Final technical report

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Abstract

The Final Technical Report describes an empirical study on the extent and nature of university-industry interaction in three countries at different levels of development in sub-Saharan Africa – South Africa, Nigeria and Uganda. The methodology included comparative indicators of social, economic, scientific and technological performance in the three countries, a contextual paper on the national system of innovation in each country, a survey of university-firm interaction from the perspective of firms in each country, and case studies of interaction in the bio-sectors from the perspective of universities in each country. With some constraints related to the funding and time available, as well as the challenges of primary research in Africa, the methodology was largely realized. Reports were prepared for each country as well as a comparative paper, and roundtables were held in each country with policy stakeholders. A major strength of the project was a collaborative network promoted with cognate teams in Asia and Latin America, so that ultimately, conceptual and empirical insights can be gleaned from 12 developing countries. The project achieved a great deal with limited funding and maximum effort, to contribute to the academic debate on the changing role of the developmental university, and to stimulate policy debate in each country and in the African region.

Keywords: university-industry interaction, innovation, development, Uganda, Nigeria, South Africa, sub-Saharan Africa
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The Research Problem

The importance of university-industry interaction in advanced economies is well documented (Agrawal 2001, Hagen 2002, Lee 2000, Mansfield 1998, Poyago-Thoetoky et al. 2002, Varsakelis 2006). However, analyses of university-industry interaction in less developed countries, especially in sub-Saharan Africa, are the exception (Lall and Pietrobelli 2002). Systematic comparative analyses, let alone with similar economies in other developing regions, do not exist. This is a problem since pursuing the ideal of a knowledge economy in the image of the developed countries, without taking the local conditions into account that constrain the production and use of knowledge and that demand some types of knowledge over others, is an unrealistic and potentially irrelevant undertaking with potentially deleterious consequences (Boer 2001, Lorentzen 2006).

The pursuit of these relationships poses challenges for universities in the South – in terms of changes to their traditional missions, the balance between research and teaching, and their response and accountability to social and economic development needs – that differ from those of their counterparts of the North. How these differences manifest themselves within and across countries and between more or less knowledge-intensive economic activities, and what this implies for harnessing the productive role of universities in economic development was, and remained, the strategic focus of the study.

Objectives

The research aimed to investigate two inter-linked objectives:

- How and why do relationships between universities and firms differ across countries and regions at different stages of economic development, and across sectors?
- How do these differences influence the contribution universities make to local and national development goals?

Four research questions were defined to guide the empirical research:

- What are the key features of the national system of innovation in relation to the historical and socio-economic contexts of South Africa, Nigeria and Uganda?
- What are the levels of innovative competitiveness, capabilities and achievements in South Africa, Nigeria and Uganda in relation to the world, relevant geographic and economic regions, and to each other?
- What are the levels of the firms' interaction with universities to meet their knowledge and technology needs in Nigeria, Uganda and South Africa? What are the main fields and sectors, the main channels and products of interaction?
- What are the constraints and incentives for firms to interact with universities and public research institutes in each country?
**Methodology**

A starting assumption was that the research aimed to contribute to addressing the dearth of systematic analyses of university-firm interaction, and indeed, of innovation systems, in the sub-Saharan African context. There were few existing databases, and the researchers were required to generate new datasets, under challenging conditions.

Each country study followed a common methodology consisting of four empirical and three conceptual components, with some adaptation and variation. In addition, there was strong commonality with the methodology of the Latin America and Asian RoKS 2005/6 regional studies, in order to enhance comparability between regions of the South.

**Systematic empirical research**

In consultation with our colleagues in Asia and Latin America, a generic methodology and survey instrument were designed for the firm survey. The African team designed case study interview schedules and report templates for the other empirical components.

1. **A historical contextual analysis**
   Uganda, South Africa and Nigeria are economies with distinct levels of development and capabilities that shape the interaction between universities and firms. Thus, the first component of the research design aimed to analyse the national system of innovation in each country. A historical periodisation was provided, to situate current science and technology policy, as well as a description of the higher education system.

2. **Overview of innovation capabilities**
   Following a review of available data sources, we compiled a set of indicators of competitiveness, capability and performance for each of the three countries, by using the World Bank’s Knowledge Assessment Methodology (KAM) as the main technique. This process highlighted two research challenges: identifying indicators that are relevant and useful for describing innovative capabilities in the sub-Saharan African context, and managing the high degree of variability in datasets.

3. **Scale and forms of interaction from the perspective of firms**
   A survey of firms was designed to investigate the nature, channels and outcomes of their interaction with universities and public research institutes. The survey aimed to use an instrument adapted from the Carnegie Mellon survey, first in Minas Gerais and then by all three regional teams. The African team adapted the instrument collectively in a workshop and then country-specific refinements were made in the case of Uganda and Nigeria (see Appendix I for the adaptation of the instrument).

Identifying the sample was a challenge for all 12 countries. The Nigerian team resolved the issue by focusing on the most economically developed region of the country, and the Ugandan team by focusing on a specific sub-sector that had been targeted in government policy. A great deal of firm resistance to participation was experienced in both countries, impacting negatively on the returns despite considerable effort on the part of the research teams. The response rate in the Ugandan case was particularly poor and meant that the survey data was not representative or generalisable in any way. It did however provide insight into the interactions of firms and universities in a sub-sector targeted for government support.

The South African case was complicated in that core questions from the survey instrument were included in the National R&D survey for 2006/7, run by the Centre for Science, Technology and Innovation Indicators at the HSRC, on behalf of the national Department of Science and Technology. The response rate to the 2006/7 R&D survey in general was lower than previous years. Unfortunately, the response to the specific questions on collaboration and interaction was minimal, rendering the data unusable for the purpose intended.
The solution was to use two datasets, those from the Innovation Survey 2005 and the R&D survey 2005/6. The datasets were designed for a different purpose, which placed limitations on the analysis possible. The focus shifted somewhat, to analyse the propensity and profile of innovating and R&D performing firms that collaborate with universities on their research and innovation activities, and to a more limited extent, to explore the benefits, outcomes and constraints of such collaboration. On a positive note, such in-depth analysis has not been undertaken in the South African context as yet, and the research adds to the emerging body of knowledge on the national system of innovation.

The generalisability of the survey data trends to the total national population of firms in the three countries is not statistically possible. Yet, each represents a significant first step in creating data to measure the interaction between firms and universities.

4. **Mode, intensity and performance of interaction from the perspective of universities**

A set of case studies of interaction focused on a selected bio-sector (Nigeria: agro-food processing; South Africa: health biotechnology; Uganda: indigenous knowledge and pharmaceuticals). The entry point to identify cases was the university. A set of research instruments developed in a prior study in South Africa (Kruss 2005) was adapted during an African team workshop (via teleconference with further iterations pursued via email). The case study design is included in Appendix II. Each case study entailed:

- a description of university policies and structures that facilitate or constrain interaction with firms
- identification of all cases of interaction in the field
- semi-structured interviews with research project leaders and their firm partners. These cases were selected in terms of their relative success in outcomes, and the knowledge-intensity of interaction.

University researchers and managers were more amenable to participation in the study than firms, and the case studies proceeded relatively smoothly. The Ugandan and Nigerian teams identified very few instances of university-firm interaction, but they provided significant insights into the engagement of universities with government and their local communities. The South African case studies provided evidence of a rich and wide-ranging set of interactions between universities and firms, as well as the constraints operating.

A working paper was produced for each of these four components: a single comparative report on indicators, and three working papers for each country: on the national system of innovation, on the firm data and on the university case studies.

**Consolidation and synthesis**

It was planned that the empirical analyses would be consolidated in three conceptual components, for the African region, and then, a further cross-continental comparative component in collaboration with colleagues in Asia and Latin America.

1. **Explaining the pattern of university-industry interaction in each country**

To address the main objective of the study, explaining how and why the scale and forms of interaction differ across countries and sectors, we attempted to integrate the trends identified in the firm survey and the university case studies, against the national system of innovation and the state of development of the sub-sector in each country context. The working papers formed the basis for drafting a synthetic report for each country, Uganda, Nigeria and South Africa.

