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No.4 African Universities and Inclusive Innovation: Case Studies in the Western Cape Province of South Africa | Follow up study

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Colofon

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Abstract

With policy makers and development practitioners raising concerns around the exclusive qualities of innovation, an interest has started to develop in how innovation can benefit disenfranchised individuals and communities and in the role of universities in this space. This report describes a CFIA-funded study of technology-based innovation projects at universities in the Western Cape province of South Africa. Sixteen projects were included in our study that was conducted in 2016.

The research was exploratory and inductive, reflecting the fact that theories on inclusive innovation and frugal innovation is in its infancy and university contributions to this type of innovation are largely unexplored. Within this set of 16 projects, we looked at the general patterns how such inclusive innovations are developed and implemented, and at their outcomes. We made use of desk research and interviews with university-based project leaders, and analysed the documents using content analysis software (Atlas.ti). Aspects associated with frugal innovation, such as new business models, reconfigured value chains and redesigned products and services, feature prominently in these projects.

We distinguished three inclusive innovation approaches, each reflecting different purposes and decision making principles. Projects of the ‘developmental approach’ were driven by the aim to uplift marginalized groups or communities, through developmental means. Project leaders taking on a ‘hybrid approach’ still considered development to be the overarching purpose of inclusive innovation, but they were guided – at least in part – by business principles in their choices around resourcing and outputs. Finally, in the ‘commercial approach’, inclusion was achieved through business models and market means. Differences in the extent to which end users were included in the innovation process were categorized into ‘top-down’ and ‘bottom-up’ processes. Our studies unearthed a third type of process used by university innovators: selective participation. Finally, projects were linked into the university context in three different ways: education-based projects; education-based research projects; projects that were first and foremost earmarked as (non-education-based) research projects.

Summarizing and integrating these different innovation approaches, levels of inclusivity, and types of university ‘vehicles’, we identified four different ‘pathways’ of inclusive innovation at universities. We find that each pathway is associated with particular challenges and opportunities for university innovators.

Table of Contents

- Abstract**..... 2
- 1. Introduction** 4
- 2. Theoretical Perspective and Conceptual Framework**..... 6
 - What is ‘Inclusive Innovation’? 7
 - Inclusive Innovation Models 9
- 3. South African Innovation System** 13
 - Introduction 13
 - Innovation and the Informal Sector 14
- 4. Methodology and Information Sources**..... 18
- 5. Case Study Findings**20
 - Institutional Origins and Frameworks20
 - Innovativeness and Societal Relevance 22
 - Educational Relevance 23
 - Project Milestones and Deliverables 24
 - Interaction with Local Communities 25
 - Business Sector and Commercialization 27
 - Project Enablers and Inhibitors 29
 - Project Outputs, Outcomes and Impacts 29
- 6. Discussion and Concluding Remarks**..... 32
 - General Concluding Remarks 32
 - Future Research and Follow-up Studies 34
- Acknowledgement**..... 37
- Bibliography** 38

1. Introduction

There is a growing interest among academics and practitioners in the role of university-driven innovation in socio-economic development of low- and middle-income countries. In spite of the recent worldwide surge of interest in this topic, there is a lacuna of robust empirical data to support the development of evidence-based policy agenda's. Research on the role of universities in support of 'inclusive innovation' processes is in its infancy (Grobbelaar, 2011).

Comparative data – either at the regional, national or international level – are scarce or absent. Inclusive innovation, i.e. the development of new products, services, processes and models aimed at resource-poor or low-income groups, is considered for its possible contribution to better life conditions and upward mobility (e.g. Jensen et al., 2007; OECD, 2013; Swaans et al., 2013). It is within these contexts that the need for socio-economic development is highest.

This report describes an exploratory study of university-driven or university-supported inclusive innovations in the Western Cape province of South Africa; a region and a country with high socio-economic inequalities. The study was conducted among the region's four major research-active universities: *University of Cape Town (UCT)*, *Stellenbosch University (SU)*, *University of the Western Cape (UWC)* and *Cape Peninsula University of Technology (CPUT)*. The four universities cooperate under the umbrella of the *Cape Higher Education Consortium*, bringing older-style international-oriented research universities (UCT and SU) together with newer, more local community-orientated universities (UWC, CPUT).

The exploratory data analysis below is based on the pilot study as well as a preliminary review of literatures in the areas of technological innovation, business strategy and inclusive innovation. We outline a theoretical, conceptual and analytical frameworks for a series of interviews with actors and university representatives in that region. We build on existing notions on regional innovation systems which allows for a theory-enriched empirical analysis of university-related 'inclusive innovation' in this region. The role of research universities in regional economic development is receiving increasing attention (Grobbelaar & GwynneEvans 2014; Grobbelaar, 2013; Tijssen, 2014), and universities are debating what engaged scholarship looks like and how support of inclusive innovation is linked to university mandates and missions.

The central aim of this exploratory research project is to investigate the general nature of university-driven or university-supported activities with regard to inclusive innovations, either for local subsistence or for entrepreneurship. This pilot study's major aims are:

- informing and enriching current conceptual frameworks;

- contribute to better methodologies and analytical frameworks for in-depth follow-up studies with a focus on measurement issues;
- to enable larger-scale follow-up studies for cross-institutional comparisons and aggregate-level data collection on university-supported innovation-promoting activities in South Africa or other African countries.

Our main analytical aims were:

- create a first general inventory of academic inputs, facilities or contributions that drive or support local inclusive innovation activities;
- to understand existing activities;
- identify general determinants and framework conditions affecting the interactions between university research staff and external partners or stakeholders.

Our analysis of findings is informed by the following research questions:

- how can university-led or university-supported innovations and competence-building contribute to inclusive development in resource-poor communities?
- can one ascertain their impacts and effects within local communities?
- what is the role of the business sector and commercialization in these inclusive innovation projects?

The next section provides a general academic framework for the study, introducing relevant theoretical notions, key concepts and analytical models. Section 3 briefly introduces the South African innovation system – both national and within the Western Cape region. Our method and information sources are described in section 4. The detailed findings of our case studies are presented in section 5. We conclude in section 6 with general remarks, some first conclusions and recommendations for follow-up research.

2. Theoretical Perspective and Conceptual Framework

Innovation in Developing Countries

Until recently, innovation studies have focused mainly on high-income countries, where innovation is often seen as the introduction of new ‘frontier’ technologies based on advanced *Research and Development* (R&D). We usually think of innovations in terms of major breakthroughs that build on complex R&D-intensive processes but the overwhelming majority is incremental in nature and result from modifications and adjustments to existing technologies.

Transfer of knowledge, skills and technologies will yield higher returns for low-income countries than investments in R&D. This is particularly true for middle-income countries where the process of catching up to high-income countries involves importing and modifying existing technology (Archibugi and Pietrobelli, 2003; Schaaper, 2014; Sorensen, 1999). Similarly, transferring technologies into low-income sectors of middle-income countries requires a core of trained people and organizational structures if the transfer and adoption processes are to be successful.

Internationally comparative studies of innovation systems in developing low-income or middle-income countries are of a relatively recent date (Fagerberg et al., 2010). According to a recent OECD report, “In a traditional Schumpeterian setting, innovation will increase inequality as benefits accrue only to innovators and possibly their customers” (OECD, 2012). There is growing recognition that economic growth in low- and middle-income countries should be accompanied by inclusive development, leading to a search to identify strategies and mechanisms to promote inclusive innovation. In dual economies, like South Africa, with both a sizable formal economic sector and a burgeoning informal sector, inclusive development requires giving some consideration to different types of income inequality and unequal opportunities in poor and low-income communities. The OECD argues: “When development leads to substantial transformations of the economic systems of developing and emerging economies, distributional issues can be even more substantial. At the same time, innovation offers potential means of addressing outcomes of growth dynamics that are not inclusive. [...] Moreover, lower income groups may themselves be innovators and find means of improving their welfare” (OECD 2012, p.9). Inequality may in fact foster innovation, but if talented but low-income entrepreneurs have no access to financing, potentially successful innovative projects cannot be realized and economic growth is hampered. As entrepreneurship is fostered among poor and lower income groups, and inequality is gradually reduced, the growth of the middle class entrepreneurship will shape demand and enable policy reforms and institutional changes in public investments for fostering inclusive growth (OECD, 2012).

Lorentzen (2011) argues that innovative activities in low-income countries will typically happen in economic sectors where R&D is not among the major drivers of innovative outcomes; he argues that low-income groups hardly feature in these innovation debates. People also innovate, maybe more than average in situations of extreme poverty and inequality - but usually without the benefit of R&D facilities and resources. In that sense, inclusive innovation is *people-centric* rather than R&D-centric.

What is 'Inclusive Innovation'?

This particular term was first introduced by the World Bank as “knowledge creation and absorption efforts that are most relevant to the needs of the poor” (Dutz, 2007), capturing mainly the knowledge capacity of users. There are two sides to the concept ‘inclusive’:

- knowledge creation, acquisition, absorption and distribution efforts targeted at meeting the needs of the low-income groups or the poor (consumers/recipients);
- Responding to innovations by the poor or low income groups to create viable goods and services (producers).

In order to make these innovations successful they should also be tailored to the needs and circumstances of low- and middle-income consumers (Prahalad 2012). Second, commercial success asks for inclusive business models. Traditional product management has a ‘productcentric’ approach while ‘polycentric innovation’ is important to address the ‘inclusiveness’ in low-income environments (Kaplinsky 2011; George et. al. 2012). Commercially successful inclusive innovations require new business models and innovation systems in which innovating universities collaborate with external partners, such as firms, governments, NGOs and local entrepreneurs.

Nowadays, there are various descriptions and definitions of the term ‘inclusive innovation’. In a recent academic research article by Foster and Heeks (2013, p. 335), inclusive innovation is very broadly defined as “the inclusion with some aspect of innovation of groups who are currently marginalized”. A more specific definition was recently introduced by Mashelkar (2012) is the following: “Inclusive innovation is any innovation that leads to affordable access of quality goods and services creating livelihood opportunities for the excluded population, primarily at the base of the pyramid and on a long term sustainable basis with a significant outreach.” The definition restricts the innovation to a subset of those that satisfy the Oslo Manual definition and which refers to activity of the firm in the last three years. Another recent definition, by the OECD - an international think-tank based in Paris, states: “... the capacity to contribute to the extent that innovation can be mobilized to improve the life conditions of lower income groups , and what policies can make it happen”

and “Innovations (by firms) for low-income individuals or groups. The aim of “inclusive innovation” is to harness science, technology and innovation know-how to address the needs of lower-income groups” (OECD, 2012). In this study, focussing on inclusive innovations (co-)developed by universities (rather than by firms), we will adopt a customized version of the OECD definition: *“Innovations for low-income individuals or groups, with active participation from universities and derived from knowledge and know-how at universities, to address the needs of lower-income groups”*.

