in informal settings. Higher education drivers may be distinguished in terms of the balance of intellectual imperatives – linked to academic reputations and core missions of teaching and research - and financial imperatives – the need to raise funding for research and post-graduate students - motivating individual academics and institutions (Kruss 2005). Financial drivers may relate to private sector demand, or in response to public policy interventions and financial incentives. Following Arza (2010), we distinguished firm strategies as either passive - driven to interact with universities to meet short-term financial objectives, to enhance production and efficient operation - or proactive - driven to exploit university knowledge resources proactively to address long-term objectives (Arza 2010). Passive strategies are more likely to lead to uni-directional, dyadic interactions, with knowledge flows mainly from the university to the firm, benefits limited to the specific firm, and few benefits for the university, the sector, the national system of innovation or development goals. Proactive strategies often lead to bi-directional and multiple stakeholder networks, collaborative partnerships where knowledge flows are two-way and there is a high potential for joint learning, with benefits extending more widely across a sector and building a national system of innovation, and potentially contributing to development.

We postulate that individuals and communities in informal settings likewise may be driven to interact with universities by passive or proactive strategies. Communities typically wish to resolve immediate and short-term problems, and these often relate to a lack of resources and entrepreneurial expertise, or require low-level technology solutions. Knowledge flows in such instances are typically uni-directional, from universities, such as expert advice, extension services or consultancy services, with little participation by marginalized communities. Communities do have proactive strategies which may drive partnerships and networks with academics to develop capabilities, conduct research to articulate and translate development needs, or collaborate on participatory and action research projects that can inform livelihoods in the medium to longer term. Knowledge flows in such instances are more likely to be bi-directional, and may engage with indigenous knowledge systems, taking the form of collaborations, or participatory networks.

Organisational structures and interface mechanisms

Research on university–firm interaction provided a basis to investigate the organisational policies, interface structures and mechanisms at the meso-level *within* universities, which build their capabilities to support and promote interaction with actors in informal settings (Kruss 2005, Kruss et al 2013, Kruss and Gastrow 2015).

Individual universities are challenged to change their missions, policies, structures and incentive mechanisms to develop the capacity to promote, support and manage interaction with firms, and a vast literature has emerged on the best ways to do this. The challenge is even greater, when interacting with marginalised communities, given major knowledge and power imbalances. A higher education literature that focuses on the structures and mechanisms required to facilitate interaction with communities provided insights (De Wit 2010, Vakkuri 2004, Jongbloed et al 2008, Roxå et al 2010). Clark (2004) suggests how

universities could develop strategic capabilities to respond to multiple new demands from government, industry and social groups, while maintaining their traditional roles as knowledge-based institutions. A key contribution is that universities need to continually 'find new ways to proceed that can be mixed with traditional procedures' (Clark 2008: 456). The ability to respond to change and be flexible and adaptive in how it organises is critical to a university's role in innovation.

Research on institutional practices to manage interaction with firms provided a useful distinction between 'internal' and 'external interface structures' (Martin 2000). We adopted this distinction to identify the interface structures in universities oriented to communities, or vice versa. Internal interface structures are dedicated forms of organisational development created within an organisation to support interaction, and ensure that change is integrated throughout the internal structures of the organisation. In universities, these may take a range of forms such as dedicated managerial posts, a dedicated office to promote innovation, community engagement or research, contracts offices, IP offices or centres for continuing education. External interface structures play a similar role but they typically have a separate legal status, to enhance flexibility and responsiveness, and to create a more professional interface. These may include technology platforms, incubators, science and agri-parks, or university-owned companies. Using these concepts, we examined whether similar structures are evident within universities in relation to actors in informal settings, and in turn, the ways in which marginalised community actors are organised, to facilitate participation in networks.

2. METHODOLOGY

The contribution of the paper is to use richly descriptive case studies to analyse existing activities in South African universities, in order to inform the literature and future practice. Given the exploratory nature of the research, qualitative and open-ended methods were more appropriate. The design focused on a comparison of multiple cases conducted using the same methodology, and analysis using the same set of conceptual distinctions.

