Strengthening Technology, Research and Innovation
Cooperation between Europe and South Africa

GOOD PRACTICES IN INNOVATION COLLABORATION BETWEEN SOUTH AFRICA AND EUROPE: CASE STUDIES

WP3: Task 3.4

Deliverable 3.3

23 October 2015

Table of Contents

Introduction

ESASTAP Plus is a dedicated platform to support the deepening of scientific and technological cooperation between South Africa (SA) and the European Union (EU) with a special focus on innovation. Innovation is viewed as a key factor to determine productivity and growth, and South Africa presents a case with a significant potential for development in innovation, and thus a strong case for EU-SA cooperation in this regard.

ESASTAP Plus will support SA-EU cooperation primarily by supporting SA's participation in Horizon 2020, but also by promoting reciprocal European participation in SA's science, technology and innovation programmes. Specific input will be provided to enrich the bilateral policy dialogue, notably to identify priority areas for mutually beneficial cooperation. A major focus will be to target coordination of Member States and Associated Countries' research policies and programmes vis-à-vis SA, encouraging the development of new joint initiatives implemented by several countries. Synergy between different EU cooperation initiatives will also be encouraged, e.g. between development cooperation and research programmes.

This report on *Good Practices in Innovation Collaboration: Case Studies,* contributes to Work Package (WP) 3: Investing in innovation for enhanced cooperation, and more specifically to Task 3.4 that is focussed on supporting innovation collaboration. The report attempts to highlight challenges, success factors and good practices of existing innovation collaborations between partners in Europe and SA. This is done through selected case studies. It is hoped that sharing of this information will contribute to the support and fostering of existing and future innovation collaborations.

In developing this report the Horizon 2020 interpretation of innovation was considered. This includes innovation that results from research and development (R&D) activities, as well as innovation that result from other activities, such as finding new uses or combinations of existing technologies or developing new business models or new ways of interacting with users. While innovation is generally understood as the commercial

introduction of a new or significantly improved product or service, innovations can also be for non-commercial applications such as for better public services or for addressing e.g. social needs (European Commission[1]).

Approach and Methodology

A case study approach was selected to provide a descriptive, explanatory analysis of the innovation collaboration between partners in Europe and SA within a particular context. This approach allows for the identification of unique aspects as well as common areas of good practice, across the cases.

The case studies were identified primarily through conversations with technology transfer professionals at universities and science councils in SA. In addition the Technology Innovation Agency (TIA)[2], the National Intellectual Property Management Office (NIPMO)[3] and the Innovation Hub[4] in SA were approached for inputs. Prior to the consultations, the ESASTAP Plus Partners developed a supporting letter with criteria for case studies, as well as a list of questions that would be explored in the development of case studies (refer to Annexure A). The focus was on long-term research collaborations that have led to inventions or collaborations that were set-up specifically to drive innovation. The idea was to get examples involving different types of partners, e.g. between public institutions, between public institutions and industry etc. It was furthermore important to capture both the perspectives of the South African and the European partner.

A number of potential case studies were identified. In some cases the collaboration was still very young and did not produce any tangible results yet, and hence the studies were

[1] European Commission, Research and Innovation, Horizon 2020, Questions and Answers (http://ec.europa.eu/research/horizon2020/index_en.cfm?lg=en&pg=faq&sub=details&idfaq=42705)

[2] http://www.tia.org.za/

[3] http://www.nipmo.org.za/

[4] http://www.theinnovationhub.com/

excluded for the purposes of this survey. In other instances, the partners on either the European or South African side did not respond to requests to participate within the time frame of the study.

The five case studies portrayed in the report were selected from collaborations that met the basic criteria and where partners in SA and Europe agreed to participate within the time frame of the study. Partners were interviewed separately after which case studies were drafted and returned to the partners and the technology transfer professionals that supported them, for further inputs.

Limitations

The sample of cases from which conclusions are drawn are small. In addition the case studies are all examples of successful collaborations. This can potentially restrict the nature of the conclusions that can legitimately be drawn from the study. Furthermore, one of the intended outputs of this project activity was to draw conclusions from lessons learnt on timing and the extent of technology acquisition and related technology transfer agreements, however no specific learnings came out of the case studies that give rise to meaningful conclusions.

The context of the study is restricted to innovation arising from research partnerships. The conclusions can therefore not be extended to innovation contexts outside the scope of the study.