Ideally, any analytical framework dealing with innovations should be informed by, or based on, the OECD’s *Oslo Manual* for classifying and measuring innovations and describing structural features of innovation systems. Categorizing inclusive innovations would then have to be framed within this manual’s ‘novelty principle’, which says that innovations should be assessed according to four degrees of novelty: the innovating firm; national market; regional market (non-global, multi-country markets); global market. Issues of systematic data collection and measurement are also relevant, as is the *Oslo Manual* to inform national innovation policies.

It might be difficult to assess the relevance of these inclusive innovations fully from such a firm-driven economic perspective, which might in many cases be low or negligible to individuals or households. However, if provided with substantial support, these innovations can contribute significantly to improving the welfare of these groups. Adoption will depend on pricing, level of demand, social acceptance, and practices among the (potential) users concerned. Local empowerment can help to address and resolve those issues. The concept of ‘knowledge markets’ could be introduced here as an overarching organising principle. Such a market, in the non-economic sense, may constitute an effective people-centric interface and an efficient means of disseminating and combining knowledge/skills bases, whether from formal or informal sources (Gault & Zhang, 2010).

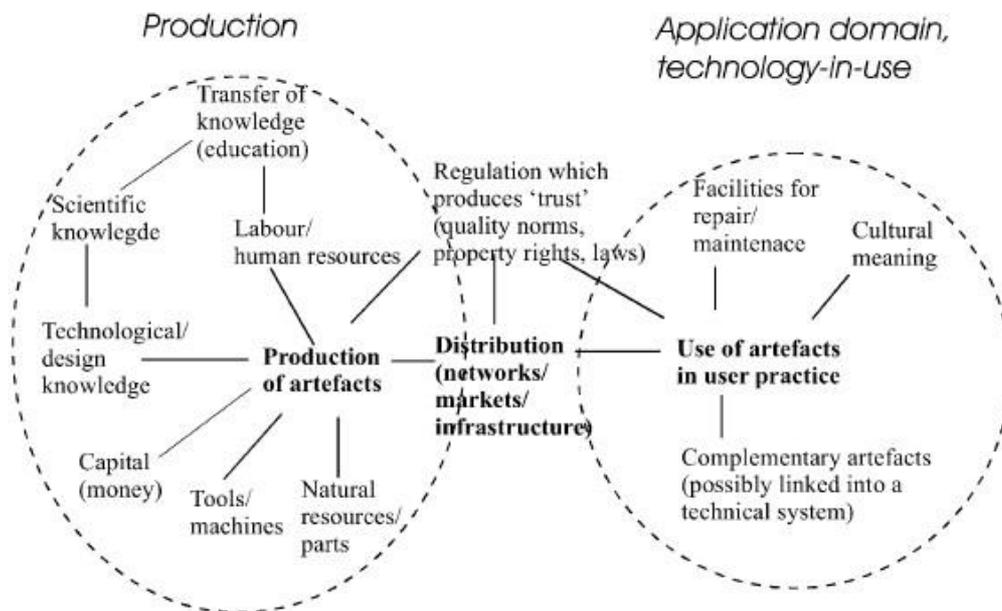
Through the creation of such a market, inclusive innovations can also contribute to entrepreneurship and local development by introducing intangibles such as new business models and new nodes with local innovation systems. Small-scale inclusive innovations contribute to enhancing economic growth and societal inequalities, while reducing instability and unreliability of existing technological and institutional infrastructures. Local resource-poor entrepreneurs in low-income communities can become part of regional, domestic or global value chains (Parrilli et.al, 2013). This may induce local entrepreneurs to become path-breaking entrepreneurs in a more traditional ‘Schumpeterian’ sense of technological innovation by developing and applying new combinations of production

factors which could lead to a decisive cost, quality or price advantage, and being able to generate revenues and make profits.

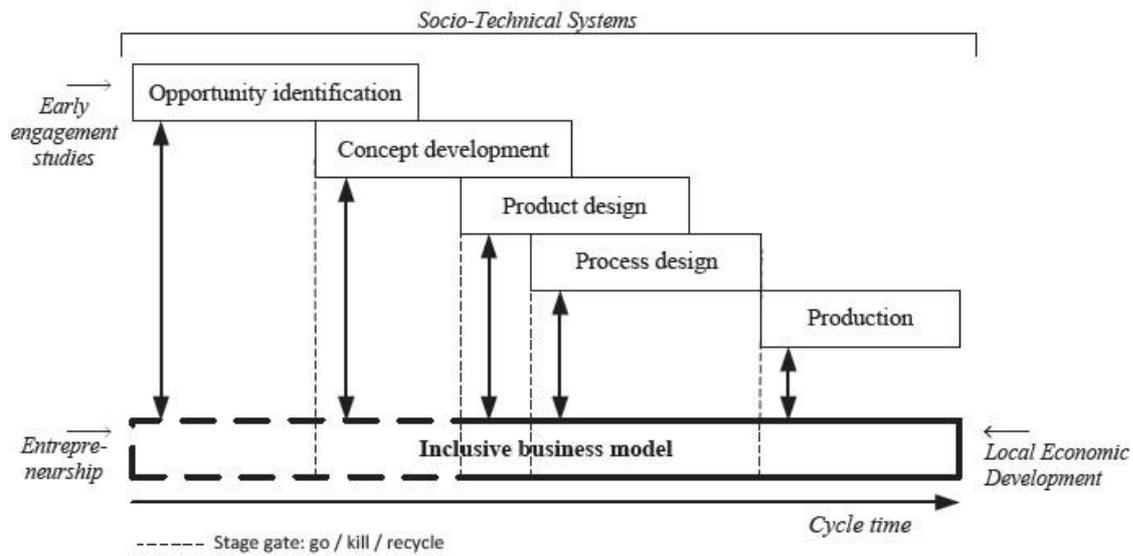
Inclusive Innovation Models

Commercial exploitation, entrepreneurship and business interests can be the heart of inclusive innovation projects from the very start, or at the very least should be one of the driving factors. In those cases, intellectual property rights and competition in the marketplace become issues; often because of the limited public resources available for carrying out such a project or creating longer-term economic sustainability. Taking entrepreneurship as starting point, **Graph 1** shows the key elements of an inclusive innovation development model based on the overarching concept of socio-technical systems (Geels, 2004). The interface between the production of technology-based ‘artefacts’ and their socio-economic applications is defined by a mixture of distribution platforms, connectivity mechanisms, and enabling framework conditions. This exploratory study focusses on the varied nature of those platforms and process characteristics of those mechanisms.

Graph 1: The Basic Sources and Elements of Socio-Technical Systems



Graph 2: Inclusive Innovation Model #1 (Business Perspective)



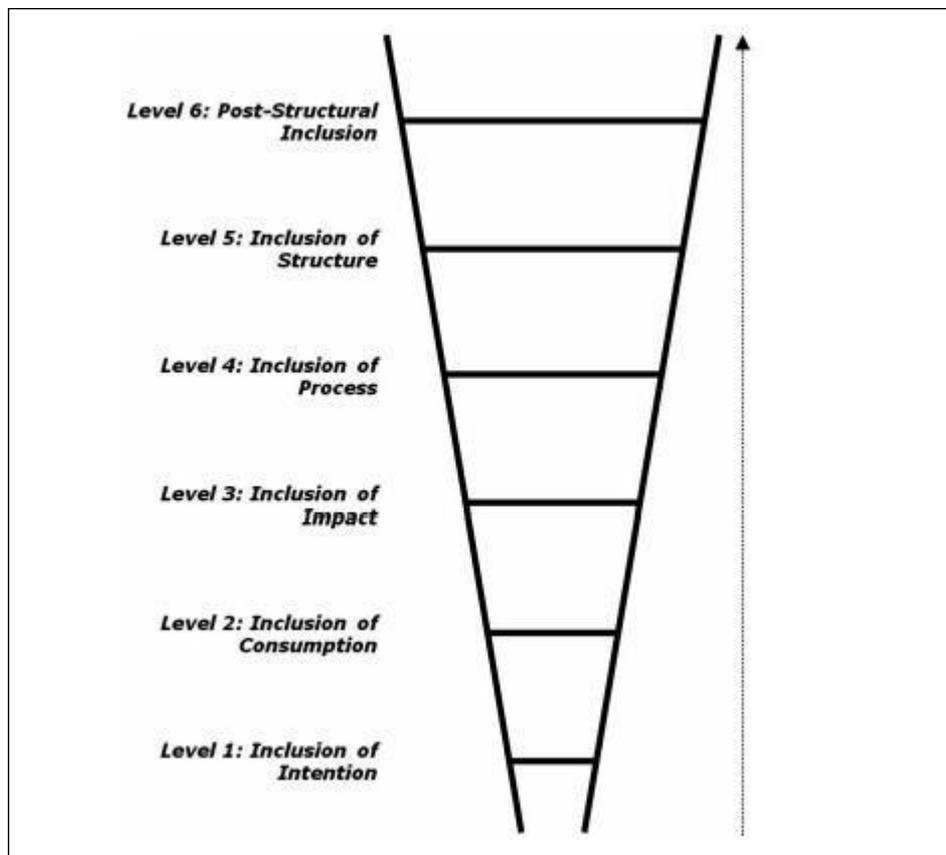
Graph 2 presents a socio-technical systems model from the business sector perspective, where a business model, entrepreneurship and local economic development are the main driving forces (Van Beers et al. 2015). This step/phase model represents a traditional, linear approach to innovation where ‘upstream’ investments and business development lead to ‘downstream’ production of processes or products for user practice and the (local) marketplace.

Focussing on outputs geared towards local economic development and business sector activities, **Graph 3** defines another linear sequence of stages toward the market-driven production of an innovation (Heeks et al. 2014). Each stage of the process is informed by an inclusive business model, with a series of stage gate (go/no go) decisions bases on economic viability considerations. The relevant inputs or economic features of low-income customers or resource-poor user communities are implicit, captured by milestones or deliverables specified in the business model. In the early stages of inclusive innovation trajectories, such business models have not yet emerged (and perhaps never will because of insufficient economic potential and/or other societal objectives).