The challenge was to combine analytically the trends identified in the four data sources. The synthesis process highlighted the need for more nuanced conceptual work, to develop more robust analytical frameworks suitable to the specificities of the sub-Saharan African context.
2. The changing role of the university
To begin to relate the insights on university-firm interaction to inform understanding of the changing role of the university, a series of national round-tables were planned.

At each roundtable, key insights from the country study were presented, with participation by a range national higher education institutions, government departments and industry organizations. A written report of the key issues raised at each of the three roundtables informed the final component of the study.

3. A comparative analysis of the changing role of the university in Nigeria, Uganda and South Africa
The final aim was to inform debate on the changing role of the developmental university at different stages of technological development, comparing the nature of interaction relative to the level of economic development of each country, and taking into account both science-based and indigenous types of knowledge.

4. Cross-regional comparison of the changing role of the university in the South
The project aimed to produce a comparative publication co-authored with project leaders in Latin America and Asia on the changing role of the developmental university in the South, with the exact format to be decided as the project evolved.
## Project Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Timeline</th>
<th>Responsible</th>
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<tbody>
<tr>
<td>RoKS awardees initiation workshop, Ho Chi Minh City, Vietnam</td>
<td>January 2007</td>
<td>Glenda Kruss, HSRC</td>
</tr>
<tr>
<td>Project initiation (Contracts between IDRC and HSRC, and between HSRC, NISER and MGPARI)</td>
<td>April 2007</td>
<td>Glenda Kruss, HSRC</td>
</tr>
<tr>
<td>Conceptualisation and planning workshop (development of conceptual frameworks and adaptation of survey instrument)</td>
<td>May 2007</td>
<td>Hosted by HSRC Cape Town: Kruss, Petersen and Lorentzen (ESSD HSRC), Kahn and Rumbelow (CESTII HSRC), Adeoti (NISER), Nabudere (MGPARI)</td>
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<tr>
<td>Comparative indicator paper (analysis of available data sources, detailed analysis of the three countries using the World Bank KAM methodology supplemented by sources such as Thomson's ISI)</td>
<td>July 2007 – April 2008</td>
<td>Petersen (HSRC intern)</td>
</tr>
<tr>
<td>Country contextual papers on national system of innovation (historical, policy and secondary data on each country)</td>
<td>Draft : May – November 2007 Final: April 2008</td>
<td>HSRC, NISER, MGPARI</td>
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<tr>
<td>University case studies: SA</td>
<td>Fieldwork: July onwards Final: September 2008</td>
<td>HSRC</td>
</tr>
<tr>
<td>RoKS awardees mid-term workshop, Mexico City</td>
<td>September 2008</td>
<td>HSRC</td>
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<tr>
<td>Stakeholder roundtable: Nigeria</td>
<td>19 February 2009</td>
<td>NISER</td>
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<tr>
<td>Stakeholder roundtable: SA</td>
<td>26 March 2009</td>
<td>HSRC in collaboration with Higher Education South Africa (HESA)</td>
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The overall experience on this project has been very good. According to team members, the project leadership has been strong, and according to the project leader, we had a very cooperative team. The implementation of the activities was not without its challenges, as hinted in the methodology section.

The major challenge was the under-estimation of the time and financial resources required to complete the empirical research. While this is a typical problem in many research projects, it is exacerbated in the sub-Saharan research context. The fact that so little data is readily available meant that our task was a demanding one, of primary data generation. The project has demanded greater effort from the researchers than originally planned, within a limited budget. The surveys took longer than anticipated, given the demands of travel, or the demands of multiple visits and calls to ensure response rates, in a context where there is little culture of compliance with research.

Some unfortunate and unavoidable delays for the Ugandan team were due the ill health of a team member and of the project leader, but this did not have a negative impact on delivery overall.

In the South African case, delays were caused by problems and limitations in accessing the firm datasets. Initial timelines were determined by those of the 2006/7 R&D survey, and then, the data proved to be unusable. Strictly controlled access to existing firm datasets was determined by our collaboration with CESTII, the research unit in the HSRC responsible for conducting the Innovation and R&D surveys on behalf of the Department of Science and Technology. This impacted on the comparability of firm data between countries, as well as the depth of analysis that was possible for South Africa.

An issue that caused some delays was communication between a team distributed across a vast continent. In general, day to day communication via email was good, supplemented by teleconferences and telephonic contact as required.

Travel to meet face to face was expensive, and hindered by complicated visa requirements. For example, our Uganda team was located in a rural area, and was forced to travel a distance of 350 km to the nearest town to obtain visas prior to travel. In Nigeria, it took three visits to the South African High Commission in Lagos (140km from Ibadan) to obtain a visa, and each visit was marked by long delays that required spending the whole day at the High Commission. It took waiting till 9pm on one occasion! These multiple visits meant that we incurred unbudgeted travel and accommodation costs, merely in order to obtain visas. Again, a great deal of time, effort and cost was spent obtaining visas for the RoKS project workshop in Mexico, but we were ultimately unsuccessful for the Ugandan and Nigerian teams. Both teams were forced to cancel their travel plans at the very last minute, leading to high cancellation penalties. The fact that the African continental team was only represented by the South African team was a major disappointment. Space for discussion and brainstorming was the main loss, impacting on the cross-fertilisation of ideas within the African team and with the other continental teams. The final comparative workshop in Cape Town workshop was thus an extremely valuable opportunity in this regard.
Project Outputs

The project has a number of outputs in the form of working papers that were used as background papers to compile the final country reports, as well as activities aimed at stakeholder dissemination and capacity building. These are listed in this section, and their outcomes are discussed in the following section. (Copies of all outputs are included in the CD).

1. Working papers

Nigeria

Uganda
Nabudere, D. Contextual policy framework for developing a national system of innovation in Uganda. April 2008.

South Africa
Petersen, I. and Kruss, G, with CeSTII. Firm interaction with universities and public research institutes: evidence from Innovation and R&D surveys in South Africa. February 2009.

Comparative

2. Final reports


3. Conference papers


4. Roundtables

How can university-firm interaction be stimulated in Nigeria? Roundtable, convened by NISER, Ibadan, 19 February 2009.


5. Roundtable reports

Adeoti, J. and Momodu, I. Report of the IDRC RoKS project Roundtable on university-firm interaction in Nigeria held on Thursday 19 February 2009 at the seminar room 1 of the Nigerian Institute of Social and Economic Research (NISER), Ibadan, Nigeria. 2 April 2009.


Petersen, I. Knowledge for development: can university-firm interaction in South Africa contribute? Summary of proceedings. Roundtable discussion – A joint HSRC and HESA initiative funded by the IDRC. HSRC Pretoria, Forum B. 26 March 2009

6. Public dissemination


7. Training

Masters Internship completed at the HSRC, July 2007 to August 2009: Il-haam Petersen

8. Cognate projects


9. Planned publications


The South African and Nigerian project leaders are preparing journal articles based on their country reports.

Project Outcomes

We can report a number of direct and indirect positive outcomes from our work, in terms of the academic field, and in terms of policy debate on innovation and higher education in sub-Saharan Africa in general and our three countries specifically.

The benefits of systematic theoretical and empirical work

*Extending conceptual frameworks in relation to low income country contexts*

The main achievement in terms of research for the team as a whole was the opportunity to engage in theoretically informed and systematic empirical work on universities and innovation in sub-Saharan African countries. We were able to reflect critically on the possibilities and problems of using a national systems of innovation approach, and a catch-up approach, in the context of both middle and particularly, low income countries.

The multidisciplinary nature of the research teams enabled us to learn from each other and provided opportunity for the team to demonstrate that understanding the challenge of university-firm interaction requires research that transcends a single discipline. The Nigerian research team was comprised of an economist, an education management specialist and an information scientist (Adeyinka). Likewise, the Ugandan team included a political scientist and a philosopher, and the South African team, a higher education specialist and an economist.

In the course of the empirical research, we were forced to question our starting assumptions about university-industry linkages, and the changing missions of the university in global and African comparative context, given the nature and state of university-industry interaction in each country highlighted by our empirical research. For example, the Nigerian project leader reported that ‘At the earlier stages of the research project we presumed to be agnostic as to whether or not university-industry linkages (UILs) exist in Nigeria. However, the results of the firm survey clearly indicated that UILs are rare, thus supporting the widely held notion that linkage between university and industry is weak. We therefore decided to focus more on the investigation of the constraints on university-firm interaction. Another area of problem is that we could not find a single case of UIL involving biotechnology. It thus became imperative to highlight what constrained biotechnology to remain largely at laboratory level in the university cases studied.’