Case Studies

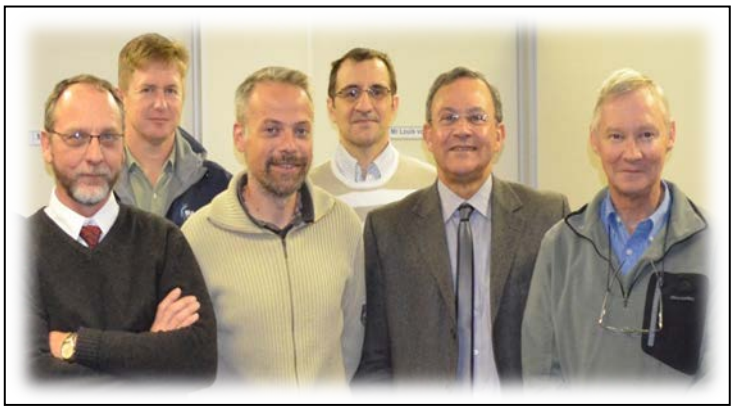
South Africa

Case Study 1: Friction Stir Processing/Residual stresses

United Kingdom

The Partners

Nelson Mandela Metropolitan University (NMMU), Port Elizabeth, South Africa
University of Plymouth, Plymouth, United Kingdom
Electricity Supply Company (Eskom), South Africa



Prof Danie Hattingh, Distinguished Professor in Mechanical Engineering and Director of eNtsa at NMMU (Front left) and **Prof Neil James**, Head of the School of Marine Science & Engineering and Associate Dean at the University of Plymouth, UK and Research Associate of the NMMU (Far right) with colleagues from the university of Sheffield and Ferrara in Port Elizabeth.

How it started

The collaboration between Prof Danie Hattingh and Prof Neil James was established serendipitously in 1996, when Prof James who moved from South Africa to Plymouth as Professor of Mechanical Engineering, met-up with Prof Hattingh at The University of

Plymouth during a research colloquium. Prof Hattingh, who was employed by the Port Elizabeth Technikon (subsequently part of NMMU) at the time, was also a part-time PhD student in mechanical engineering at Plymouth. After a conference in Australia in 1997, Prof James visited Port Elizabeth and during this visit it became clear that they shared common research interests and that there were sufficient grounds for research collaboration.

Support and results of the collaboration

During 2001 Prof Hattingh took a period of sabbatical leave from NMMU to work at Plymouth University with Prof James on Friction Stir Welding (FSW) of aluminium plates. This project was funded by Hoogovens in the Netherlands. This was a productive collaboration which resulted in an early and well-cited paper on the effect of FSW process conditions on fatigue performance. Prof Hattingh returned to South Africa and with the assistance of the National Research Foundation and Dr Patterson of Aluminium Federation of South Africa (AFSA) started a FSW research programme at NMMU. The aim of this programme was to create an international research facility that would generate local knowledge and expertise to develop the technology for the manufacturing industry. The first FSW platform at the NMMU was built by converting an “old” conventional milling machine which produced the first FSW in South Africa in 2002 using 6mm Aluminium plates. The Welding Institute of the United Kingdom held the original patents on the FSW process, but had not protected the technique in South Africa. NMMU was able to use the technology and build new applications and techniques on the existing patents.

During 2008 a new FSW platform was commissioned at a cost of R7million (€510k) to boost the research. The funds came from the NRF and the NMMU. This provided the NMMU with advanced capability to explore new applications and facilitate the transition of FSW from the laboratory to the industry environment. It also opened the field for FSW of Titanium and Stainless Steel, now successfully done at the NMMU. The current FSW research programme is focused on aluminium for the transport industry, Ti6Al4V for the medical and aerospace industries and 304L stainless steel for the nuclear sector. The

NMMU went further by developing a purpose built FSW platform for the nuclear industry, which at the time was considered as one of the smallest units of its kind.

Prof Hattingh is the Director of eNtsa, a research and technology transfer centre at the NMMU providing high tech solutions for the power, nuclear and transport industries. During recent international benchmarking exercises eNtsa was rated as world class and one of the best technology transfer centres in South Africa.

The Friction Processing group are involved with both academic research works as well as commercial funded contact research projects. It is estimated that approximately R12 million (€930k) worth of commercial contract work has been done to date. The main industry partners associated to the Friction Processing technology are ESKOM, South Africa's national electricity supplier and GRW – manufacturer of bulk carriers. In addition, the work with Eskom on Friction Processing has led to the development of a variety of specialised welding application platforms for specifically friction hydro pillar processing (FHPP), a technology that is being commercialised as WeldCore™. This technology is being pioneered at Eskom, but is being rolled out nationally and internationally. The WeldCore™ technology allows for on-line, in situ samples to be taken of metal structures. These removed core samples are then assessed to determine remnant life of high value components. The resultant hole in the structure is then repaired by using friction hydro pillar processing – a variation of friction stir welding where a consumable tool is used as opposed to a non-consumable tool. This Weldcore® innovation has two patents and a trade mark associated with it.