These ‘upstream’ stages require a different type of model, like the ‘ladder of inclusive innovation’ introduced by Heeks et al. (2014); a process-oriented sociological model based on a levels of engagement of low-income user groups in the trajectory, and the progressive pervasiveness of the inclusiveness within the user community. Level 1 innovations are inclusive if they aim to address the needs of the targeted user group. Level 2 implies adoption and usage by that group. Level 3 implies impacts of those applications. Level 4 refers to users as active (co-)creators of (co)developers of the innovation. Level 5 entails inclusiveness of the structures (organizational, socio-economic, or otherwise) in which the innovation is created,

developed or applied. In Level 6 the related knowledge/skill generating processes within those structures, and related communication/transfer mechanisms, are also inclusive.

Graph 3: Inclusive Innovation Model #2 (User Engagement Perspective)



Each inclusive innovation project or trajectory may tap into different levels and elements of this inclusivity ladder. Typically, the lower levels will relate to conventional innovations, of the product/process type, where users are mainly ‘passive’ consumers. These innovation activities and impacts was still within the analytical scope of the *Oslo Manual*. The higher levels entail increasingly intensive degrees of active cooperation, user-producer interaction, and community involvement in learning, design and development processes. Clearly we should replace the simplified linear model by a more complex model that recognizes all relevant actors and evolving alignments between them, as well as all transformations and recontextualizations that occur when innovations are transferred to and absorbed into user environments and perhaps taken up in economic value-chains. Here, the concept of ‘inclusive innovation’ blurs into bottom-up ‘grassroots innovation’, i.e. “... solutions developed by lowincome groups to meet challenges which they and their community face” (OECD, 2013). This is also the domain of ‘democratized innovation’ in Von Hippel’s (2004) terminology, where community-based innovations or user-induced innovations are derived from joint research, participatory designs, co-production of knowledge, co-development of skills, coinvention of technologies, or other joint learning activities and public engagement.

All these models are high-level abstractions, selected out of several other possible models that represent distinct analytical perspectives of inclusive innovation processes. These two models represent highly different ‘innovation regimes’, i.e. sets of structural mechanisms, determinants and goals. Each model is meant to serve as a supplementary conceptual framework to help organise and interpret the diversity of findings from our empirical case studies, more specifically those described and analysed in subsections 5.5 and 5.6 where business interests are compared to community engagement, and tangible outputs to intangible processes. Here we will see that university-driven initiatives to improve the local innovative capacity within communities and small, indigenous firms (either in the formal or informal economy) whose innovation processes are neither ‘western style’ linear and ‘business model’ driven.

3. South African Innovation System

Introduction

South Africa is typical of a middle-income country grappling with the challenges of an emerging economy which is characterized by the emergence of higher level organizations in the form of new industries and markets, with the balance tilting away from variation towards selection of products, primarily at the level of the firm, and largely governed by the market (OECD, 2007). The economy is comprised of manufacturers, mining and a services oriented sector that is globally engaged. Some companies in the manufacturing and service sectors are engaged in product innovation and have extensive business sector R&D investments (CeSTII, 2010; 2011). The potential for parts of the emerging national system of innovation to compete in the global knowledge economy is evident, but accelerating innovation more widely across the economy is constrained by lack of skills and human development demands. Empirically, the patterns of interaction found in South African firms largely reflect this general pattern. Firms in general reported a relatively high rate of innovation in comparison with European Union (EU) averages.

A national or regional innovation system usually comprises a diversity of actors, located within a geographic zone, who are directly and indirectly engaged in the process of innovation. While an innovation is often perceived as the ultimate output of just one core innovating actor (usually a private sector business company), in reality the innovative product or service surfaces from interactions and interrelationships between different actors within the system. These innovation partners may comprise of suppliers, customers, government organizations, or institutions and universities in the higher educational system.

National innovation surveys in South Africa include questions on the 'knowledge base' of firm generated innovations. To characterize this base, these inputs are often classified into the following set of categories described as:

- research and development activities;
- knowledge, skills and training gained from universities or research institutes;
- intellectual property;
- design, planning and testing of new products;
- market preparations for new products, and planning and implementation of new methods.

With regards to the first and second category, firm propensities to draw on local universities – whether for R&D or innovation support – is associated with larger firms and those with higher levels of technological intensity, and more strongly with high technology sectors. Strong sectoral differences are evident. Firms that cooperate with universities on innovation are more

likely to be in the manufacturing sector (50%), followed by wholesale and retail (20.5%), financial and business services (14%) and few in the mining sector (4%). The propensity of small and medium-size firms to cooperate with universities is quite limited. Many small and medium-sized firms are not well connected to, or co-evolved with, local knowledge sub-systems at universities or local user or client communities.

Innovation and the Informal Sector

Is the informal sector a potentially important generator of inclusive innovations? In those cases innovation will include forms of learning and adaptation that might be either marketled, socially-driven or a mix of both (DST, 2012). Although South Africa does not lack government policies and initiatives supporting the domestic development of R&D and innovation, there has never been a clear cut policy on innovation, entrepreneurship and inequality. South Africa needs to critically consider how innovation works in the informal sector, given that it represents the main source of income for a significant share proportion of its population. South Africa's *National Development Plan* (NDP) recognizes the importance of stimulating economic growth, and local economic development policies, as a means to combat poverty and inequality, but concrete plans that focus on innovation for or from low-income groups are not provided (NDP, 2012). The NDP acknowledges that there is little support for the informal economy, where poor communities and township economies are unable to retain local spending power or to attract investments for individual entrepreneurs who can overcome market and social barriers and integrate their innovative activities in both formal and informal markets.

The informal sector remains peripheral to understanding South Africa's innovation potential and capacity. Performance indicators that could help assess innovation facilitation can be grouped into three broad classes:

- Direct financial support: sources of funding by program, financial support from NGOs or venture capital sources;
- Indirect financial support: tax credit support, government subsidies;
- In-kind support by university or intermediates: mentoring, advice and access to networks and markets, access to the research infrastructure (equipment and facilities).

Within middle-income countries like South Africa, inequality in terms of innovation performance, should address the role and contribution of "islands of excellence" that are far in advance of others in terms of innovation capacity or potential and the spillover opportunities they may generate for adopters and followers (OECD, 2013). These 'innovation seeds' could be anything ranging from 'knowledge intensive' geographic areas, clusters and urban areas; 'innovation hubs' with expertise and leadership in certain technology fields; small

companies that are innovation leaders in certain activities or domains; research labs; or universities and their science parks.

The South African government, via its *Department of Science and Technology* (DST), has an *Innovation and Inequality framework* in place addressing the poor and informal economy in terms of opportunities, services and economic participation (Mkhize, 2014).

Although innovation systems is a well-recognised concept on the national level, provincial governments in South Africa have only recently started to debate, investigate and explore mechanisms through which innovation can be leveraged and supported regionally. Grobbelaar and colleagues have designed a policy-learning framework with innovation support mechanisms on regional South African government level (Grobbelaar et al., 2014). Although some work has been done on analysing the innovation system in the Western Cape province (Van Heyningen, 2011), there remains a lack of understanding of what the wider support for such activities may mean for how the various institutional actors interact and develop sustainable relationships.

Whether financial, in-kind, or through networking, the degree of collaboration between the university and the local community, as well as the involvement of other ‘innovation agents’ (government, innovation intermediaries, or firms) is an important measure of linkages in the local innovation ecosystem. Public-private partnerships are especially important in the followup stages of university-led projects. One of the critical outcome measures of the activities by innovation intermediaries is the enhancement of entrepreneurship – for instance in terms follow-up contracts, intellectual property (IP) agreements, or the creation on spin-off companies within the formal economy.

Research Universities and Inclusive Innovation

Grobbelaar and colleagues list ‘Inclusive innovation’ as one of the policy focus areas, alongside ‘Enterprise support’, ‘Investment attraction and trade promotion’, ‘Sector development’, and ‘Human capital development’. Although local universities are mentioned as one of the institutional actors contributing to the regional innovation system, the nature of their role and contribution of universities are included generically within the ‘learning region’ concept (Rutten and Boekema, 2007) which is based on several factors including ‘Basis of competitiveness’ and ‘Human infrastructure’. In the first factor, ‘knowledge creation’ and ‘continuous improvement’ are mentioned; in the second factor, we find ‘knowledge workers’, ‘continuous improvement of human resources’ and ‘continuous education and training’. Contextualized within a learning region, the role of university staff (both in research and teaching/training) should be perceived as the local knowledge and skills base, the qualified

experts who interact, initiate and innovate to produce ideas and disseminate outputs to users of many sorts.

As knowledge increasingly drives economic development, public universities are assumed to be critical sources for learning and innovation for firms in developed economies (Lundvall, 1999). Their research focused on interactions with firms, and on strategies to promote innovation through institutionalized university-industry linkages, such as knowledge transfer offices, incubators and science parks. Within the South Africa context, research-intensive universities can be perceived as ‘islands of excellence’ straddling the interface of R&D systems and the higher education systems. We assume that individual staff members or organizational units on these ‘islands’ contribute to the socioeconomic development of local communities of low-income consumers or resource-poor people. The nature and intensity of these interactions may range from ‘passive and indirect’ modes, such as facilitating a general support system, to ‘active and direct’ modes of active collaboration and co-creation.

The vital role of these universities in local innovation systems has emerged on the policy agenda in many developing countries, especially larger nations that seek to compete in the global knowledge economy. These trends are also increasingly pervasive in South Africa, where knowledge intensification is recognized as critical to address development challenges. In many countries universities are generally acknowledged sources of inputs for knowledge creation, dissemination and innovation-support activities. Research universities are committed to the production and dissemination of knowledge and skills, in a range of disciplines and fields. These highly specialized organizations have laboratories, libraries, and other infrastructures that also permit teaching and training at the highest possible level. Many of research universities in middle- and high-income countries have crucial roles to play in developing differentiated and effective academic systems, and in making it possible for those countries to join the global knowledge society and compete in sophisticated knowledge economies. In addition to research and teaching, these university contributions to wider society are simply labelled as the ‘third mission’.