A key insight related to the importance of partners and productive agents other than firms in our contexts, whether farmers, small-scale producers, community groups, NGOs or local government agencies. The Ugandan study in particular found that foreign donors and NGOs play a significant role as intermediary partners of universities and other actors.

Such insights impelled us to question our theoretical assumptions, and to attempt to contribute more systematically to the field of innovation studies.

*The benefits of comparative work across the South*

A second major research strength of the project was the insights afforded by comparative work across the South – within sub-Saharan African, and with our Asian and Latin American colleagues. This allowed for a rich cross-fertilisation of ideas and experiences and added depth to our analysis.

The initial (Vietnam), mid-term (Mexico) and final RoKS (Cape Town) regional project team workshops were extremely positive opportunities to develop methodologies and analytical frameworks across the 12 countries. The cost of the workshops exceeded budgetted allocations, but the strength of the research network that has emerged, and the valuable contribution of the comparative global perspective to the country studies, is well worth the investment.
The planned comparative book is likely to make an important contribution to the field, given that it presents for the first time, systematic studies of university-industry interaction in a wide-range of developing countries in the South, from Korea to Uganda.

**The benefit of capacity-building**

Such a research achievement was directly linked to the capacity-building for all the researchers in the 12 countries involved in the project, no matter how senior. There was a continual sense of excitement at working on a common set of problems in concert, and the value of sharing articles and papers was evident in the emerging analysis in each report.

The project leader from Uganda explained that the Marcus Garvey Pan-African Research institute gained in that this was a first collaborative research project of its kind since its establishment, which had immediate relevance to its mission of promoting research on African development. The research also improved our researchers’ capacities in raising new issues that we had never covered before, especially in the area of innovation.

Similarly, the project leader from Nigeria claimed that the experience in this study has definitely enhanced the capacity of team members to conduct research in a multidisciplinary team. The larger African regional team that include South Africa and Uganda has provided a platform for cross-country experience for the Nigerian team members. Though we have been limited in terms of direct face-to-face contacts, the exchange of ideas and intellectual discourse amongst the team members have been very useful in strengthening our individual research capacity. For NISER, the Nigerian team was exemplary for other research colleagues on how to work within an international research collaborative framework.

A second form of capacity-building was the internship that the project provided. Il-haam Petersen was new to the field but proved herself extremely capable, co-authoring a number of the reports, co-authoring a conference paper, making presentations at internal seminars, RoKS workshops and international conferences. She has carved out her own niche area directly related to the project, and prepared an excellent proposal to pursue doctoral studies at Trinity College Dublin from September 2009 - ‘A broad innovation systems approach for sustainable development in Africa’s Least Developed Countries: towards aid from hand-out to hand-up’.

**Stimulating further research**

**Research on UILs in SADC countries**

The South African team was approached by a new regional organization, the Southern African Regional Universities Association, SARUA, and requested to conduct a study on the nature of university-industry interaction in the SADC member countries. The research aimed to inform its policy and engagement with institutions in the region.

The study we designed centred on an adaptation of the Latin American/Asian university survey instrument and was conducted in the universities in 15 SADC countries. The project leader presented this work at three workshops with vice-chancellors and research managers from the SADC universities. SARUA published the report and it has been disseminated widely in the SADC. A key issue for debate was the strong recommendation that African countries should not adopt the notion of an ‘entrepreneurial’ university but rather, should develop their own models of ‘responsive’ universities, based on analyses of their own conditions. The research in a wider range of sub-Saharan African countries fed into the RoKS project and allowed us to draw conclusions with greater confidence. The cross-pollination between the two projects – using a closely similar framework and methodology – was thus extremely valuable.
Research on U?Ls
Our insight of the significance of university responsiveness to partners other than industrial firms has stimulated a new research direction. Some tangible outcomes arising from the new conceptual direction are:

- The HSRC team initiated a project to review the literature on innovation and development in low income countries.
- The HSRC team initiated a pilot project to study university-community engagement in South African universities.
- The sub-Saharan African team has developed a proposal to research the role of universities in national and local innovation systems in the emerging biofuels economy being promoted in many African countries, extending the team to include a wider range of countries – Ghana, Malawi, Tanzania.

Stimulating stakeholder policy debate in each country

The roundtables as vehicle for stakeholder policy debate
Stakeholder roundtables were held in each country in March 2009, as a means of dissemination of the main research trends, but also, as a means to inform debate on the changing role of the university. The variety of participants at the roundtables signals the nature of the national system of innovation in each country. In Nigeria, the roundtable was hosted by the Nigerian Institute of Economic and Social Research; participants were drawn from universities and public research institutes, reflecting the very recent policy interest in science, technology and innovation for development.

The Ugandan roundtable, hosted by the Markus Garvey Pan Afrikan Institute, had a wider range of participants drawn from universities, research institutes, a small, medium and micro enterprises (SMME) association and a farmer’s cooperative, reflecting the agricultural base of the economy.

The South African roundtable was co-hosted by the HSRC and Higher Education South Africa (HESA), an association of vice-chancellors of all public higher education institutions, in an attempt to build longer term relationships and ensure greater impact of the research. The stakeholder profile reflected greater networking and complexity in the system of innovation, with particular interest from universities of technology, government departments and intermediary associations, such as innovation incubators and higher education associations, as well as public research institutes and a representative from industry.

The limitations on dissemination
We concluded that the stakeholder roundtables were held rather late in the research process, and that there was not a sufficient budget allocation to these activities.

The dates set were determined partly by the delays in empirical work and hence in finalizing reports, but equally so, by timelines set by external stakeholders and partners. It was apparent that the roundtables could have had greater impact and allowed for more follow up activities, were they held earlier. Moreover, the funding available placed limitations on the roundtables, and the follow-up dissemination activities possible. For example, the Nigerian team found that the funding for the roundtable was not sufficient to include stakeholders at a distance from Ibadan; and the South African team found that a series of regional roundtables across the provinces would have been desirable to simulate wider policy debate.

Despite these limitations, and although they were but a single event, the roundtables appear to be having a ripple effect within each country. Tangible outcomes were reported in each country (reports on each roundtable are included on the CD).
**Tangible outcomes of the roundtable in Nigeria**
The roundtable provided an expanded multidisciplinary approach to the study, and the study team was able to gain additional insights from the perspectives of engineers, food scientists, agronomists, animal scientists, agricultural economists and so on.

Reform in the Nigerian educational and science and technology systems has been recent, stimulated as part of overall economic reform process since 2003. The study was valuable in that it provided current empirical evidence for university and industry stakeholders on the state of university-firm interaction. It highlighted that interaction between the university and the productive sectors of the economy is particularly weak. A policy memorandum was prepared for government after the roundtable session, which called for national policy and the establishment of a mediating structure to promote collaboration, as well as attitudinal change within universities, and to stimulate research that is demand-driven and socially responsive (See Appendix III).

One outcome of the study was thus strong advocacy for attitudinal change among stakeholders. It was recognized that attitudes that constrained UILs include lack of political will to address R&D challenges, an entrepreneurship culture that lacks support for R&D, research that is done mainly for academic publication, and divergent views emanating from the mindsets of scientists and industrialists. Changing these attitudes will require concerted efforts on the part of all stakeholders, and researchers agreed at the roundtable to take the lead in showing examples of changed attitude.

The project has served as a catalyst for the three universities included in the case study component, to become more active in promoting university-firm interactions. In fact, one of the main conclusions of the roundtable was that every researcher that participated in the roundtable should imbibe a changed attitude towards research and industry. It was agreed that research should no longer be solely for academic publication but also primarily for addressing the needs of the society. The roundtable stressed that industry would be interested in university research if such research is demand driven and addresses the concerns of industry.