The NMMU's Technology Transfer Office has worked with Prof Hattingh and Eskom to drive the commercialisation of the technology. A due diligence process has been undertaken to ensure the technology is ready for commercialisation and the market potential has been assessed. A spin-off company, Mantacor, has been created to take the technology forward. Funding has been received from Eskom and from the Technology Innovation Agency in South Africa towards late stage development and early stage commercialisation.

A second joint interest between Prof Hattingh and Prof James was residual stresses and their measurement. When Prof James started applying for experimental time at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France measuring residual stresses with synchrotron radiation, he invited Prof Hattingh to join the project, as Prof James' research team was rather small. The joint work focused on Residual Stress mapping on welded aluminium samples to compare the residual stress distribution and study the influence of fatigue cycles on residual stress re-distribution. The ESRF facility provided over 38 days of synchrotron and 17 days neutron radiation beam time with real facility costs of around €800k. This collaboration worked extremely well and Profs Hattingh and James have collaborated on all synchrotron and neutron diffraction experiments over the last 12 years.

Besides the FSW platform that was produced through the collaboration other innovations were occurring around the collaboration including the partners' input into the development of software for the ESRF/ILL to process residual stress data on site in real time, through collaboration with Prof Peter Webster from the University of Salford in the UK. The involvement of Prof Axel Steuwer, currently at the MAX-lab National Research Laboratory for Nuclear Physics and Synchrotron Radiation Research at the University of Lund must be acknowledge, as he brought critical knowledge pertaining to diffraction sciences to the team.

Both partners have contributed innovative value to the collaboration: Prof Hattingh in the friction stir process development and instrumentation, Prof James in the use of synchrotron/neutron diffraction to measure residual stresses in engineering size components, and in linking the process parameters to fatigue performance. The net result has been an increased understanding of process-performance-prediction relationships and the development of industrially relevant FSW platforms for manufacturing and the power generation industry. It should also be noted that the key element in commercialising this was the involvement of Eskom through another long-time collaborator of Profs James and Hattingh, Dr Mark Newby and Mr Philip Doubell of Eskom's Research, Testing and Development Department – this relationship allowed the team to drive the collaboration into areas of key importance to power generation.

Challenges in the collaboration

This collaboration has been very productive and successful with minimal challenges. The major challenge was finding funding on an ongoing basis for travel between South Africa and the UK, and a funding mechanism for shared PhD studentships and conference attendance.

Other outputs of the collaboration

The collaboration has produced many academic outputs including 18 peer-reviewed journal papers in leading international journals since 2003, and 13 papers in international peer reviewed conferences. Six of the conference presentations were either keynote or plenary lectures. In addition Profs James and Hattingh have collaborated on 18 synchrotron/neutron diffraction experiments at ISIS, ENGIN-X, ESRF or the ILL. There have also been three co-supervised PhD degrees awarded and many on-going research student progress meetings at NMMU - Prof James is appointed as a honorary professor at NMMU.

Currently, Profs James and Hattingh are partners in a Leverhulme Foundation funded International Network grant on Multiaxial fatigue of FSW tubes (grant held by Sheffield University and also partnered with the University of Ferrara).

Key Success Factors and Good Practices

1. Having trust amongst partners.
2. Regular and open communication. This prevents potential misunderstandings and allow for higher efficiency.
3. Having common social interests as well as work-related interests are important - collaboration deepens over dinner!
4. Be a reliable partner and deliver on time.
5. Plan for time to work jointly in each other's environments - different environments

act as springboards to innovation.

6. Build collaboration around complimentary skills/expertise. This will ensure that an equal scientific/engineering contribution is made over time.
7. Be proactive in identifying the potential that a collaboration holds and driving this to support innovation.
8. Focus on the development of a network to support innovation from early on.
9. Involve industry as early as possible to drive the collaboration into areas of key importance to industry.
10. Collaboration with industry is essential for getting post graduate students prepared for high level technology development and innovation.
11. Involve the Technology Transfer Office to advice on and support protection of intellectual property and to drive the commercialisation of the intervention.
12. Link the collaboration to various areas of mutual benefit.
13. Identify research thrusts where the different environments can be leveraged to produce innovation and advantage.