Supporting local socioeconomic development comes in many modes. While some university departments and academics will commit to community engagement or student service learning, others will focus their efforts on industry-oriented technological innovation, interacting with firms and technology transfer in pursuit of national goals. For example by helping local entrepreneurs and innovators in emerging markets to devise low-cost strategies, to either tap or circumvent institutional complexities and resource limitations to innovate, develop and deliver innovative products and services to low-income users with little purchasing power. Collaboration and coordination at the individual level brings the role and contributions of the academic researcher, or university support staff member, to the fore –

either as a reflective knowledge-producing scientist or as the facilitator of learning platforms and processes (Pohl et al., 2010).

This microeconomic view however covers only part of the local ‘university-business ecosystem’. The expression ‘third mission’ tends to convey the idea of the university reaching out to society, but universities also need to import ideas and if necessary adapt them to national needs. In doing so, universities can leverage their knowledge resources to the benefit of a much broader range of social partners. They can also act as not-for-profit drivers of inclusive innovation, where contributions range from R&D activities, teaching, training and skills development, supply of general resources and support facilities to the co-creation of innovations and commercialization through spin-off companies. The role of research universities in local inclusive innovations can therefore be quite diverse. Typically it will involve:

- working together with the local community in identifying their needs and act as a catalyst to achieve goal setting by users themselves;
- engaging in (desk) research addressing local needs to inform decision-making, and conduct collaborative research with the community members to ensure sustainability;
- co-production of knowledge and/or co-development of innovations to meet community challenges;
- providing teaching and training services to create, or scale up, technical expertise and entrepreneurial skills;
- offering facilities and resources to scale up the activities and their quality to generally acceptable standards.

4. Methodology and Information Sources

The empirical information within this evidence-seeking study is gathered by both desk research and ‘field work’ – the latter involving a survey questionnaire and face-to-face interviews with research managers and stakeholders from user communities, universities and the corporate sector. The questionnaire was developed in February-March 2014, in close cooperation between Tijssen and Dijksterhuis. A preliminary version was tested in a face-to-face interview on February 25th with Prof. Willie Perold at Stellenbosch University’s Centre of Renewable and Sustainable Energy Systems.

A web search of the four universities, to identify programmes or projects (either completed or on-going) that could fall under the heading ‘university-supported technological inclusive innovations’ (abbreviated to UTII from now on) was conducted by Dijksterhuis. This scoping study resulted in a ‘long list’ of forty-six candidate UTII programmes/projects: 16 within the *University of Cape Town* (UCT); six within *Stellenbosch University* (SU); 20 within *Cape Peninsula University of Technology* (CPUT), and four at the *University of the Western Cape* (UWC).

Telephone and email communications with contact persons of candidate programmes/projects provided additional detailed information to decide on the final ‘short list’ selection for administering the survey. We focused on ‘data quality’ rather than ‘project quantity’ - the right kind of content (technological innovation) and objectives (serving underresourced end users/communities) were the key selection criteria for our exploratory case studies of UTIIs.

The questionnaire was distributed in March 2014. Filled-out questionnaires were received by mid-April from fifteen respondents, several of which reported on two or more projects (in one case on thirty-two projects): Desmond Jackson (CPUT); Rayner Moodley (CPUT); Nick Pinfold (CPUT); Johan Van Niekerk (CPUT); Malcolm Dodd (SU); James van der Walt (SU); Mqhele Dlodlo (UCT); Kirsten Bobrow (UCT); Mike Louw (UCT); Barbara Schmid (UCT); Samuel Ginsberg (UCT); Sam Surka (UCT); Rethabile Melamu (UCT); Ana Casaneuva (UWC); Bill Tucker (UWC). We assume that this set of projects provides us with an illustrative, but not necessarily representative, overview of such UTIIs in the Cape region. The study involved additional projects and respondents, but these were of a non-UTII nature and therefore not included in this final sample of case studies.

The questionnaire findings raised a host of research questions that were further examined and discussed during a series of face-to-face interviews with UTII-active academics at the four universities. Some of these interviewees were selected via the filled-in questionnaire, others were selected through follow-up searches of university websites or approached via personal contacts.

To structure the general content of the face-to-face interviews, a set of follow-up issues was developed by way of a general guideline to prioritize and address relevant issues during the semi-open conversation. The interviews were meant to both broaden and deepen our general understanding of project's main characteristics and to identify relevant contextual parameters.

We conducted seven interviews at the four universities: Rayner Moodley and Nick Pinfold (CPUT); Retha de Harpe (CPUT); James van der Walt (SU); Samuel Ginsberg (UCT); Ulrike Rivett (UCT); Ana Casaneuva (UWC); and Bill Tucker (UWC). This group of people includes six principal investigators or project managers involved in UTII projects, and one staff member of the technology transfer office (Casaneuva). The interviews covered a total of 15 projects - either on-going or finished. Some of these projects were covered by the questionnaire, others were not. Minutes of each interview were made by hand. The content analysis of the transcripts was done by focusing on distinctive features of each project with regards to the projects research questions.

5. Case Study Findings

Institutional Origins and Frameworks

Collectively, the questionnaires reflect a diversity of projects. Some in early stages, some in a more advanced stage, others completed; failed and successful; with or without active engagement of local resource-poor communities. Irrespectively, all case studies point at the importance of faculties as idea generators, project supervisors and project champions. In most cases, a fairly small number of university staff were involved - on average four staff full-time equivalent (fte) - where one large international collaborative project at UCT involved 20 people.

Inclusive innovation projects either originate from a single university department (initiated and/or supervised by one or more faculty members), from cooperation between departments within a university, or cooperation between departments of different universities.

Unanswered questions are:

- What are the different roles of faculties in inclusive innovation projects at universities? How do they play these roles effectively?
- When do people at different universities work together? What is the value of cooperation between departments within and between universities when it comes to inclusive innovations?

All case studies involved partnerships - with communities and/or other stakeholders. Most projects represent university-supported, user-centred 'distributed innovations' where a variety of institutional actors and individuals - each holding complementary knowledge, skills and perspectives – interact, cooperate and engage as members of 'creative communities' or 'experimentation collectives' (or another more suitable descriptive label).

Many types of external partners were involved in these projects. Most respondents manage multiple 'ties' and collaborate across sectors (non-profit; government; business). Partnerships serve as enablers in multiple ways. Firstly, they provide access to expertise. Powell et al. (1996) argue that 'networks of learning' are the locus of innovation when sources of expertise are widely dispersed. While the authors discuss these concepts in the context of biotech firms, they seem to hold value for our study as well. Technology-based inclusive innovations require both technological and social expertise. In the study, universities and businesses seem to be particularly strong on the technological side, while community leaders and NGOs often

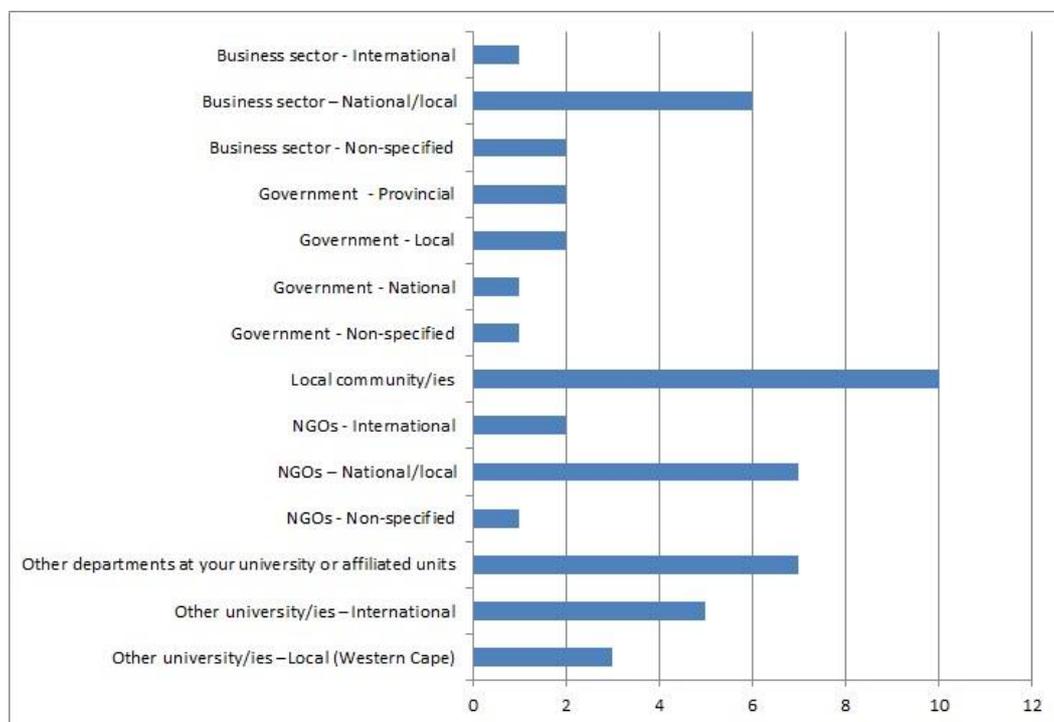
provide the social expertise. Secondly, partnerships provide access to funding. In most cases, funders were government, semi-independent government research agencies and NGOs.

Graph 4 exhibits the distribution across the various categories. Overall, it is mainly local or national partners: local communities, other departments at the same university, NGOs and business enterprises. Interestingly, other universities in the Western Cape are less frequently mentioned than international universities – which may reflect weakly-developed regional academic networks. Half of the projects have businesses as partners.

At least 10 out of 18 projects were initiated inside the university, as evidenced by: university’s educational mandate in these projects; student course work (individual/group projects, internships and/or theses) a significant part of all 10 projects, which speaks to the educational value of inclusive innovation projects.

At least five out of the 18 projects were initiated outside the university; four projects by local parties (not-for-profit; government research organization; business); one by an international partner. The two consortium-based inclusive innovation projects (ARTIST, Aquatest) were both initiated outside of the university.¹

Graph 4. Active Involvement of Other Organizations within UTII Projects (frequency count of answers)



¹ It might be interesting in follow-up studies to find out if there are any examples of consortium-based inclusive innovation projects initiated/led by Western Cape universities and if not, why not.