The University of Agriculture, Abeokuta (UNAAB) later invited Dr. John Adeoti as one of the main speakers at the university’s Annual Research Review Symposium with the theme, ‘Building University-Industry Synergy for National Development’, held on 7 April 2009. UNAAB was one of the universities that participated in the case studies and the roundtable discussion.

**Policy outcomes of the Ugandan roundtable**
The research enabled the team to have dialogues with academics, scholars and communities about the role of knowledge development in the process of policy development and implementation.

The Ugandan roundtable took even bolder steps. Participants resolved to establish a Forum for Interaction to intensify and promote the current base of informal relationships between universities, firms, communities and small enterprises. Representatives of Gulu University, Kyambogo University, the Uganda Small-scale Industries Association and the Markus Garvey Pan Afrika Institute were mandated to establish a Forum on Interactive Learning that could link universities, small-scale industries, farming and animal husbandry communities in the conflict-ridden Northern region of Uganda (see Appendix IV).

Although it is early to speculate, the impact of the research on institutions such as the Uganda National Council of Science and Technology and the National Agricultural Research Foundation, is bound to be significant. The lessons learnt are that there was a realization of the lack of a coherent national policy on innovation although efforts towards policy formulation were afoot. Attention was drawn to the fact that the model of Science, Technology and Innovation (STI) on its own would not serve Uganda well, but a combination of STI Mode and the doing, using, interacting (DUI) Mode would serve the country better.
The Ugandan project leader is preparing a publication based on the final country report, with the aim to influence government policy as well as reaching out to industry, academia and civil society and community groups.

Moreover, the Markus Garvey Pan Afrikan Research Institute has become a registered higher education institution in Uganda from 2010, and will be drawing on the research to inform its teaching.

**Outcomes of the South African roundtable**
The outcomes of the South African roundtable were perhaps less tangible. However, the fact that the roundtable was organized in collaboration with a national higher education organization was intended to establish a more long term relationship. The team followed up the roundtable by writing an article on the policy debate on the changing role of the university in all three countries, in an HSRC publication intended for wide public dissemination to policy stakeholders (included on the CD).

Subsequently, there has been considerable follow up by individual universities. For example, the project leader has been invited as a key note speaker at seminars/colloquia on university responsiveness and engagement with industry and community, at the Vaal University of Technology (September 2009) and at Fort Hare University (October 2009). The roundtable also sparked interest and caught the attention of researchers working on a similar project on higher education and economic development in Africa, with the possibilities of future collaboration.

**The impact of South-South interaction**
The fact that the final RoKS workshop was held in Cape Town also contributed to extend dissemination of our project and deepen the potential outcomes nationally.

We hosted a public seminar via video-conference in Pretoria, Cape Town and Durban, to present the main trends of each continental study (see Appendix V). The seminar was very well attended by policy makers, academics and university leaders, and a lively debate ensued. The event was reported prominently in an influential national newspaper with a wide readership among the business community (see Appendix VI). The opportunity for South-South research dialogue was particularly appreciated by those who attended.
Overall Assessment and Recommendations

Above all, the project has proved extremely valuable in providing the opportunity for comparative analytical work across a wide range of countries in the South. The RoKS programme officer is to be commended for her direct efforts to promote collaboration and networking across the Asian, African and Latin American teams that enriched all involved. As the outputs are more widely disseminated in the form of journal articles and books, the project is likely to impact strongly on knowledge and future research on university-firm interaction in developing countries. The research network that has built up over the past two years between African, Asian and Latin American partners will endure beyond the life of the current projects which end in 2009.

In sub-Saharan Africa, the project has addressed a significant gap, in stimulating systematic research on the role of universities in development. Economic development and poverty reduction requires that African policy makers understand and apply themselves to how knowledge generated locally can be employed in the productive sectors of the economy – whether firms, farms, community cooperatives. On this basis, the teams have made a modest initial contribution to policy debate on the role of universities in Nigeria, South Africa and Uganda, as well as to other countries in the Southern African development community.

Judging by the outputs, the study has been extremely cost effective and has achieved much within the limited funding available, given the willingness of the researchers to invest a great deal of effort and time. However, a wider scope than was possible to reach in the course of this research is required in future. For example, the focus in Nigeria was partial in that it was limited to the Western Nigeria region. The coverage of other regions within each country, and the extension to include a more comprehensive array of African countries could provide more robust and rigorous insights than was possible within the funding available. African countries require a stronger and more systematic evidence base to inform contextually appropriate policy-making, and such research contributes directly to the task.

A few very specific recommendations for future projects based on our experience are:

- The amount of funding available for empirical research in each of the three countries restricted the scope and coverage of the project. Larger total funding allocations are recommended, especially with respect to countries where there was little or no opportunity for local additional funding, such as Nigeria and Uganda.
- The time and resources available for dissemination activities was not sufficient, which impacts on the depth and reach of project outcomes. We would definitely recommend allocation of a longer period of time for projects. Three, rather than two years would be advised, with dissemination activities planned for the last six months. Likewise, greater budget allocation to networking activities would allow for meaningful dissemination activities.
- Based on the positive experience of the internship and the intern’s contribution to the project, we would recommend future projects to allow for a larger budget allocation to attach more interns to projects.
- Similarly, we would recommend that future projects make a larger budget allocation to travel and subsistence for full team workshops and research planning meetings.

The team would like to express their strong appreciation to the IDRC for the opportunity to pursue the study and to become part of larger global networks working on science, technology and innovation in developing countries. We sincerely hope that this project will indeed be the seed for a long and fruitful collaboration.
## Appendix I. The survey instrument adapted for use in Nigeria

### GENERAL INFORMATION

| **FIRM’S NAME:** |  |
| **INDUSTRIAL SECTOR:** |  |
| **FOUNDATION YEAR:** |  |
| **ADDRESS:** |  |
| **CITY:** |  |
| **PHONE:** | **FAX:** |
| **E-MAIL:** |  |

Technology or R&D or Product Development Manager:

| **SIZE (number of employees):** |  |
| **NUMBER OF workers/staff involved in R&D activities:** |  |
| **NUMBER OF R&D workers WITH POST-GRADUATE DEGREES:** |  |
| **OWNERSHIP STRUCTURE:** Local ________% Foreign ________% |  |
| **HEADQUARTERS:** Name: _________________ Location: _________________ |  |

Respondent: **NAME:**

**POSITION/DESIGNATION:**

---
INSTRUCTIONS

The survey is designed to be responded by R&D managers (if your firm has R&D expenditures) or by the person in charge of technology (if your firm has not R&D expenditures). Please answer each item based on your best estimate. It is not necessary for you to search your files or consult with colleagues to provide more detailed answers. Instead, please answer to the best of your ability based on your understanding of your unit and its activities. Soon you will be contacted by telephone by our interviewers who will take your answers.

GENERAL DEFINITIONS (Definitions used by IBGE)

<table>
<thead>
<tr>
<th><strong>Products and Processes Technologically New or Significantly Improved</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>In this survey, technological innovation is defined as the introduction of a product (good or service) technologically new or significantly improved in the market or the introduction of a productive process technologically new or substantially improved for the firm.</td>
</tr>
<tr>
<td>Technological innovation refers to a new (or significantly improved) product and/or process to the firm, not necessarily being new for the market/sector, even if it has been developed by others firms/institutions.</td>
</tr>
<tr>
<td>The innovation can come from new technological developments, new combinations of existent technology or from the use of other knowledge acquired by the firm.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Innovative Activities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovative activities are representative activities of the firm’s efforts to improve its technological assets and, consequently, for the development and introduction of products and processes technologically new or substantially improved.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Research and Development (R&amp;D)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and Development is the creative work done in a systematic way that aims to increase the knowledge and the use of this knowledge to develop new applications such as products and processes technologically new or substantially improved. Drawings, construction and tests of prototypes and pilot-installations are, many times, the most important part of R&amp;D activities. It also includes software development, since it involves some technological or scientific improvement. In developing countries, the main function of R&amp;D is to master, adapt and improve imported or existing technologies.</td>
</tr>
</tbody>
</table>
1. Introduction of New **Products** and **Processes** or Significantly Improved **Products** and **Processes** in the last three years:

1-a) New (or significantly improved) Products
   a) no new product
   b) improvement of an existing product
   c) new for the firm, but not for your country
   d) new for your country, but not for the world
   e) new to the world

1-b) New (or significantly improved) Process
   a) no new process
   b) improvement of an existing process
   c) new for the firm, but not for your country
   d) new for your country, but not for the world
   e) new to the world

2. This question refers to the percentage of your firm’s revenue invested in in-house R&D activities **according to your estimative**.