Selection of case studies

The first challenge was the purposive selection of good exemplars for case study. An earlier mapping study provided an overview and breadth of perspective to guide selection, focused on four types with distinct orientations, roles and histories in the national system: a research university, a comprehensive university, a university of technology and a rural university. A survey was conducted of the interactive practices of the individual academics at each university (see Kruss et al 2013). The most frequent external partners reported were other "academic"[2] partners, followed by ''community''[3] partners. Firm partners, contrary to the extensive policy attention paid to university-industry linkages, tended to be the second least frequent partner, with variations between different types of university.

[2] "Academic" partners included international and South African universities, funding agencies and science councils (Author et al 2013)

[3] individuals and households, and a specific local community

However, interaction focused on *livelihoods* in informal settings was not common across the four universities. It was much more common to find academics indirectly interacting with communities by conducting research or teaching to enhance their *quality of life*, for example, low cost water purifiers developed using nanotechnology. These technologies are produced as socially-oriented research, but the academics, and their universities, typically remain at a distance from the diffusion and adoption of the new technologies in local settings. There were also many projects focused on student service learning or student volunteerism based in communities, in health and education fields particularly. All of these activities could fall under the broad rubric of innovation for inclusive development; but our focus for this research was specifically on the issue of livelihoods.

The purposive selection of case studies thus proceeded through an iterative process, starting with the survey data, information from websites, and interviews with project leaders. Information about each potential case was mapped against a matrix of selection criteria informed by the conceptual definitions outlined in the previous section, to determine whether it was suitable for the research purposes. We focus on four cases that best fit the criteria, in this paper.

Case study design

The case study design was simple: semi-structured interviews with all actors in the network, supplemented by background research and documentary analysis that included relevant policies and information about each actor and the outcomes of their interaction. Fieldwork followed a purposive snowball methodology, and interviews were semi-structured, customised for academics, community leaders, community participants and other intermediary actors such as local government. A narrative approach was used, so that the interviewee first told the story of the interaction, from its origins to its current state. Along the way, conceptually informed questions were used as entry points to systematise the underlying story. Interviews with community leaders and community participants were conducted at their 'home' location, which allowed researchers to visually inspect the location and activities, and relate these observations to the testimony of the interviewees. Valuable contextual information could be gained, for example information about housing, the condition of the natural environment or the levels of poverty.

Systematic comparison of trends across the four empirical cases allowed for the distillation and abstraction of a set of enablers and constraints of interaction, discussed in section four. Section three first describes the four cases, to lay the basis for comparative analysis.

3. INTERACTION TO PROMOTE THE LIVELIHOODS OF MARGINALISED COMMUNITIES

Abstracting across the four cases, we identified two distinct patterns of interaction around livelihoods in informal settings:

1. Academics interact directly to *support community access to livelihoods*. This form of interaction involves the university in networks of multiple actors with complementary expertise. Capability-building includes the development of capacity to engage with political authorities, whose policies could further marginalise communities and impact negatively on their livelihoods.
2. Academics interact directly by *introducing processes, products or organisational forms new to community survivalist livelihood activities*. This involves the university in partnerships where the main channels of interaction are typically student interns or local development actors, funded by the university or donor funding it has recruited.

University-informal sector interaction to protect access to livelihoods

These cases featured learning and technological capability building on the part of (some people in) marginalised communities, and extensive academic learning, capability building, and knowledge generation. The nature of technological innovation at the heart of the interaction was limited, but there was evidence of organisational innovation new to community, and the potential for future technical innovation.

Fishing community: A long-term interaction grew between a marine science research unit at a research university with a strong global and national reputation, and a marginalised fishing community located in an isolated estuarine setting, remote from the university. The primary objectives were to protect the community's access to its traditional fishing grounds and livelihood practices, while maintaining environmental sustainability, and successfully negotiating with national government environmental agencies that sought to shut down access. The academics were driven by intellectual imperatives, to grow the disciplinary field, but also, what we call social development imperatives - a commitment to extend their knowledge to the benefit of citizens and the public good, and to contribute to development.