Some projects are stand-alone ‘ad hoc’ initiatives, while others link into a knowledge hub or R&D platform (e.g. CPUT’s Kujali socio-tech innovation incubator or UCT’s Knowledge CoOp). A link to a hub or platform is not necessarily a guarantee for success (i.e. socio-economic impact, or even implementation). Some hubs or platforms are specifically focused on technology-related inclusive innovation (e.g. CPUT’s Kujali socio-tech innovation incubator, UCT iCOMMS), while others have a broader focus (e.g. UCT’s Knowledge Co-Op – community engagement, may or may not be innovative or technology based). Does it matter whether the hub/platform is informal or institutionalized? And how does having a robust organizational structure around the inclusive innovation project impact on the social and intellectual capital available to the project? How important is knowledge/skills specialization for the development of social and intellectual capital. Does the degree of specialization influence technology-related inclusive innovation at universities in terms of how much additional capital would be built?

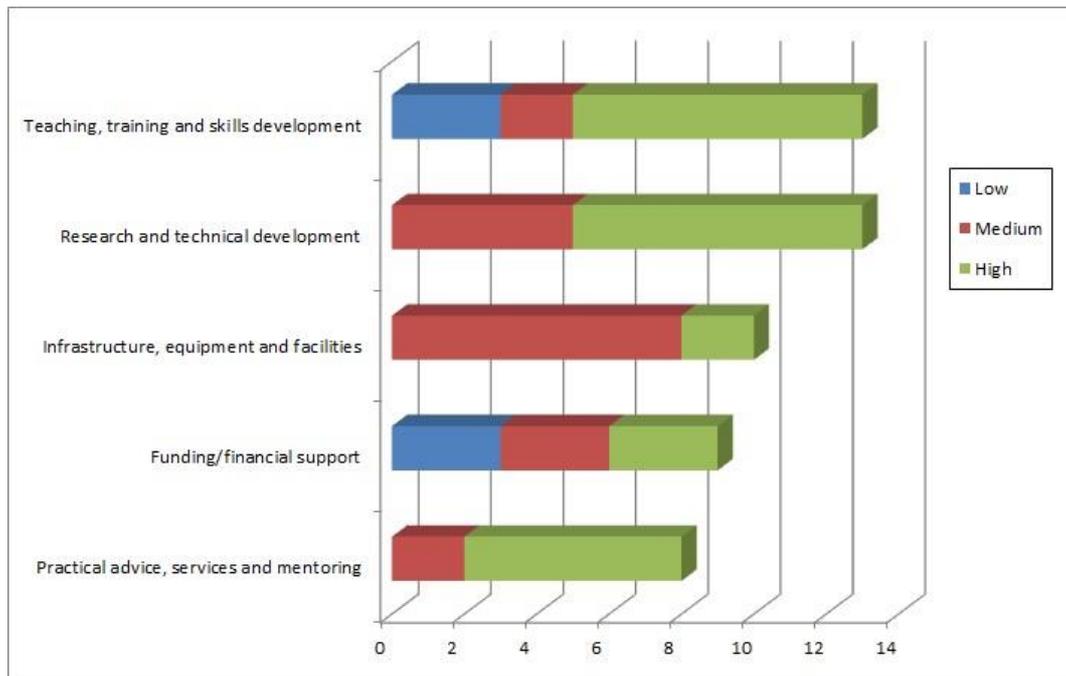
Innovativeness and Societal Relevance

As for the novelty of the UTIIs, in terms of a new technology or technology-based approach, four were seen as new to local communities, three were considered innovative at a provincial level, another three projects at a national level and eight projects were regarded as innovative internationally; six were considered novel within the university itself. Some respondents ‘collapsed’ various levels of innovativeness into one, which creates a problems of comparability across respondents and hence validity issues.

Each respondent was asked to assess the relevance of university inputs and contributions to the project on a three-category scale from ‘High’ to ‘Medium’ to ‘Low’. **Graph 5** displays the opinions per type of contribution. We find a diversity of contributions with teaching, training and skills development (‘teaching’) and research and technical development (‘R&D’) mentioned most frequently by respondents. Teaching and R&D were included in the list of university contributions respectively by eighty-nine and eighty-three percent of the project managers. Close to seventy percent of respondents who mentioned teaching considered it to be a highly relevant contribution. For R&D, this was sixty-seven percent. University funding and financial support (‘funding’) to projects shows a mixed profile. Out of the sixty percent of respondents who indicated that funding was a relevant contribution to their project, slightly less than half perceived the contribution as highly relevant, while the rest was equally divided between medium and low relevance. Funding is not limited to direct financial contributions. Some respondents considered universities’ help with securing external funding as a funding and financial support contribution as well.

Contributions in terms of ‘Infrastructure, equipment and facilities’ were mostly of medium relevance; this apparently is not a decisive ‘make or break’ factor. ‘Practical advice, services and mentoring’ was actually seen as the most relevant contribution overall; most respondents saw this as a ‘high relevance’ activity, and none judged this as ‘low’.

Graph 5. Perceived relevance of the key inputs and contributions by universities



Educational Relevance

Although respondents did not always include student education under ‘project objectives’ in their questionnaire responses, practically all projects involved students in the research & development and/or implementation stages. A considerable amount of inclusive innovation work in the projects takes the form of third or fourth year projects and Master and PhD theses. Several respondents referred to the opportunity for students to apply theory to practice through the project, and contributing to the development of social consciousness and confidence.²

Faculties often provide the direction, sometimes by coming up with the idea and offering students the opportunity to participate (e.g. UCT Khusela, UCT low-cost fence, UWC Mankosi network), other times through their supervision of the project work. Faculties also seem to

² Social consciousness as an educational gain from inclusive innovation projects is expected to be more relevant when students come from more affluent backgrounds, and less so when they are from under-resourced communities themselves. Confidence building may be more relevant when students are from under-resourced communities.

play an important role in ensuring project continuity and are pivotal in the process of securing new resources. When their educational requirements are fulfilled, students are likely to move on. This does not necessarily mean that the project then has been completed. The pilot study offers various examples of projects that have had multiple students working on them over time, for example UCT Khusela and UWC Mankosi network. Faculties also contribute to project continuity by acting as a ‘repository’ of social and intellectual capital, which they build up over time. Relationships with internal and external stakeholders and knowledge, skills and attitudes relevant to the project can be shared with new stakeholders. When inclusive innovation is primarily an educational tool, there may be less of an incentive for faculties and the student(s) involved to take the project beyond the educational requirements. At the same time, a successful educational outcome of a project may encourage faculties to ‘recycle’ the project.

Project Milestones and Deliverables

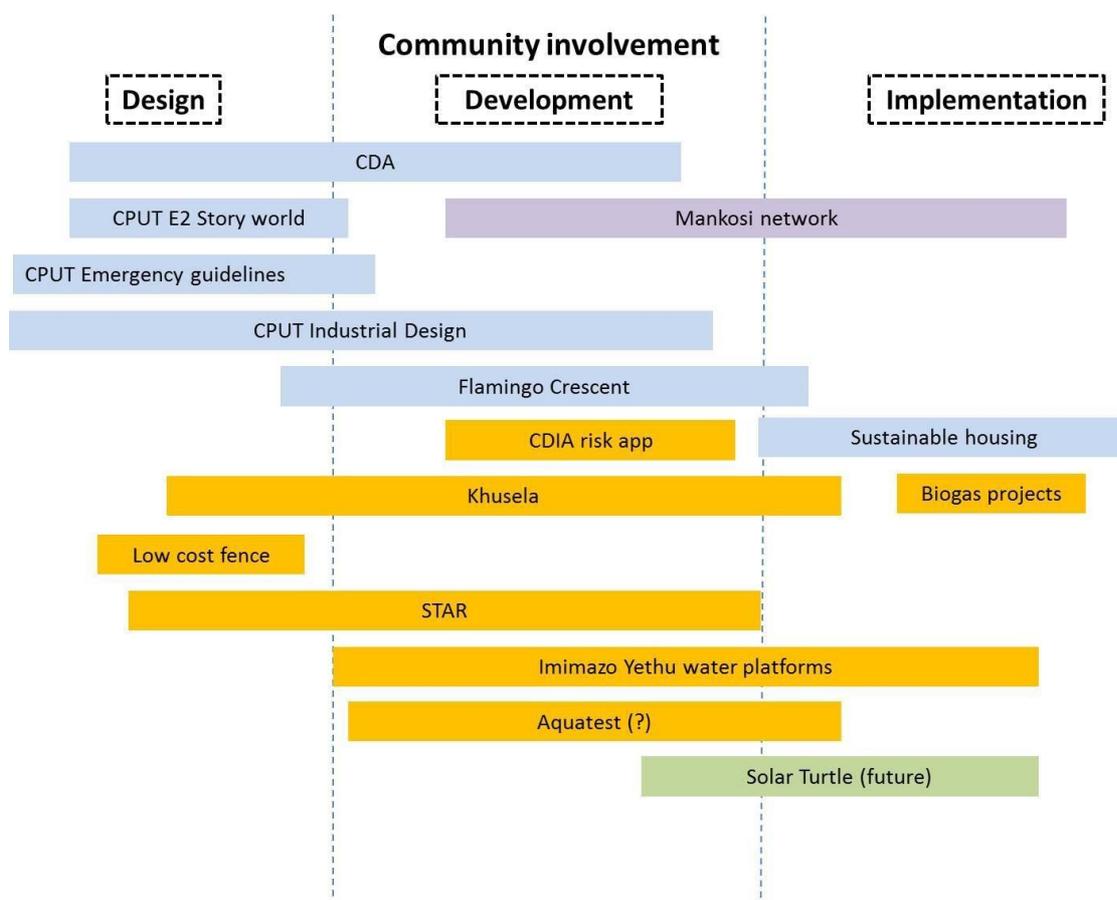
The respondents were asked whether there were any clearly specified milestones and/or deliverables related to university inputs and contributions. Their responses were varied and point at different interpretations of the question. While some project managers consider course requirements related to the project to be part of the milestones and deliverables, others don’t. A few respondents mentioned ‘IP-related’ research outputs (i.e. publications, patents). Only two respondents provided a short list of milestones. In both cases, these milestones were part of a formal reporting structure, in place because of a funder (UCT Khusela) or an international research partner (UCT STAR).

The vast majority of the projects (77%) had clearly specified milestones and/or deliverables. When asked about the impact or benefits of the university’s contributions, most respondents interpreted this to be the impact on or benefits for under-resourced end-users/communities. Out of the fifteen projects for which information about the effects/impact/benefits is available, five have made it to implementation, all but 1 are UCT-based projects (UWC Mankosi, UCT Aquatest, UCT washing platform, UCT biogas, and UCT ARTIST). Another four projects are in process – with one of these being relatively close to implementation (UCT Khusela) and three making progress (CPUT Sustainable housing, CPUT Flamingo Crescent, US Solar Turtle). Then there are projects that require input (money, time, skills) to move to the next stage (US Water purification, US Portable cooling unit, UCT Low cost fence, UCT CDIA). The final category consists of projects that are unlikely to be implemented due to, for example, lack of resources or interest.