   In the last three years, an average of ______% of the revenue was invested in R&D activities.

   (IF YOUR ANSWER IS ZERO PER CENT, PLEASE GO TO QUESTION 5)

3. **R&D: organization**

3-a) Organization
   a) Informal R&D activities (non continuous)
   b) Informal R&D activities (continuous)
   c) Continuous R&D activities distributed throughout the whole firm
   d) Formal R&D department

4. Are there other plants of the firm where R&D activities are performed?
   □ YES  □ NO

   If affirmative, indicate the location of the firm’s other plants which have R&D activities:
   **State:**________  **City:**________________________
   **State:**________  **City:**________________________
   **Other country:**________________________

   (PLEASE GO TO QUESTION 6)
5. What are the reasons why your firm does not invest in R&D?

1- Not important 2- Slightly important 3- Moderately Important 4- Very important

Reasons for not investing in R&D

<table>
<thead>
<tr>
<th>Reason</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>a) The firm does not innovate</td>
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<tr>
<td>b) Small market size does not allow recovering R&amp;D investments</td>
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<tr>
<td>c) R&amp;D investment is too risky</td>
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<tr>
<td>d) R&amp;D is too costly for the firm</td>
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<tr>
<td>e) Lack of access to credit</td>
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<tr>
<td>f) Difficulties to appropriate R&amp;D results</td>
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<tr>
<td>g) Lack of public support</td>
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<tr>
<td>h) R&amp;D is not necessary for the firm’s innovation</td>
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<tr>
<td>i) External sources of information are sufficient for innovation</td>
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<tr>
<td>j) Universities substitute firm’s R&amp;D</td>
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<tr>
<td>k) Public research institutes substitute firm’s R&amp;D</td>
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</tbody>
</table>

II – SOURCES OF INFORMATION AND KNOWLEDGE

6. During the last three years, has your firm benefited from information or knowledge from any of the following sources which either suggested new product/process or contributed to the improvement of existing product/process?

<table>
<thead>
<tr>
<th>Sources of information</th>
<th>Suggested new product/process</th>
<th>Improvement of existing product/process</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) The firm’s manufacturing operations</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>b) Affiliated suppliers (supplier linked to your unit through ownership, such as a parent, sister or subsidiary firm)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>c) Independent suppliers (not linked through ownership)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>d) Customers</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>e) Universities</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>f) Public Research Institutes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>g) Competitors</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>h) Cooperative or joint ventures with other firms</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>i) Consulting or contract R&amp;D firms</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>j) Fairs and expositions</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>k) Technical publications and reports</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>l) Internet</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>m) Indigenous knowledge systems</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>n) Professional/trade associations</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>o) Indigenous knowledge system</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>p) Others:</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
7. Which one of these sources was the most important for **suggesting new product/process**?
   Letter: ________

8. Which one of these sources made the most important contribution to **the improvement of existing products/process**?
   Letter: ________

   (IF YOUR ANSWERS ARE “NO” BOTH IN TOPICS “e” (UNIVERSITIES) AND “f” (PUBLIC RESEARCH INSTITUTES) IN QUESTION NO.6, PLEASE ANSWER QUESTION 9, OTHERWISE, GO TO QUESTION 10)

9. Why universities and public research institutes are not important as information sources for innovation?

   1- Not important 2- Slightly important 3- Moderately Important 4-Very important

   **Reasons why universities and public research institutes are not important sources of information**
   a) Our firm’s R&D is enough to innovate
   b) Universities have no understanding of our line of business
   c) Public institutes have no understanding of our line of business
   d) Contractual agreements difficult
   e) Lack of trust
   f) Quality of research is low
   g) University concerned only with *big science*
   h) Geographic distance
   i) Dialogue is very difficult
   j) Intellectual property issues

10. Below there are some channels of information about the R&D activities or innovations of **OTHER FIRMS**. Please score each of the following in term of the importance of that channel’s contribution to your innovative activities.

   1- Not important 2- Slightly important 3- Moderately Important 4-Very important

   **Channels of information**
   a) Patents
   b) Publications and reports
   c) Public conferences and meetings
   d) Informal information exchange
   e) Recently hired technical personnel
   f) Licensed technology
   g) Joint or cooperative R&D projects
   h) Contract research with other firms
   i) Products (for example, by reverse engineering)
   j) Trade associations
   k) Fair and expositions
11. Below there are some channels of information and modes of interactions about the research activities or research findings of UNIVERSITIES. Please score each of the following in terms of that channel’s contribution to your innovative activities.

<table>
<thead>
<tr>
<th>Channels of information/ Modes of interactions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>a) Patents</td>
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<tr>
<td>b) Publications and reports</td>
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<tr>
<td>c) Public conferences and meetings</td>
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<tr>
<td>d) Informal information exchange</td>
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<tr>
<td>e) Recently hired graduates with advanced degree</td>
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<tr>
<td>f) Licensed technology</td>
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<tr>
<td>g) Consulting with individual researchers</td>
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<td>h) Contract research with universities</td>
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<tr>
<td>j) Joint or cooperative R&amp;D projects</td>
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<tr>
<td>k) Participation in networks that involve universities</td>
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<tr>
<td>l) Temporary personnel exchanges</td>
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<tr>
<td>m) Incubators</td>
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<tr>
<td>n) Science and/or technology parks</td>
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<tr>
<td>o) Firm is owned by an university (URE)</td>
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<tr>
<td>p) Firm is a spin-off of an university</td>
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</table>

12. Below there are some channels of information and modes of interactions about the research activities or research findings of PUBLIC RESEARCH INSTITUTES. Please score each of the following in terms of that channel’s contribution to your innovative activities.

<table>
<thead>
<tr>
<th>Channels of information/ Modes of interactions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Patents</td>
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<tr>
<td>b) Publications and reports</td>
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<tr>
<td>c) Public conferences and meetings</td>
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<tr>
<td>d) Informal information exchange</td>
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<tr>
<td>e) Recently hired graduates with advanced degree</td>
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<tr>
<td>f) Licensed technology</td>
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<tr>
<td>g) Consulting with individual researchers</td>
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<tr>
<td>h) Contract research with public institutes</td>
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<tr>
<td>j) Joint or cooperative R&amp;D projects</td>
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<td></td>
<td></td>
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<tr>
<td>k) Participation in networks that involve public institutes</td>
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<tr>
<td>l) Temporary personnel exchanges</td>
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<tr>
<td>m) Incubators</td>
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<tr>
<td>n) Science and/or technology parks</td>
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</tr>
<tr>
<td>o) Firm is owned by a public institute</td>
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<tr>
<td>p) Firm is a spin-off of a public institute</td>
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</table>
13. During the last three years, how important was for your innovative activities the use of the following research outputs produced by or resources from universities or government research institutes?

1- Not important  2- Slightly important  3- Moderately Important  4-Very important

<table>
<thead>
<tr>
<th>Research Outputs</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Research findings</td>
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<tr>
<td>b) Prototypes</td>
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<tr>
<td>c) New techniques and instruments</td>
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<tr>
<td>d) Laboratories/Metrology</td>
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</table>

III– SCIENCE AND ENGINEERING FIELDS

14. How important to your innovative activities is the contribution of University or Public research conducted over the last 10 years, by science and engineering fields? (Indicate the university or research institute most important for your innovative activities in each field (especially those moderately or very important).