Over the course of twenty years, the interaction shifted from a uni-directional dyadic partnership to a complex network, drawing in academics and students in other disciplines such as history, economics and education. Innovation oriented activities included the development of community representative structures, capabilities for engaging with government actors, participation in research and monitoring activities, the recruitment of NGO agencies to support the network, and the search for alternative livelihood opportunities. The degree of active participation by community leaders was significant, in terms of driving the agenda for interaction, participating in research to monitor fish stocks, and identifying solutions. Outcomes include new organisational forms and direct community involvement in national decision-making fora. There have been substantial intellectual benefits for the university, including new knowledge production, field-building, and the development of postgraduate students. The scale was small and localized, but potentially replicable, evident in the improved multi-disciplinary understanding of the social and environmental aspects of estuarine management, which can be of value to similar communities in other areas.

Sustainable human settlements: A very new interaction between an impoverished and racially defined marginalised community, living on the outskirts of a metropolitan area, and a local comprehensive university situated in a the metropole of an impoverished region, was initiated in response to community protests against the lack of formal housing and services, and the threat of removal. Local government authorities acted as an intermediary to involve the university to conduct research to inform a solution acceptable to all, based on the lead academics' expertise in the field of development studies, and social development commitments. The interaction was based on a participatory action research methodology, and had as its primary aim the participative identification and implementation of sustainable housing and settlement practices such as solar heating, environmentally sustainable sanitation methods and building materials. These were part of a broader effort to protect the community from attempts by national government actors to enforce relocation from an environmentally sensitive area, to a new area that would be distant from informal work opportunities (as domestic workers for example) and therefore threaten access to livelihoods. Efforts to add environmental value in partnership with an NGO were integral to the approach and focus of interaction. The processes to promote community agency were carefully planned in terms of a systematic approach to build capacity, which may provide multi-disciplinary knowledge and processes that can be replicated in other informal settings. The case was too new to have yielded specific outputs or outcomes.

New products or processes to create livelihood opportunities

These cases created and supported livelihoods directly, in terms of attempting to shift individuals or groups away from survivalist activities and towards more sustainable income-generating opportunities, or to connect them into informal or formal sector value chains. They illustrate the intense human and financial resources required to achieve such objectives and the constraints on growing initiatives to a wider scale.

Women's sewing co-operative: A long-term relationship between a clothing and textiles technology platform funded by national government agencies to serve SMMEs, located at a university of technology in a large metropolitan area, and a dynamic NGO leader, supported the growth of a women's sewing co-operative. The women used domestic sewing machines, and the constraints of these limited skills and consequent inability to access formal markets in terms of price and quality requirements, drove the NGO to seek technological capability building from the university of technology. An external interface structure focused on community engagement and service learning served as a broker to match the cooperative with the university actors that could meet its needs. The primary mode of interaction was the transfer of technology from the technology platform, (which itself functioned as an external interface mechanism), in the form of access to sophisticated design and prototyping facilities and expertise. A central role was played by students in service learning programmes, which formed a channel for exchange of formal and tacit knowledge, and mutual learning. The interaction enhanced technological upgrading and improved livelihoods, sustained over more than five years, but the reach remained very small, to only a small number of local women. Sustained access to formal markets was a challenge, with more success in accessing informal sector markets. Academic benefits were primarily oriented to students, and to build the

reputation of the technology platform. To date, there have been no attempts to replicate the interaction to other groups or settings.

Indigenous cattle project: An interaction between the Faculty of Agriculture at an isolated rural university located in an impoverished region, and local farming communities yielded a model that could be replicated in other settings. The primary objective of the project was to re-introduce an indigenous African breed of cattle better suited to the harsh local environment and small-scale farming than imported breeds. The main driver was the lead academics' intellectual imperatives and commitment to community development. Community participants were mainly driven by the reactive strategies of small cooperatives or local subsistence farmers, to take advantage of the opportunities and resources offered.