Interaction with Local Communities

The study shows some interesting differences between the projects in the extent to which endusers are involved and *how* they are involved.³ Community members/end users were involved in one or more stages in most projects. Their contributions ranged from input into design ('cocreation') to testing (development) and implementation. Several respondents commented on the importance of these contributions to their project ('significant improvement of the device'; 'very relevant to the design and implementation'; 'community was the vessel for this project'). Clearly these projects cover several levels of the 'Inclusive Ladder' model introduced in section 2.3.

Graph 6. Community Involvement in Projects



Graph 6 introduces a preliminary overview of community involvement in the different stages for the projects included in the pilot study. The projects undertaken at CPUT share an emphasis on co-creation, i.e. involving end-users in the design stage of the project. CPUT is a university with a relatively large number of students from poorer communities, who have an inherent understanding of the context (intellectual capital) and connections to these

³ Two respondents indicated that their projects did not have any community/end user involvement.

communities (social capital). CPUT's student population has a relatively large representation of low- and lower-income learners who may be providing 'bridging social capital', which encourages co-creation to take place. In the majority of projects at the other institutions, endusers have less or no involvement in the design stage. They may be brought in at the development phase and, due to the nature of the innovation, are likely to be part of the testing phase – if testing is part of the project. In several projects, community members help to implement the innovation, either on a one-off basis (e.g. UCT washing platform) or for a longer period of time (e.g. UCT biogas projects, UWC Mankosi).

The selected quotes from the questionnaires and interviews displayed in **Box 1** illustrate some of the insights into the role of end-user/community participation gained from the inclusive innovation projects included in this pilot study. The quotes, originating from the questionnaires or the transcripts of follow-up interviews, serve to illustrate the diversity among the projects, and specific characteristics of projects.⁴

Box 1 Quotes on features of local community engagement

“As far as our course and students go there has been a concerted effort to use participatory research to help with real problems. With regards to the implementation of those solutions, we fall short. Funding and university structure needed to implement some of the better projects does not exist. Very few projects have been implemented and those usually with no real and ongoing support from the university or government. Local communities have been welcoming and supportive to us. Over the years we have learned how not to be perceived as do-gooders by using co-creation methods.”

“Working with the community made it more difficult to work with predetermined timelines and milestones. Unforeseen events such as uprising, social unrest can throw a spanner in the wheel.”

“The local tribal authority decided where to place mesh nodes in terms of a mix of technical, e.g. line of sight, and social parameters, e.g. safety. They also determined the business model, e.g. paying to charge a cell phone and free internal calls on the network. They will determine the business model for the interconnection fees. We collect survey data after each major ICT intervention in order to measure socioeconomic impact.”

“Local communities have been very relevant to the design and implementation of the current project and for testing a viable strategy to engage with local community members in design, iterative development, and testing of health care interventions. Our success in using a formal, standardized process to develop an appropriate intervention underpinned by behaviour change theory suggests this strategy could be used more widely in community research settings. Members of the local community have also contributed their time, bio-data, and social capital by participating in the trial to test the intervention.”

⁴ The quotes are anonymized to protect the confidentiality of the sources and integrity of the interviewees in so far as our transcripts are not a verbatim copy of their exact wording during the conversation

“Community engagement has resulted in a significant improvement of the device. Communities have been polled to understand what functionality they require, what price-point needs to be attained and community leaders have been key partners in explaining the project to community members and enlisting their support for the upcoming pilot phase.”

“Getting locals involved so that they drive the agenda”; “NGOs are there permanently on the ground, part of the community”; “Tribal authority and community cooperative is applying for network license”; “Always remain vigilant what the community needs”.

“Women empowerment is the key principle of this project”; “Men do the talking. Women more difficult to convince, but will be more committed”; “Communities like to own things, not rent”; “Community becomes part owner in the franchise”; “Lack of commitment from the community is a major risk”.

“We rely on academics to initiate projects; very few have a community perspective or shared interests”.

“The community now talks about the technology, they have learnt from the project”.

“Working with local communities is a challenge when other universities, which are already involved in that same community, start to protect their interests”; “Community engagement with foreign nationals is difficult at times, due to lack of acceptance by locals”; “For success in communities you need comprehensive scalable solutions in a package”; “Recognition of the work done in communities is considered valuable by community members”; “You only have one chance to get it right in the community”.

“The greatest learning effect in the community: understanding who is responsible for what: locals, the municipality, government authorities”; “When you become a resource for the community, it sucks you in and presents you with ethical dilemmas”; “User-centric co-designed products are preferable; don’t assume you know better”; “There is usually no dependence on technology in the rural community; their negative feedback is honest (“this is of no use to us”); “Key to success is understanding the local context”.

“I’ve had a couple of chats with township residents; nothing was co-created, but it changed the technical specifications substantially”.

Business Sector and Commercialization

One of the inclusive innovation models introduced in section 2.3 focused specifically on entrepreneurship and business models. Here we will map this economic output model on our case studies to gauge the added value of such an analytical perspective for understanding their characteristics and dynamics.

In several cases, support from universities or NGOs comes with the requirement to develop and implement a viable business model, such as the Solar Turtle project run by the social entrepreneur James van de Walt at Stellenbosch. In other cases South African ‘big industry’

funding from Telkom helped to kick-start projects, such as Bill Tucker's ICT projects at the University of the Western Cape. The selected quotes in **Box 2** reflect how companies and business interests may shape UTIIs. It nicely outlines the mindset of these social entrepreneurs and problems faced by university staff when interacting with economic agents to launch UTII-based products and services in the marketplace.

Box 2 Quotes on features of business-related aspects

"You have to think about commercialization from day 1"

"I have worked for Eskom for 12 years and would not engage in a project unless it has strong commercial potential"

"The plan was always going to go commercial; I saw the potential from the beginning"

"My project got bad press from competitors in the industry"

Box 2 (continued)

"Competitor companies might strip the product to get hold of the code"

"A large health company asked local government to develop internships that are now involved in the project"

"The most difficult thing is to get angel funding"

"I'm looking for CSIR funding or investors from private funders; companies who have employees in rural communities"

"When I ran out of funding, an entrepreneur knocked on my door and also became project manager"

"The university IP issues are extreme; I want my innovation to be open sourced and shared"

"You need capacity and experience to engage in hard negotiations on economic issues and IP; my university's research office assisted me"

"I had a lot of trouble establishing IP and ownership; some partners wanted to claim all IP"

"The project will spin-off into a company; the IP stays at my university; they gave me a generous royalty-free license"

"The NGO has lost interest in the project because of other commercial attractive projects"

"It is too early for a spin-off company: there is no user involvement yet, and I don't have the resources for commercialization"

“South Africa is too small a market; for economic returns you have to look internationally”

“The business model is currently geared more around charging people’s cell phones than on charging for network usage (although this may change when we interconnect to voice and internet connections – coming soon)”

“The local tribal authority ... also determined the business model, e.g. paying to charge a cell phone and free internet calls on the internet.”

Project Enablers and Inhibitors

The pilot study provides some preliminary data on factors that facilitate or hinder technology-related inclusive innovation projects at universities. University reputation emerges as a potentially relevant factor. A good reputation could facilitate access to innovation opportunities and resources; a lesser reputation might do the opposite. In organizational innovation literature, reputation – and visibility – have been linked to connectedness and access to opportunities and resources via ‘benefit-rich’ networks.

Our data point at the importance of a ‘project champion’ – i.e. an individual (or individuals) who actively promotes the project – to the progress and success of inclusive innovation projects. The champion can be an internal (faculty, student) or external stakeholder (client, research partner). This preliminary finding is supported by organizational research on technological innovation, which links the presence of a champion to the success of technological innovations (for example, Schön, 1963; Tushman and Nadler, 1986). In organizational literature, innovation champions have been associated with transformational leadership, risk taking, innovativeness and the ability to influence. The distinction has been made between formally appointed and emergent informal champions. Contextual factors such as the level of decentralization of decision-making authority have been said to be a potential influence on the role and impact of innovation champions.

Project Outputs, Outcomes and Impacts

When asked about project effects, impact and benefits, the survey respondents discuss ‘outputs’ (goods or services produced) and/or ‘outcomes’ (impact on social, economic or other indicators arising from the delivery of outputs – definition OECD).

Those outputs included innovative products (e.g. UCT Khusela; UCT low cost fence), software applications (e.g. CPUT Emergency Guidelines; UCT CDIA risk assessment app; UCT

Aquatest) and combinations of product, application and/or process (e.g. CPUT Mankosi network; US portable cooling system).

Some respondents left it at outputs, i.e. the direct – more tangible – results of their projects. The majority, however, also described the potential or realized impact of project outputs on end-users lives and/or larger communities.

Lott and Chazdon (2009) distinguish between social impacts; health, food and nutrition impacts; political impacts; cultural impacts; financial impacts; building and infrastructure impacts; and natural resources impacts. They define social impact as strengthened or expanded connections among people, groups and organizations. Several respondents highlighted the social impacts their projects had on the communities they worked with (e.g. CPUT Flamingo Crescent; UCT water platforms; UWC Mankosi network). Health, food and nutrition impacts refer to the increased ability of families, organizations, communities or sectors to promote physical and mental well-being. UCT Khusela is an example of a project with an expected health impact by helping to prevent shack fires. UWC's water purification pots is another example. Political impacts are described as the increased ability of families, organizations, communities or sectors to access and mobilise public resources. CPUT Flamingo Crescent and UCT Aquatest provide examples of this type of impact. Helping the community to learn how to organise and mobilise themselves and building social capital between the community and the municipality is mentioned as a primary objective of the Flamingo Crescent project. Cultural impacts is reflected in the strengthened ability of families, organizations, communities or sectors to support, celebrate and transmit knowledge of diverse worldviews to future generations. E2 Storyworld could be seen as an example of this, as the aim of the project is to collect and share stories of care givers to other members of the community. Financial impacts are defined as increases in private and public wealth that is invested in the well-being of families, organizations, communities or sectors. The UWC Mankosi project, based on a so called 'micro-revenue model', offers one example. Building and infrastructure impacts are improvements of structures and infrastructures that contribute to the well-being of families, organizations, communities or sectors. CPUT's Flamingo Crescent and Sustainable Housing projects and the UCT water platform project are clear examples. Finally, natural resource impacts refer to the strengthened ability of families, organizations, communities or sectors to protect landscape, air, water, soil and biodiversity of both plants and animals. CPUT's sustainable housing project and the UCT biogas projects fall within this category. It is clear that one project can have multiple types of impact. Further investigating the types of impact of technology-based inclusive innovation projects at universities might result in valuable insight into the potential of universities to be relevant to under-resourced communities.