1- Not important  2- Slightly important  3- Moderately Important  4-Very important

<table>
<thead>
<tr>
<th>Fields</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Agronomy</td>
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<tr>
<td>b) Computer Science</td>
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<tr>
<td>c) Food Science and Technology</td>
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<tr>
<td>d) Biology</td>
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<tr>
<td>e) Industrial Design</td>
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<tr>
<td>f) Civil Engineering</td>
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<tr>
<td>g) Engineering of Materials and Metallurgy</td>
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<tr>
<td>h) Mining Engineering</td>
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</tr>
<tr>
<td>i) Electrical Engineering</td>
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<tr>
<td>j) Mechanical Engineering</td>
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<tr>
<td>k) Chemical Engineering</td>
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<tr>
<td>l) Physics</td>
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<tr>
<td>m) Geosciences</td>
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<tr>
<td>n) Mathematics</td>
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<tr>
<td>o) Medicine</td>
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<tr>
<td>p) Veterinary</td>
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<tr>
<td>q) Chemistry</td>
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<td>r) Other(specify: )</td>
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<td>s) Other(specify: )</td>
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<tr>
<td>t) Other(specify: )</td>
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</table>
IV – COLLABORATION WITH UNIVERSITIES AND PUBLIC RESEARCH INSTITUTES

(Please, answer this section only if your firm has collaboration – formal or informal - with universities and/or public research institutes)

15. What are the reasons for your collaboration with universities and/or public research institutes?

1- Not important   2- Slightly important   3- Moderately Important  4-Very important

Objectives of collaboration

<table>
<thead>
<tr>
<th>Reason</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Technology transfer from the university</td>
<td></td>
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</tr>
<tr>
<td>b) To get technological/consulting advice from researchers and/or professors in solving production-related problems</td>
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</tr>
<tr>
<td>c) To augment the firm’s limited ability to find and absorb technological information</td>
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</tr>
<tr>
<td>d) To get information about engineers or scientists and/or trends in R&amp;D in the field</td>
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</tr>
<tr>
<td>e) To contract research helpful to the firm’s innovative activities (complementary research by universities and public labs)</td>
<td></td>
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</tr>
<tr>
<td>f) To contract research that the firm cannot perform (substitutive research by universities and public labs)</td>
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<tr>
<td>g) To make earlier contact with excellent university students for future recruiting</td>
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<tr>
<td>h) To use resources available at universities and public research institutes</td>
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16. Overall, has collaboration with universities and research centers been successful in terms of meeting the expected objectives?

Choose one answer

a) Yes, so far collaboration has been successful to meet the objectives
b) No, collaboration has not been successful to meet the objectives
c) Collaboration is still going on but I trust objectives will be met in due time.
d) Collaboration has not been completed yet but I do not expect objectives to be met

(IF YOUR ANSWER IS A OR C, PLEASE GO TO QUESTION 18)
17. Why collaboration with universities and research institutes failed to meet expected objectives?

1- Not important  2- Slightly important  3- Moderately Important  4-Very important

Reasons
a) Mismatch between knowledge available at the university/research institute and that needed by the firm
b) Differences in timing
c) Differences in points of view and/or objectives
d) Researchers at the university/research institute are too "science-oriented"
e) Researchers at the university/research institute are not enough "science-oriented"

f) Low sensitivity of universities to firm’s demands
g) Differences regarding the appropriability of the results of the collaborative project (intellectual property issues)
h) Lack of preparation of firm’s personnel to deal with university
i) Other (specify: )
j) Other (specify: )

18. For how long has your firm’s collaboration with universities/public research institutes been important?

Choose one answer
a) Not important, so far
b) This year
c) Less than two years
d) Less than five years
e) Less than ten years
f) More than ten years

V – ROLE OF UNIVERSITIES

19. Please, evaluate the importance of the following roles of universities for your firm.

1- Not important  2- Slightly important  3- Moderately Important  4-Very important

Roles of universities
a) Teaching
b) Research
c) Social
d) Entrepreneurial
Appendix II. The case study design

Case study research questions:

What are the constraints and opportunities for knowledge-intensification of firms (in the agro-food processing sector/biotech sector/pharmaceutical sector) through interaction with universities?

- What is the main mode or channels of interaction, in terms of knowledge intensity?
- What are the outcomes of this interaction – ie does the interaction work/succeed or not?
- What are the conditions in the university that facilitate and/or constrain this un/successful interaction?
- What are the conditions in the firm that facilitate and/or constrain this un/successful interaction?
- What are the policy conditions and government mechanisms that facilitate or constrain?

The empirical entry point to identify cases of interaction is the university. However, we will need to identify at least one case of no interaction through the firm survey.

It is critical to bear in mind that the unit of analysis is the university-firm interaction.

We want to understand the nature of the interaction in terms of knowledge intensity, and we want to understand the outcomes of the interaction to be able to judge whether it ‘works’ or not.

We need to identify key conditions in the university, the firm and in policy that can explain why each specific form of ‘limited’ or ‘strongly’ knowledge intensive interaction is successful or unsuccessful.

The instruments are designed to achieve this:

1. A set of instruments to identify cases of interaction (Forms of interaction Schedules 1 to 2)
2. A set of instruments to investigate the nature of the selected case of university-firm interaction in more depth (Interaction schedules 1 and 2)
3. A set of instruments to investigate conditions in the university (University Schedules 1 to 5)
4. A set of instruments to investigate conditions in the firm (Firm schedule 1)
5. A template to write up the case study

There are multiple possible data sources:

1. The university
   a. general policy, structures, data from websites and documentation
   b. research deans/directors/heads of innovation through interviews
2. The research group/department
   a. head of department interviews
   b. project leader interviews
   c. data on interactions gathered from interviews
3. The firm
   a. Data on firm conditions from websites and interviews
   b. R&D manager interviews
   c. Product development managers etc working with universities, interviews
4. The interaction
   a. interviews with researchers involved/project leader
   b. interviews with firm staff involved/project leader

1. Identifying cases of interaction (Forms of interaction schedule I and II)

Schedules 1 and 2 allow us to identify all possible forms of interaction in a specific department or research unit in the university, as the set of interactions from which we will select case studies.

Schedule 1 is simply an excel sheet that allows us to record pertinent information, once we have gathered it using Schedule 2. It will yield a list of all interactions in the university to inform our sense of the activity and performance in the department; and, importantly, it provides a set from which we can select cases.

Schedule 2 is an adaptation from the firm survey, on knowledge intensity, channels, outcomes and benefits of interaction. It includes items that request the head of department to list their main interactions with firms and the nature of firms.
We may require an unstructured interview with the head of department that allows us to complete Schedule 2 and follow up with more in-depth questions.

Once we have completed Schedule 1, we can then select a set of case studies of interaction.

There will be three categories of cases:
- Those with no interaction between university and firm
- Those with limited interaction between university and firm
- Those with knowledge intensive interaction between university and firm

In addition, we need a spread of cases of interaction that are successful/work or not. Criteria that they ‘work’ relate to specific outcomes, length of time the relationship has been sustained, perceptions of benefit, etc – we will need to specify the specific reasons why we categorise each case as working or not.

We also want a spread of small, medium and large firms in the total set.

For ‘no interaction’, it will not be possible to identify cases through the university. At least one case will need to be identified from the firm survey, in which there is known university capacity, but no interaction with the firm.

Hence, the number of universities we go to may vary. It need not be 6, but there should be at least six case studies of interaction, preferably more. It may be that we select cases from two types of university – general, and S&T oriented.

2. A set of instruments to investigate the nature of the selected case of university-firm interaction in more depth (UIL schedules 1 and 2)

Interaction schedule 1 is an interview for the project leader and other researchers working on the selected case.

Interaction Schedule 2 is the same interview for the main person responsible for the project in the firm, and other firm managers who may be centrally involved.

3. A set of instruments to investigate conditions in the university (University Schedules 1 to 5)

University Schedules 1 to 3 provide a set of matrices on which we can record data about each university systematically in a way that facilitates comparison. The comment box is not optional but rather, it should be used to record critical data on the specific forms in that university.

University Schedule 4 is set of questions and possible sources that allow us to gather and analyse data to complete the matrices from university web-sites, documentation and interviews.

University Schedule 5 is an unstructured interview schedule for research deans/ directors of innovation, on practices in the university, also as a source to inform completion of the matrices.

Forms of interaction Schedule 2 will also provide key information on the research group, in terms of their interactive capability – the full set of forms of interaction with which they engage.

4. A set of instruments to investigate conditions in the firm (Firm schedule 1)

Firm Schedule 1 provides a profile of the firm. Some of the data may be obtained from firm websites, the rest will need to be obtained from interviews.