Organisational innovation entailed the establishment of a cooperative within a community, which managed a 'gift' of breeding cattle procured by the university, which in turn, was to be passed on to another cooperative once the herd had reproduced. The academic conceptualised and managed the project and controlled funding, without active community participation or accountability, or networking between the cooperatives and farmers. It used the project as a service learning and research site for undergraduate and post-graduate students. Research capacity, niche expertise and skilled graduates resulted to the benefit of the university. Local agricultural extension officers played a key role as intermediary partners and channels of interaction at the operational level. The project had a wide reach, to 72 communities in the region, as well as the initiation of schemes in other universities, so that it operated in seven of South Africa's nine provinces, but with varying degrees of success. Cooperative participants reported improved livelihoods as a result of improved performance of cattle herds. However, the number of 'gifts' passed on remained low, and highly variable between schemes. The potential for linkages to formal markets for organic beef and leather was recognised and a national scheme initiated under a high-level national innovation coordination body, but again, this was not realised. Each cooperative was in effect a passive recipient, in a uni-directional partnership with the university, supported by local agricultural extension officers.

In the next section, we identify and discuss conditions that enabled and constrained these interactions.

4. ANALYSING CONDITIONS THAT FACILITATE AND CONSTRAIN

We abstract comparatively from the descriptive analysis of each case, using the working concepts outlined above (Kruss and Gastrow 2015). Although the empirical research focused on the meso-level of the capabilities and drivers of the university and community actors, and on the micro-level of their interaction, the analysis highlighted the need to consider dynamics at the macro-level of the national system of innovation. A second significant empirical observation was that a given factor or condition could serve to support and strengthen the interaction if it was present, or act as a blockage if it was absent. The complex combination of facilitators and constraints shape the nature and possibilities of the interaction between actors in each case.

Alignment with national and regional policy processes

Science and technology or higher education policy and funding instruments did not drive nor catalyse directly the actors in a positive way in any of these cases.

In fact, misalignment between the policy goals of different government actors was a systemic blockage leading communities to seek interaction with universities, to resolve their problems in a proactive manner. For example, in the face of a threat from national marine authorities to restrict or even shut down traditional fishing activity, the fishing community required evidence to support their claim that their practices were sustainable. Competing sustainability paradigms and priorities at different levels of government thus drove communities to seek university expertise to protect access to livelihoods. Ongoing contestation between government actors with differing mandates led to major blockages and delayed the resolution of threats to livelihoods for extensive periods.

Alignment with national, provincial or sectoral policy imperatives and processes could be an enabling condition, providing funding and resources that could drive or support universities to interact with communities. A technology platform created and funded as part of a national government initiative to link cooperatives and SMMEs with expertise in universities of technology was a key enabler of interaction in the sewing cooperative case. The indigenous cattle project model captured the imagination of a national industrial development funding agency, and was aligned with the agenda of provincial departments of agriculture, which meant funding and expansion of the model to other provinces, and the involvement of local agricultural actors. National policy on sustainable human settlements provided an enabling framework, so that the local municipality could fund the university, given local government's lack of competences or an evidence base to inform policy implementation.

Government actors – at national, provincial or local level – thus could act as public sector intermediaries to enable interaction. They may provide funding for technology acquisition, and play a brokerage role. A lack of competences and resources, and misalignment of policy purpose could act as a constraint, where such intermediary functions are required.

University strategies, structures and mechanisms

University interface structures did not drive interaction directly, in the sense of initiating, funding or brokering linkages, as is often their role in relation to formal sector enterprises.

A major blockage at the meso-level is caused by the distinctive nature of the university as knowledge producers. Most academics see their roles as teaching or research, and may resist a 'third mission' role, or contest what it should mean ideally. Since the late 2000s, the South African higher education sector was challenged to conceptualise and institutionalise community engagement and social innovation as part of a three-fold mission of teaching, research and community service (Kruss et al 2013). University leaders made changes to institutional policy, and created formal interface structures to promote 'community engagement', in various ways. While the strategic organisational ethos of a university encouraged interaction, there was typically a wide disjuncture with practice, reflected in our cases.