Some projects included a formal outcomes measurement component (e.g. CPUT Mankosi network; UCT StAR; UCT CDIA risk assessment app), but an informal or more loosely defined assessment of socio-economic impact seemed to be the more common approach.

6. Discussion and Concluding Remarks

Methodological Issues

Clearly, the subjective assessments by the university staff themselves are not to be taken as a final judgment of relevance. This would require an independent evaluation by at least one impartial expert, as well as adopting a sufficiently extended time-span to collect information for a longer-term perspective. Moreover, closer analysis of the questionnaire and the findings bring two possible response biases to the fore and their associated validity issues: (a) ‘relevance’ being interpreted either as ‘potential relevance’ or ‘actual relevance’; (b) ‘teaching’ could mean either teaching students or teaching/training members of the community.

This sample of UTIIs is too small for drawing any general conclusions. These findings are at best a first, crude indication of general characteristics. Given the efforts spent on scanning all UTII-related projects that were listed on the university websites, and accessing through other information sources, we can safely rule out the possibility that these are false findings resulting from a severe selection bias.

General Concluding Remarks

New research findings or other contributions from universities to society do not automatically lead to innovation and economic growth. Naturally, there is no single best way to innovate, nor is there a single ‘optimal’ approach to developing effective inclusive innovation processes and structures. It is not enough to hope that somehow the university-based research, knowledge and skills will find application. These applications must be planned for from the beginning and sufficient resources provided. Hence, ‘problem-solving’ applied research at universities should be married to local communities for maximum local development impact. The key to improving the socioeconomic impact in developing countries lies in adaptation of knowledge and skills to local needs. What is required is a better understanding of – and support for – the linkages between the supply of new ideas and the need or demand from local economies for those inputs.

The two common features of the various cases studies are (1) their university-related technological innovations and (2) the involvement of local communities. As such they represent a very diverse set of ‘socio-technical innovations’ with user-induced feedback loops, building of organizational capacities and creating competencies, and aimed at producing societal developments. Some are ‘distributed innovations’, where key contributions from several actors, others are ‘centralized innovations’ produced mainly by the university for low

income user communities. Each project is unique, as are the ‘innovation pathways’ that lead through institutional and techno-economic landscapes to an end result. Should we even attempt to impose an overarching structure to such diversity and dynamics? Can we answer the question to what extent, and under which conditions, do local universities fulfil the role of initiator, catalyst, support system, or driving force to generate valuable inclusive innovations?

If so, how can we capture and describe these complexities in a single framework or model? More specifically, do our first findings exhibit common general features that warrant further conceptualization in terms of ‘innovation regimes’, i.e. a model or a paradigm with stabilized configurations of ‘rules’ based on institutionalized patterns of ongoing innovation practices and diffusion processes (Dosi, 1982; Nelson, 1994). Adopting such a model and a joint analytical framework not only reduces analytical complexity to diagnose current or previous activities and outputs, it also defines roles for various actors in the institutional landscape, the division of tasks and responsibilities, and possible impacts of innovations in terms of (expected) socio-economic benefits. If the innovation regime is defined too crudely, the associated diagnosis will not represent reality and possible recommendations for actions or policies will not be productive. The most extreme case of information reduction occurs when we adopt a ‘linear model’ version of a university-centred innovation regime where universities contribute in their traditional role as knowledge supplier and being engaged in applied R&D for the benefit of developing ‘centralized innovations’.

A stronger evidence base is required for private and public actors to promote inclusive innovation effectively at the regional or national level in low- or middle-income countries. At least by comparison of their understanding of economic markets and business sector innovation systems in high income economies, there is a deficiency in knowledge bases on low-income markets and innovation systems. The gap for public sector actors and inclusive innovation is even larger, and there is clearly an important role for the research community to play in evidencing the extent, the nature, the inducements to and the obstacles to the development and deployment of inclusive innovation.

We need assessment, monitoring and evaluation systems in place to gauge the progress. Without such a system, the different participants and stakeholders cannot learn and adapt their responses as the work evolves. Independent reporting on these university projects not only prove to local or domestic taxpayers and stakeholders that their resources and money is properly accounted for, but they can also highlight poorly designed or incorrectly framed initiatives.

Qualitative methods should be used to complement quantitative data, to understand innovative behaviour, its determinants, and its impacts at the level of the individual, communities, firms or public organizations. At the national level one could think of initiatives to collect data through the national R&D Survey to identify university-based research activities for community outreach and use the Innovation Survey to identify fast growing small firms that are emerging from the informal sector and creative industries. Other statistical sources, such as the national companies register, tax authorities or business associations may reveal additional information. One could also think of developing a dedicated survey questionnaire to assess community outreach, regional engagement and inclusive innovation activities within the entire South African higher education system.

Within the international framework of the *Oslo Manual*, innovation survey methods can be modified and adopted for measurement, more specifically by using different approaches including mandatory or voluntary surveys, census or sample surveys, surveying domains of innovations.

The question arises whether, in the view of a government or other institutional stakeholders, addressing these socio-economic issues is sufficiently important to justify the cost of developing these infrastructures, methodologies and performances indicators that are needed to inform the policy debate and to monitor and evaluate policy once it is implemented.

Future Research and Follow-up Studies

Drawing on the results of our case studies, we aim to further develop the research project towards a better understanding of the nature of inclusive innovation projects at universities in emerging market contexts and, with that, of the role of universities within inclusive innovation processes. Our aim is to contribute toward a better understanding of how to map, track and evaluate such projects and issues around IPR-formation and ownership, and the relevance of formal and informal relationships.

In follow-up studies we could look at ways of classifying, assessing and measuring economic and societal value of university-related inclusive innovations. These innovative products, processes or services might make significant local contributions in a specific circumstance because of lower cost or convenient delivery conditions. Cost-effective approaches that ensure wider applicability and accessibility may be particularly useful and of great potential economic value. An obvious challenge for such an assessment is the fact that these innovations might have below-potential effects outside the local community because of lack of visibility, sustained support, or because of market failures. Within the framework of the Heek et al.

‘Ladder model’ (section 2.3), the relationships between the level and type of community involvement in university-supported inclusive innovation projects and the success are worth exploring. It would also be interesting to find out more about the relationship between the project objectives (espoused and in use) and the likelihood of innovation implementation, looking at the resource allocation choices of the project representatives at universities.

Most technological innovations in low- and middle-income countries are not immediately based on inputs or contributions from universities, but originate from local entrepreneurs or small-scale companies – often through reverse engineering or translating available knowledge to home-grown needs, and modifications of existing knowledge that is acquired through dedicated teaching and training. The success rate of the knowledge uptake may critically depend on whether or not activities are initiated with local partners and when knowledge also comes from local interests. The role of entrepreneurs and companies in university-driven (inclusive) innovation activities need to be further explored.

Relevant questions are: to what extent is student work on inclusive innovation driven top down (university policy, funding structures) or bottom up (faculty/student interests)? One could look at the relationship between the perceived educational and/or social value, the level of social and intellectual capital accumulated (knowledge, skills and attitudes) and a project’s success rates in terms of: implementation, (intended) educational outcomes, and innovation uptake.

Further research could shine more light on the educational benefits of inclusive innovation projects and to what extent and how project managers are using the educational potential of such projects effectively. Skills related to creativity and innovation do not feature in the pilot study data. Future research could give insight into the extent to which such skills matter, from an educational point of view and for implementation. And whether there is a relationship between the student ‘asset base’ and an institution’s approach to inclusive innovation.

What could be investigated in future research is to what extent universities are selected as innovation partners based on reputation, and what impact university reputation and visibility have on inclusive innovation.

Further research could provide more detailed insight into the role of business sector champions, venture capitalists and NGOs in inclusive innovation processes at universities. Technology-based inclusive innovations may not have the same strategic importance to universities as technological innovation has for many companies, but the organizational

literature on technological innovation and the role of champions in its success are expected to be of value. Research on academic entrepreneurship may be relevant too.

As internal and external collaboration features so prominently in the pilot study, further research may be used to provide insight into this aspect of technology-based inclusive innovation at universities. Possible research questions include: How do university innovators collaborate? How does the university's network position – linked to its reputation and visibility – influence the innovator's ability to collaborate? When and how do routines develop and what is their impact on inclusive innovation at universities? What, if any, is the impact of having an international partner? What is the role of IP and how is it managed in networks of learning?

The pilot study sample included projects that did not make it past the development stage, projects that are in progress and projects that made it to implementation. The data give some possible clues as to why some projects 'get stuck' while others don't. Already mentioned as possibly relevant were project objectives (educational versus social), the presence of a champion and access to intellectual and social capital. A more elaborate literature review and a follow up, full scale study would give further insight into the critical success factors of inclusive innovation projects at universities.

In further research, we could explore whether and how different approaches to outcomes/impact measurement affect level of innovativeness, and project implementation and success (innovation adoption and use). A more formal approach might facilitate innovativeness as it allows for more structured learning and project implementation and success through explicitly defined socio-economic outcomes. Anderson and Billou (2007)'s 4A's framework, developed to capture key principles of successful business innovation at the base of the economic pyramid, could be relevant in a university context as well. The authors argue that for innovations to be adopted and used by low-income earners, they need to be affordable, accessible, acceptable and in end-users' awareness. Affordability was explicitly considered in, for example, the UCT Khusela project. Research among community members gave the project team insight into the maximum amount people would be willing to pay for the Khusela device, which then became a requirement in the development process. Being able to offer the device at a price point that is acceptable to the prospective end-users increases the chance of the innovation being adopted and repeatedly used.

For an innovation to be used, it needs to meet the needs of its end-users. In the case of CPU's Mankosi network project, the project leaders consulted the tribal leaders of a rural community in the Eastern Cape about the community's needs and then developed their solution. Having

the community's tribal leaders and other community members closely involved in the development process contributed significantly to acceptance. In an article about the project, the university representatives speak about "...building a sense of community ownership of both the network and the business model because doing so is imperative in assuring the success and sustainability of the network".