5. Government policy as facilitator or constraint

Here reflection is required, drawing on the contextual paper, on how government policy aims to facilitate university-industry interaction in general or in relation to the specific biosector of focus – in relation to the practice in this case.

How aware are project leaders and how well do they think a specific funding or support strategy is working in relation to their case? (This is one of the focus issues in the Interaction interviews)

The sources are the contextual paper and the interviews with project leaders and firm managers.

POLICY MEMORANDUM FROM THE STUDY ON UNIVERSITY-FIRM INTERACTION IN NIGERIA

NISER, 05 March 2009

1. INTRODUCTION
The role of knowledge in economic development cannot be over-emphasized in an increasingly competitive global economy. The contribution of universities to economic and social progress depends on the extent to which firms are able to employ the knowledge generated by universities to improve firm performance. Fostering interaction between universities and firms has been a major challenge in Nigeria. There has been no evidence of significant collaborations between universities and firms. The study from which this policy memo is drawn investigated the conditions in the Nigerian universities and manufacturing firms that constrain or facilitate university-firm interaction. The main research question for the study is 'what are the constraints on and opportunities for the emergence of developmental universities in Nigeria?' Universities are known to be centres of knowledge generation and training for community development. The ability to undertake innovative research and apply its output is complex and embedded in a context of inter-organizational relationships. The interactions between firms and universities are often regarded as products of a developmental orientation of research activities that are aimed at addressing community problems. For Nigeria, the scope and dimension of community oriented research are limited. However, there is a growing concern that universities in Nigeria should be alert to the development challenges in their communities and begin a drive to making research and training activities relevant to the immediate societal needs. In the national system of innovation (NSI) framework, the educational and training system and the industrial establishments are expected to interact and be involved in mutually beneficial knowledge exchanges that engender innovation. A developmental university in this context would be actively involved in a network of agents that create new products and services or new models of achieving economic objectives. In essence, a developmental university would not only generate new knowledge that improves the stock of knowledge, but also produce change agents that carry knowledge into society and motivate society to employ and build on knowledge from the ivory towers. While the firm is the centre of the innovative activities in the NSI, the developmental university interacts with firms and other elements of the NSI to create critical skills and impetus for the entrepreneurial functions required for innovation as the engine of economic growth.

Economies that are innovation driven (i.e. knowledge economies) are characterized by evident university-firm interactions especially in strategic sectors of the economy. The university-industry linkages (UILs) in such contexts are an important feature of interactions among the actors that are involved in the generation and use of technological knowledge. In Nigeria, an important potential beneficiary of UILs is the agro-food processing sector, which accounts for at least one quarter of Nigeria’s manufacturing value-added. Agro-food processing has always been considered strategic to the Nigerian economy. Successful agro-allied processing in Nigeria would rely on knowledge inputs from universities especially because the capability for firm level research and development (R&D) is weak. The agro-food processing was thus selected as the platform to examine the state and extent of university-firm interaction in Nigeria.

The methodology for the study has three components. The first entails policy account and review of existing empirical literature on economic and technology development activities in Nigeria in order to set the economic and technological development background for the analysis of the university-firm interactions. The second component involves a survey of firms in the Nigerian manufacturing sector aimed at providing data for the analysis of firms’ perception of UILs. The
third component comprises the case study of university practice in Nigeria, which provided information for the analysis of the university’s perception of UILs. For the case study of university practice, one university of agriculture, one university of technology and one non-specialized university were selected. The study also included a one-day roundtable discussion that brought together distinguished professors from the three case study universities. The roundtable reviewed the findings of the study and discussed its policy implications in order to proffer pragmatic suggestions on how to stimulate university-firm interaction in Nigeria.

2. OBSERVATIONS

2.1. Policy mechanisms and the national system of innovation in Nigeria

• While Nigeria has made diverse and widespread attempts to develop science and technology (S&T), the findings showed that until 2007 the development planning process in Nigeria failed to appreciate the central role of science, technology and innovation (STI) in economic and social development. S&T development focused on the supply of scientific knowledge without due consideration for the relevance of knowledge generated to the expected user. NEEDS-2 was the first policy framework that clearly recognized STI as cross-cutting and central to economic growth and development.

• The existing apparatus for achieving the objective of scientific development and technological innovation in Nigeria is highly disjointed in establishment, management and operation. It is however demonstrated that policy concerns are beginning to address the challenge of a relatively weak national system of innovation characterized by poor linkages between universities, R&D institutions and manufacturing firms.

2.2. University-industry linkages (UILs) from the perspective of firms

• Nigerian firms have used existing production processes to manufacture products that are only new to Nigeria (not new to the world), and firms’ R&D capability is still relatively weak.

• Universities took the least position in the perception of firms as sources of information and knowledge that had resulted in new projects or completion of existing innovative projects.

• Lack of collaboration between firms and universities is not because researchers are not interested in deepening knowledge. The three factors that ranked highest (in order of importance) as reasons why successful collaborations are rare are: low sensitivity of universities to firm’s demands; mismatch between knowledge available at the university and that needed by the firm; and researchers at the universities are too “science oriented”.

• Firms generally perceive the quality of R&D in the universities to be low, and hence depend largely on their limited in-house R&D, and sometimes on R&D done abroad.

2.3. University-industry linkages (UILs) from the perspective of universities

• The universities studied have distinguishing features in their research culture and vision; and the state of knowledge intensification in agro-food processing differ considerably as demonstrated by the nature and extent of UILs that were identified.

• The research culture and vision of the university of agriculture appear to be relatively well established. There is a relatively firm institutional structure and well articulated framework for research. The development of the agricultural sector and agro-food processing form the major focus of the university and ample evidence of research activities (both on-going and completed) exists in agro-food processing.

• Biotechnology is clearly recognized and promoted by the university of agriculture as an important technology platform for increasing food production and industrial technology development for agro-food processing.

• Biotechnology firms in Nigeria are currently non-existent, and agro-food processing firms that apply biotechnology are yet to appreciate the existence of local competence in biotechnology.

• Modern biotechnology is still relatively an emergent technology in Nigeria and support for its development is currently weak. Biotechnology research and application are still highly
limited and constrained especially by lack of research infrastructure and necessary funding support.

- The focus of the university of technology is biased towards building local technological capability. In this respect, the development of agricultural technology, especially aimed at tackling the challenges of post-harvest losses has been its major concern.
- The institutional framework for research at the university of technology appears relatively less developed compared to the university of agriculture, and data provide no evidence of existence of significant research in biotechnology.
- The non-specialized university is apparently the oldest and more experienced of the three universities. Though the research culture and institutional framework for research are well established, the evolution and transformation of the knowledge generation mechanisms have been slow. However, the challenge of making the research activities to address the renewed vision and mission of the university has resulted in considerable transformation of the research culture of the university. Research in agro-food processing has been a major beneficiary of this transformative process.
- Though there are indications that research infrastructure at the non specialized university is being improved, especially through on-going major support from an international organization, it is unclear whether the university is consciously promoting the application of biotechnology in agro-food processing research.
- While the university of agriculture presented two interesting cases of UIL, the university of technology presented only one, and the non specialized university also presented one.
- The two UIL cases at the university of agriculture and the one at the non specialized university showed that there is potential for developing knowledge intensive university-firm interactions. However, the constraints are diverse and presently becloud efforts to advance the limited success that has been achieved in the UILs.
- In the case of the university of technology, UIL is adjudged to be at its infancy and the case illustration is a consultancy research project which typifies the examples of UIL that have so far been experienced by the university.
- It was also discovered that two of the three universities are currently promoting the basic philosophy of entrepreneurship as an important aspect of training and research. It is expected that this would be a pathway to generate firm spin-offs from research outputs, and to train students to be self-employed. For example, if students get the right training and entrepreneurship orientation, they will discover that biotechnology can easily give them a one-room industry which may generate products worth millions of Naira. For researchers, the case of bottled palm wine and amylase enzyme technology at the university of agriculture signified the potential spin-offs that could be generated by biotechnology applications in agro-food processing.

### 2.4. Constraints on university-industry linkages (UILs)

Constraints identified by the case study universities and firms involved in UILs may be classified into three categories: infrastructure related, policy related, and attitude related.