Organisational policy may not be clearly articulated, which means that there is little incentive or reward for interaction with marginalised communities, as in the case of the rural university. A lack of internal alignment was widely observed, in that internal interface structures that function to promote and support research and innovation typically coordinated their activity within the university; but those interacting with marginalised communities tended to operate separately, within departmental units or relying on donor funding. There was little institutional funding for research to the benefit of marginalised communities, a constraint on the progress of projects, which typically require extensive time to build relationships. Another evident constraint was the steep learning curve required for academics to shift from interaction with formal organisations such as firms or NGOs, to engage with informal actors, communities and small cooperatives (see Olmos-Penuela et al 2014). In the South African case, there are major racial, language and cultural differences between academics and communities that act as barriers to interaction, alongside the more typical knowledge and educational differences.

Our analysis therefore suggests that individual academic champions who were committed to social development and driven to grow their academic disciplinary field through the processes of interaction with communities, made a critical difference in enabling each case. Intellectual and social imperatives were the major drivers of interaction; and interaction was sustained over time because it fed into their research agenda and grew their academic field and reputation. Krucken et al (2009) similarly found that in German universities, most interaction was not rewarded academically, and hence, driven largely by individual commitments.

The form of interaction however, was influenced by the university mandate and strategic direction, and the structures and mechanisms put in place to realise these. Differences were observed between cases located at different types of university (see also Pâlsson et al 2009). At the research university, the fishing community interaction was initially oriented to research with traditional uni-directional knowledge relations, and slowly evolved into a bi-directional, mutually beneficial network. The lead academic built networks to bring in missing expertise critical to the project. A small, self-funded research centre operated as an external interface structure with the flexibility to interact with the fishng community, and as an internal interface structure to recruit academics from other departments into a set of multi-disciplinary cognate projects. The enablers at the comprehensive university were similar – a strong academic committed to development, building an academic field and trialling a participatory action research methodology, generally supported by the university's strategic commitment to engagement, but not formally linked to any of the formal internal structures established to support engagement, research or innovation. The lead academic initiated the indigenous cattle breeding project in line with the rural university's strategic focus on teaching and research to promote local community development, but operated with little formal university support. Donor funding allowed for the creation of a project office to serve as an external interface structure at the local level, to provide operational support to the farmers, but the project was not integrated into university structures, and retained features of uni-directional service learning and agricultural extension types of relationship.

With its applied technology mandate and commitment to work-integrated and service learning, in contrast, interaction at the university of technology took the form of technology transfer to SMME partners. Academics' role in the interaction was mediated through a formal external interface structure, a technology platform. The design and prototyping services offered are specific to universities of technology. The formal structures pushed individual academics to actively identify and interact with actors in SMMEs. Interns and students in service learning programmes were available as the main channel of interaction, working with the women in the sewing cooperative on a daily basis, while the academics provided oversight and expertise.

Community strategies, structures and mechanisms

Constraints on the marginalised communities are innumerable – lack of resources, lack of education and skills, competition for scarce resources. Yet except for the indigenous cattle case, they initiated contact with universities to resolve livelihood problems. Hence we focus in this section on the conditions at the meso-level within communities that enabled their agency.

Individuals from marginalised communities played a key role as champions, moving between the academic and university interface structures, and the larger community-based groups. The initiator and main point of contact was a single community leader who possessed the skills to engage with academics.

Academics set in place a process of social and organisational innovation to elect a committee that would represent the community and provide a formal link to the university and other actors involved in the network. The fisher folk and the informal settlements communities elected a committee to liaise with other actors, which allowed decisions and activities to be driven by their proactive strategies. These committees conducted research to inform livelihood strategies, in partnership with the university. Aside from these basic structures, the interface between the community and other actors was largely informal and tacit.

However, the depth of participation and cooperation within these committees and cooperatives was a potential constraint. For example, farmers in one co-operative indicated that there was a high level of complacency among some members, in terms of their practical involvement with inspections and general tending of the indigenous cattle. There was contestation around whether and how individuals would gain personally, or whether funds realised should be used for communal projects, which impacted on participation. A passive dynamic was manifest in relation to the introduction of new fencing practices required to ensure the purity of the new breed, in contrast to the traditional practice of communal open pasture for example, with an expectation that the project should provide the resources, rather than farmers themselves.