Accessibility is about making sure that prospective end-users can get hold of the product and/or services. UCT's Knowledge Co-op is an example of how universities could potentially facilitate accessibility. This platform "...aims to make it easier for community partners to access UCT's skills, resources and professional expertise". Besides facilitating access, an initiative like this contributes to communities' awareness of universities and the opportunities these universities represent. Awareness was also mentioned in relation to the UCT Aquatest project, where it referred to the project's contribution to the community' awareness of universities and of municipal structures for water and sanitation. Here, awareness was part of the project outcomes, which is another way in which this aspect of socio-economic change can be relevant in inclusive innovation projects. The 4A's framework is a framework that could be included in the research going forward. It provides a lens through which to evaluate the drivers for success and failure in university-led inclusive innovation.

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Bibliography

- Albuquerque, E., Inadequacy of technology and innovation systems at the periphery. *Cambridge Journal of Economics*, 31, 669-690, 2007.
- Anderson, J., and Billou, N., Serving the world's poor: innovation at the base of the economic pyramid. *Journal of Business Strategy*, 28, 2007.
- Archibugi, D. and Pietrobelli C., The globalization of technology and its implications for developing countries: windows of opportunity or further burden?, *Technological Forecasting and Social Change*, 70, 861-83, 2003.
- Blankley, W., Moses, C., Main Results of the South African Innovation Survey 2005. Cape Town: HSRC Press, 2009.
- CeSTII, National Survey of Research and Experimental Development Reports. Cape Town: Centre for Science, Technology and Innovation Indicators, Human Sciences Research Council, 2010.
- CeSTII, South African National Survey of Research and Experimental Development Statistical Report: 2010/11, Cape Town: Centre for Science, Technology and Innovation Indicators, Human Sciences Research Council; Pretoria: Department of Science and Technology, 2012.
- Van Beers, C., Knorringer P. and Leliveld A., Can Frugal Innovations be Responsible Innovations? In: Van den Hoven, J., Blaauw M. and Ortt R. (eds.) *New Perspectives on Responsible Innovation*, Springer Publishers, forthcoming 2015.
- Dosi, G., Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change, *Research Policy*, 11, 147-162.
- DST, South Africa Department of Science & Technology, Pretoria: Ministerial Review Committee on the National System of Innovation, 2012.
- Dutz, M., *Unleashing India's Innovation: Toward Sustainable and Inclusive Growth*, Washington DC: World Bank, 2007.
- Fagerberg, J., Srholec, M., Verspagen, B., Innovation and Economic Development, In: Hall, B., and Rosenberg, M. (Eds.), *Handbook of Economics and Innovation*, volume 2. Amsterdam: North-Holland, 833-872, 2010
- Freeman, C., *Technology policy and economic performance: lessons from Japan*, London: Pinter, 1987.
- Gault, F., Science, technology and innovation indicators: opportunities for Africa. *African Statistical Journal*, 6, 141-161, 2008.
- Gault, F., Zhang, G., The Role of Innovation in the Area of Development. In: Kraemer-Mbula, E., Wamea, W., (Eds). *Innovation and the Development Agenda*, Ottawa: Ottawa International Development Research Centre, 2010.
- Gault, F., Bell, M., Kahn, M., Muchie, M., Wamae, W., Building Capacity to develop and use science, technology and innovation indicators for grassroots innovation, *African Journal of Science, Technology, Innovation and Development*, 4, 22-31, 2012.
- Geels, F.W., From sectoral systems of innovation to socio-technical systems. Insights about dynamics and change from sociology and institutional theory, *Research Policy*, 33, 897-920, 2004.
- George, G., McGahan, A., and Prabhu, J., Innovation for Inclusive Growth: Towards a Theoretical Framework and a Research Agenda, *Journal of Management Studies*, 49, 661-683, 2012.
- Grobbelaar, S., Gwynne-Evans, N., Brent, A.C., From Enterprise Development to Inclusive Innovation – a framework for supporting policy-learning in the Western Cape Province of South Africa, Submitted to *Innovation: management policy and practice* (2014).

- Grobbelaar S., Towards higher impact for universities in a regional system of innovation. International Sustainable Development Research Conference (ISDRC) 2013, Stellenbosch (South Africa), 1-3 July 2013.
- Grobbelaar, S., Gwynne-Evans, N., Quo Vadis? 20 years of supporting regional economic development in the Western Cape Province of South Africa. PICMET 2014 Conference proceedings, Japan.
- Heeks, R., Foster, C., Nugrohoac, Y., New models of inclusive innovation for development, *Innovation and Development*, 4, 175-185, 2014.
- Jensen, M., Johnson, B., Lorenz, E., Lundvall, B-A., Forms of knowledge and modes of innovation, *Research Policy*, 36, 680–693, 2007.
- Kaplinsky, R., Schumacher meets Schumpeter. Appropriate technology below the radar, *Research Policy*, 40, 193–203, 2011.
- Kruss G, Adeoti J., Nabudere D., Universities and knowledge-based development in subSaharan Africa: comparing university–firm interaction in Nigeria, Uganda and South Africa. *Journal of Developmental Studies*, 48, 516–530, 2012.
- Lorentzen, J., Food on the table and disease at the door: insights from low-income countries and regions for measuring innovation’, *Innovation and Development*, 1, 77-89, 2011.
- Lott, S. and Chazdon, S., The effect of leadership development: Individual outcomes and community impacts. University of Minnesota, Extension Center for Community Vitality, 2009.
- Lundvall, B-A., Innovation as an interactive process: from user-producer interaction to the national system of innovation. In: Dosi, G. et al. (Eds.), *Technical Change and Economic Theory*, London: Pinter, 349-369, 1988.
- Lundvall, B-A., *The Globalising Learning Economy. Implications for Innovation Policy*, Luxembourg: Office for Official Publications of European Communities, 1999.
- Lundvall, B-A., Joseph K.J., Chaminade, C., *Handbook on Innovation Systems and Developing Countries: Building Domestic Capabilities in a Global Context*. Cheltenham: Edward Elgar, 2009.
- Mashelkar, R.A., On building an inclusive innovation ecosystem, Paris: OECD, 2012 (http://www.oecd.org/sti/inno/Session_3_Mashelkar_Keynote.pdf)
- Moses, C., Sithole, M., Blankley W., Labadarios D., Makelane H., Nkobole N., The state of innovation in South Africa: findings from the south african national innovation survey, *South African Journal of Science*, 108, 1-5, 2012.
- Mkhize, N., Knowledge and Innovation for Inclusive Growth Project, Presentation at the OECD Symposium on Innovation and Inclusive Growth, Paris, 19th March 2014
- National Planning Commission, *National Development Plan 2030: Our Future-Make it Work*. Pretoria: Department of the Presidency, 2012.
- Nelson, R., Winter, S., *An Evolutionary Theory of Economic Change*, Cambridge (Mass.): Harvard University Press, 1982.
- Nelson, R., The co-evolution of technology, industrial structure, and supporting institutions, *Industrial and Corporate Change*, 3, 47-63, 1994.
- OECD and Eurostat, *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. (3rd edition). Paris: OECD, 2005.
- OECD, *Review of the South African Innovation Policy*, Paris: OECD Directorate for Science, Technology and Industry, Paris: OECD, 2007.
- OECD, *Innovation and Inclusive Development*, Paris: OECD, 2013.
- Parrilli, M. D., Nadvi, K., and Yeung, H., Local and Regional Development in Global Value Chains, Production Networks and Innovation Networks: A Comparative Review and the Challenges for Future Research. *European Planning Studies*, 21, 967-988, 2013.

- Prahalad, C.K., Bottom of the Pyramid as a Source of Breakthrough Innovations, *The Journal of Product Innovation Management*, 29, 6–12, 2012.
- Pohl, C., Rist, S., Zimmerman, A., Fry, P., Gurung, G., Schneider, F., Speranza, B., Boillat, S., Serrano, E., Hadron, G., Wiesmann, U., Researcher's roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal, *Science and Public Policy*, 237, 267-281, 2010.
- Powell, W.W., Kput, K.W., Smith-Doerr, L., Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, 41, 116-145, 1996.
- Rutten, R., Boekema, F., From learning region to learning in a socio-spatial context. *Regional Studies*, 46, 981–992, 2012.
- Schaaper, M., The Human Factor in Innovation. Chapter 2 in *The Global Innovation Index 2014*, Fontainebleau, Ithaca and Geneva: Cornell University, INSEAD and WIPO, 2014.
- Schön, D., *The Displacement of concepts*. London: Tavistock, 1963.
- Schumpeter, J.A., *The Theory of Economic Development*. Oxford University Press: London, 1934.
- Schumpeter, J.A., *Business Cycles*. Porcupine Press: Philadelphia, 1939.
- Sercovich, F., Teubal, M., Innovation, technological capability and competitiveness: catching up policy issues in evolutionary perspective. Paper presented at Globelics conference. Mexico City, 2008.
- Sorensen, A., R&D, Learning and Phases of Economic Growth', *Journal of Economic Growth*, 4, 429-45, 1990.
- Swaans, K., Boogaard, B., Bendapudi, R., Taye, H., Hendrickx, S. and Klerkx, L., Operationalizing inclusive innovation: lessons from innovation platforms in livestock value chains in India and Mozambique. International workshop on New models for innovation for development, University of Manchester (United Kingdom) 4-5 July 2013.
- Stats SA, Quarterly Labour Force Survey: PO211, 4th Quarter 2012, Pretoria: Statistics South Africa, 2012.
- Tijssen R.J.W., Hollanders H., Using Science and Technology Indicators to support knowledge-based Economies, UNU-MERIT Policy Brief, 2006
- Tijssen, R., Inclusive innovation in the Cape Town region: local universities as a driving force? CREST workshop, Stellenbosch University (South Africa), 13 February 2014.
- Tushman, M. & Nadler, D., Organizing for innovation. *California Management Review*, 28(3), 74-92, 1986.
- Van Heyningen, P., Regional Innovation System of the Western Cape: Strategy overview, Retrieved from <http://www.saine.co.za/wordpress/wpcontent/uploads/2012/02/Regional-Innovation-System-of-the-Western-Cape.pdf>, 2011.
- Von Hippel. E., *Democratizing Innovation*, Cambridge (MA): MIT Press, 2004.