- **Main infrastructure related constraints include:**
  - poor research facilities and equipment,
  - poor electric power supply,
  - poor access roads, and
  - poor communication infrastructure.

- **Key policy related constraints:**
  - lack of incentives and poor government support for industry R&D,
  - lack of a national policy onUILs, and
  - poor funding of research

- **Key attitude related constraints include:**
  - lack of political will to address R&D challenges,
- entrepreneurship culture that lack support for R&D, and
- divergent views emanating from the minds of scientists and industrialists.

3. RECOMMENDATIONS

The following recommendations emanate from the findings of this study.

- Building local technological capability would require raising the quality of R&D in universities and active promotion of collaborative R&D projects between firms and universities.
- The nature of education presently offered by the Nigerian university system is limited in its developmental focus. The universities neither stimulate risk taking nor encourage venture into productive activities. For example, there is no major agricultural farm owned by any of the three universities in this study. Agriculture is currently not looked at as business from the mindset of the educational system. Agriculture-related education should therefore be made more attractive and practical oriented. Universities should have business plans to make agriculture work within its training curriculum. Universities should explore partnerships with industry in order to develop and interact effectively, especially in the agricultural sub-sector. Agro-food processing provides a lot of employment opportunities, which university-industry linkages could turn into immense benefit to society.
- The challenges posed by the constraints to university-firm interactions may also be addressed by education and advocacy programmes. The university curricula review should progress in consonance with the development dynamics in society and industry. Universities that have upgraded their research and teaching to world-class standards would be approached by industries that are dynamic due to competition in the economic environment.
- The government can be the catalyst of university-firm interactions by adequate support for research and use of Nigerian university experts rather than foreign consultants.
- Government’s poor support for research has also been a hindrance to firm spin-off effect. For example, multi-disciplinary research as advocated by one of the university case studies may provide opportunity for spin-offs if government policy is supportive.
- The roundtable specifically agreed that:
  - The university system and researchers need a changed attitude to scientific research. Research should connect with society and industry, and not purely for the sake of academic promotion. A review of the scientific appraisal system in the universities would be necessary to ensure that innovative research is encouraged and rewarded above traditional contribution to knowledge.
  - There is the need for the establishment of a unit for mediating between university and industry in every university, and an agency that oversees university-industry linkage at the national level. The national institution would act as midwife for promoting innovative demand-driven research and provide incentives for research that addresses societal needs.
  - There should be a national policy on university-industry collaboration. This will specify roles for stakeholders and provide incentive for UILs. The policy should aim at improving government support for research, harmonize results of publicly funded research, and ensure that funds for research is domiciled in a reputable agency mediating between universities and industry.
  - The statutes and acts that established universities should be revised to incorporate entrepreneurship tenets into the university teaching and research.
4. CONCLUSION
From the findings of the study it is apparent that university-firm interaction in Nigeria is highly constrained both from the perspective of firms and the perspective of universities. The role of government as a mediator is yet to be articulated and existing policy framework for education, science, technology and industrial development remained impotent in fostering university-firm interactions. This notwithstanding, it is evident from the findings of this study that both industry and the university system recognize the inherent weakness of the university-industry linkage and the need to address it. The acknowledgement of the role of science, technology and innovation (STI) as a cross-cutting factor in the NEEDS-2 framework and the ongoing reform in the university system as demonstrated by two of the three case study universities in this study suggest that potential exists for significant R&D that are demand-driven and carried out in a network that has evident university-firm interactions. Nurturing this potential is crucial for building local technological capability which is required for economic development and poverty reduction.
**CONCLUDING STATEMENT**

This Round Table was convened at Hotel Bavita-Kampala on 7th April 2009 for the purpose of considering the research country report that was undertaken by the Marcus Garvey Pan African Institute (MPAI), entitled “Knowledge for Development: University – Firm Interactions in Uganda.” The participants observed that there were attempts being made by the government of Uganda to craft a framework for interactive knowledge transfers between universities and industry. However, they noted that due to the uncoordinated way in which the interactions were being pursued, linkages were being undertaken more on individual informal basis without proper institutionalization.

The study had revealed constraints in the linkages between universities, firms, communities and small enterprises – emerging out of informal relationships with universities, and it found this to be a positive base for further evolution of these experiences. This is because these informal linkages, interaction between universities–firms–industries–communities-and small enterprises appear to emerge in certain ‘path dependency’ that has historical roots in the Ugandan society on which Uganda can build its own model of economic development arising out of its history.

Through this realization, the roundtable decided to form a Forum for Interaction to discuss further the intensification of these interactions. Gulu University, MPAI and others were requested to work on formation of a Forum for Interactive Learning that could act as a link between the universities, small-scale industries, and farming and animal husbandry communities. The rallying point could be initiating discussions on:

**Resettlement of the communities in Northern Uganda after two decades of conflict and displacement: innovative thinking on issues resonating around old and new settlements. This should lead to a new model of socio-economic transformation in Acholiland from which the rest of Ugandan society can learn-by doing, using and interacting.**

The following individuals were unanimously mandated to commence the process of convening the Interactive Forum:

1) Prof. C. W. Balidawa  
Gulu University

2) Prof. P. O. Bwangamoi  
Gulu University

3) Prof. Dani W Nabudere  
Marcus Garvey Pan African Institute

4) Dr. Rose Namugaya  
Kyambogo University

5) Mr. Kawoya James  
Uganda Small Scale Industries Association

The team from Gulu University was requested to brief the Vice-Chancellor of Gulu University in order to bring him aboard. They were also asked in collaboration with MPAI, to do a 15-page concept paper to convene conversation whenever Gulu University is ready to host the Forum.

**KAMPALA, 7TH APRIL 2009.**
Appendix V. Poster for cross regional seminar, HSRC.

The Developmental University in the South

The following seminar may be attended in Pretoria, Cape Town and KwaZulu Natal.

The challenges that universities in developing countries face are different to their counterparts in advanced countries, given the specific problems they need to address through knowledge and technology, in the context of a growing knowledge divide, and on a base of largely resource-based productive activities. How these differences manifest themselves within and across countries and sectors, and what this implies for harnessing the productive role of universities in economic development, is the central concern of a research project on knowledge for development in sub-Saharan Africa, Latin America and Asia.

The research project includes 12 countries in the three regions and focuses on university-industry interaction. The research project is funded by the Canadian International Development Research Centre (IDRC).
Researcher warns against privately funded research

SUE BLAINE
Education Correspondent

DEVELOPING states needed to consider the risks involved in partnering the idea that universities collaborate with industry, Argentinean researcher Valeria Arre said in Pretoria yesterday.

Arre was presenting findings at a Human Sciences Research Council seminar on the role of the “developmental university” in Latin America, sub-Saharan Africa and Asia.

Knowledge was increasingly important for countries’ economic development, and universities had an increasingly important role to play in the attainment of economic prosperity, said Arre’s fellow researcher Prof Xamin Lee of the Seoul National University.

South Korea had the world’s second-fastest growing economy from 1960 to 2000 and is still a player in the global economy, although its performance has slowed markedly.

Developing states had to consider the implications of the prioritisation of knowledge produced in public institutions, the costs to the state in terms of time for teaching and researching solutions the countries’ development commitments as well as the way in which privately funded research changed universities’ research agendas, said Arre, an economics researcher at the Argentinean National Research Council.

“Research builds on research, so if research is privately owned, then the data is not useful,” she said.

Lee said because of this South Korea had “changed the rules” so that all research done in state-funded institutions belonged to the state.

The multinational research team surveyed universities and public research institutions in 12 countries in the region.

Lee’s team found very informal interaction between small firms with little or no in-house research and development (R&D) activity common in Asia, formal contract research interaction between universities and medium-sized firms with some in-house R&D activity and then less formal interaction between universities and large companies, with strong in-house R&D capacity.

The African research team spokesman, Prof Dan Nabi, executive director of the Africa Study Centre, an academic think-tank in Mbabane, said his team found that the level of a country’s development also influenced interactions between universities and industry.

The team looked at SA, Nigeria and Uganda, and found only SA had a national innovation system. It was only in SA that the interaction between industry and universities was strong.