The challenge to build interface structures within the community to facilitate agency and linkages to the university are thus time-consuming and considerable. One solution was that other intermediary actors in the network became the direct contact point and channel of interaction.

Intermediaries as channels for interaction and knowledge flows

The role of intermediary actors in maintaining the network was not foreseen, but empirical trends revealed this as an important enabler, particularly in relation to the diffusion or adaptation of existing knowledge and technologies within communities.

Intermediaries also played a key role in bringing in missing complementary expertise that the lead academic or community partners lacked. Thus, intermediaries served to enhance the flows of knowledge in networks, whereby tacit knowledge of community members could enhance the solutions developed to address livelihood problems, or to build capacities of community members. The role of intermediaries in the everyday engagement with communities contributed to mutual learning and capacity building.

In contrast, intermediaries could block the processes and dynamics of building relationships with communities. Traditional leaders acted as gatekeepers for access to rural communities in the indigenous cattle case, for example. The consent of the local chief was required before interaction with a co-operative could be operationalized. Many academics do not have the skill - or the time and resources - for such engagements. Students and interns or intermediary actors such as local project and public sector agricultural extension officers were the main channels of interaction, bringing codified knowledge from the university, engaging on a daily basis, and consequently, benefiting through experiential training and tacit learning from the community partners. The academic leader operated at one remove to provide intellectual leadership of the project, control funding, and be drawn in actively at key points to give direction and high-level support.

The nature of community participation and tacit knowledge flows in the interaction

The cases provide support to the development studies literature, in that uni-directional, service forms of interaction that offer packaged solutions may create dependency and invoke a sense of passivity and entitlement, weakening the capacity of actors in informal settings. Bi-directional network interactions present more opportunity to create (a degree) of mutual benefit and mutual learning. Thus, the nature of the interaction itself, in terms of the extent and nature of community participation and knowledge flows, became an enabling condition to strengthen interaction over time. Over a (long) period of time and interaction, university teams could learn to work in different, more participatory ways, based on recognition of the value of the communities' tacit knowledge. Here we provide two contrasting examples to illustrate.

In the sewing cooperative case, initially the channels of interaction were uni-directional, with expertise and resources flowing primarily from the university of technology. Over time, the nature of the interaction became more bi-directional, with an increasing degree of knowledge exchange evident. While the academics, interns and students brought their formal codified knowledge, as well as embodied knowledge in the form of equipment, it was recognised that they gained tacit knowledge from their experience.

Participation by cooperatives was largely passive and limited in the indigenous cattle case, and it is worth examining knowledge flows in greater detail. A community-selected 'livestock manager' received basic training and equipment from the provincial agriculture

department, including organisational training, basic animal branding techniques, castration and basic animal health. Training was undertaken by a coordinated team of interns, students and extension officers, but the uptake of training and mutual learning did not go smoothly.

The evidence suggests that a clash of scientific and indigenous knowledge structures was a major constraint, limiting participation. According to community members, staff and students from the university never questioned them directly about their traditional knowledge nor shared academic knowledge generated through the interaction. Knowledge flows from the community were limited to practically-gained tacit knowledge, rather than potentially valuable indigenous knowledge or co-construction of knowledge, with little active learning on the part of the students or community.

Funding

Funding may be a blockage that prevents more academics from interacting with actors in informal settings. In all cases, steady access to financial resources and what these make possible was reported as a constraint. It was strongly evident that universities and national government do not provide sufficient funds to promote and support interaction in informal settings. Even small amounts of funding could make a big difference at local level. Funding is no guarantee of 'success' however, and lack of funding is not a guarantee of 'failure' either, as the fishing case attests – the academic continued working with the community over 20 years, as and when funding allowed. Funding may facilitate ongoing interaction over time, but it is only one of a complex set of intersecting conditions shaping the nature and outcome of interaction.

CONCLUSION

There is much research on how universities contribute to economic development and growth (Geuna and Rossi 2015) but little research on how universities are oriented to the informal economy, particularly, to benefit marginalised households and communities engaged in survivalist activity. Our research was exploratory, aiming to conduct conceptually informed empirical case studies on the ways in which universities can and do extend their knowledge and innovation flows to marginalised actors in informal settings, to contribute to a transformative agenda of innovation for inclusive development.

We began with working concepts, and now reflect on whether and how these assumptions and concepts should be refined or questioned, in the light of the empirical research.

We were led to question - should universities interact with marginalised communities around livelihoods – is it one of their roles? At first glance, the four case studies highlighted the difficulties for universities to have a significant impact in informal settings. The interaction typically resulted in direct livelihood benefits for a very small group of households or individuals, often with high costs in terms of time, funding and resources. Nevertheless, the involvement of university actors meant a contribution to new knowledge that could be replicated in other settings to the benefit of other marginalised communities. In addition, a key outcome was the development of new skilled actors - the students involved in formal and tacit learning processes – who were more socially aware and oriented to inclusive

development. These potentially strengthen the national system of innovation and contribute to orient it more firmly to inclusive development goals. We thus argue that universities should *also* promote technological capability building in informal livelihood settings, aimed towards inclusive development, as part of their third mission of innovation and engagement.

We appropriated concepts from the university-industry interaction literature to investigate interaction with communities. How well did these work? For academic actors, a third type of driver of interaction emerged, related to their commitment to social justice and the public good, which we named 'development imperatives'. These operate in tension with the financial and intellectual imperatives driving interaction with firms or government agencies or other knowledge producers. As with firms, addressing communities' passive strategies may be one phase, to initiate a long-term collaboration with a research team; and where there has been collaboration over time, there is likely to be a mix of forms of interaction evident. Individuals and households were likely to be motivated to participate in pursuit of reactive strategies, but community leadership actors were more likely to be driven by proactive strategies, in the longer term interests of the group. The difference was linked to the degree of active participation facilitated in the interaction itself. This complexity points to an area that requires further research.

The main aim of the paper was to identify enablers and constraints of such interaction. The analysis explored how 'skillful but imperfect rational' (Lundvall 2010: 331) actors in universities and communities were driven to interact with one another, to develop new competences. Here the analysis of empirical trends revealed an unexpected result. Each condition identified could act as an enabler when present, or a constraint when absent or not functioning well. We thus conclude that these factors and conditions operate as dynamic intersecting 'forces' at macro-, meso- and micro-levels, shaping what is possible in complex ways. Table 1 provides a conceptual model of the main intersecting conditions, and we discuss the research directions they point to, below.

Four empirical trends point to areas that require further conceptual development and more focused empirical research. First, interaction was most directly driven by the intellectual and development imperatives of individual academic champions, matched by the proactive livelihood strategies of community based champions. Policy, structures and incentive mechanisms in different types of university shaped the nature of interaction, the degree of participation and the outcomes, but did not drive interaction. More fine-grained concepts are required to investigate the intersection between individual drivers and organisational conditions.

Linked to this, second, it was evident that conditions in the national, sectoral and local policy environment intersect with the organisational conditions within universities and within the organisations of marginalised community actors, to enable and constrain interaction, and shape its nature and outcomes. A more structured investigation of linkages into the policies, structures and actors within the national/ regional / sectoral / local system of innovation would be beneficial.

Third, the critical role of intermediary actors in the networks in terms of brokering relationships, providing funding and providing complementary expertise, was highlighted. Conceptual distinctions to identify these functions would be helpful.

Fourth, the critical significance but challenge of promoting bi-directional knowledge flows and forms of interaction that take the indigenous knowledge, language, culture and institutions of marginalised communities into account, were highlighted. To explore these dynamics at the micro-level in greater depth would add to the innovation for inclusive development research agenda.

In conclusion, the paper has gone some way to explore the dynamics of university involvement in innovation to address livelihood problems in informal settings, in a highly unequal country context. In doing so, it has developed working concepts and proposed how they may be refined for further research. It suggests how a transformative framework of innovation for inclusive development can inform an expanded understanding of the third mission of the university.

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