South Africa

Case Study 2: Decision Support Model (DSM) for the identification of export opportunities

Belgium

The Partners

North-West University (NWU), Potchefstroom, South Africa

University of Antwerp (UA), Antwerp, Belgium

The Department of Trade and Industry (The dti), South Africa

Prof Wilma Viviers, Professor in International Trade and Leader of the TRADE (Trade and Development) research entity in the Faculty of Economic and Management Sciences at the NWU (Right) and **Prof Ludo Cuyvers**, Director of the Centre of ASEAN (Association of South-East Asian Nations Studies) and Emeritus Professor (since 2011) in the Faculty of Applied Economics at the UA. Prof Cuyvers is also the president of the European Institute for Asian Studies, a think tank in Brussels, and a member of the Board of Directors of Flanders Investment and Trade, the Flemish export promotion agency.

How it started

Profs Viviers and Cuyvers first worked together in the early 2000s in a study comparing competitive intelligence practices of exporting companies in South Africa and Flanders.

This collaboration had its roots, somewhat fortuitously, in an earlier study in which Prof Viviers had participated, together with the University of Ottawa and a colleague from IBIS Business and Information Services (a leading competitive intelligence firm in South Africa), involving a comparative analysis of competitive intelligence practices in South Africa and Canada. Prof Viviers and her business partner from IBIS saw an opportunity to use the results of the SA-Canada study (which had been funded by the National Research Foundation [NRF] in South Africa) as a basis for responding to a call to participate in the Flemish Government's Programme for Bilateral Scientific and Technological Cooperation (BSTC) between Flanders and seven priority countries, including South Africa. In order to participate, though, the South Africans had to find a Flemish partner. The Flemish Ministry of the Flemish Community Science, Innovation and Media Department intervened and facilitated contact with Prof Cuyvers at the University of Antwerp. This was the start of a research partnership that is now in its 12th year.

With the joint South Africa and Flemish project team assembled under the direction of Profs Viviers and Cuyvers, the BSTC-funded project got underway. Two members of the Flemish team were Prof Patrick De Pelsmacker from the Antwerp Management School and Prof Marc Jegers from the Free University of Brussels. Both were acknowledged experts in designing and conducting surveys in private companies, including small and medium-sized enterprises, and were also recognised for their expertise in marketing research and industrial economics.

After the successful completion of the four-year project, Profs Viviers and Cuyvers were keen to extend their collaboration, with Prof Viviers showing particular interest in adapting a Decision Support Model (DSM) that had been developed by Prof Cuyvers, for the South African environment. The dearth of quality data on global market opportunities for South African goods and services was well known at the time and was a key factor driving the DSM adaptation idea. The DSM that Prof Cuyvers developed was used to identify realistic and high-potential export opportunities for Belgium with a view to assisting the Belgian government in its export promotion endeavours. The DSM was first applied to Belgium in the early and mid-1990s, with the development and running costs of the model being covered by the Flemish Government, the Flemish Foreign Trade Organisation, and the

University of Antwerp. Prof Cuyvers subsequently also customised the DSM for Thailand and the Philippines.

Support for and results of the collaboration

Profs Viviers and Cuyvers saw the next phase of their collaboration as centring on the refinement of the existing DSM in the face of growing competition and instability in the global trade arena, as well as the application of the DSM to the South African trade environment and, ultimately, the full customisation of the model for South Africa. Prof Viviers approached the dti (South Africa's Department of Trade and Industry) about the proposed initiative and they were (and have since been) very supportive – to the extent of providing funding for the application of the DSM in South Africa in 2007, 2009 and 2010. The dti also offered expert advice that helped to guide the process of updating and refining the model. In addition, Prof Viviers applied to South Africa's NRF for a research grant to be able to, with a group of postgraduate students, develop a unique DSM for South Africa. With the NRF grant approved, Prof Viviers formalised the DSM customisation project with the establishment of an Export Promotion Research Group (EPRG) at the NWU. In July 2012, this group was transformed into an institutional research niche area called TRADE (an acronym for Trade and Development), the new platform for Prof Viviers' unfolding research initiatives in the export promotion and other trade-related fields.

The DSM incorporates a multi-stage filtering system which analyses all countries in the world together with millions of product-country combinations, and through a process of elimination, arrives at the most promising markets for each identified priority product. Complementing the DSM is the DSM Dashboard, which is specialised software developed by Prof Viviers' research team at the NWU to interpret and present the DSM results in an interactive and user-friendly way. While the DSM and the Dashboard are protected by copyright, the only inherent piece of intellectual property is the algorithm that was originally developed by Prof Cuyvers and subsequently used by the NWU to adapt the model for South African circumstances. As a market selection tool, the DSM is in a class of its own, with a thorough literature search (forming part of a PhD study) failing to reveal any similar models elsewhere in the world.

Together, the DSM and the DSM Dashboard constitute a unique offering, and the prospects for broad commercialisation are good. The DSM has a particularly important role to play in the trade policy arena as, by pinpointing high-potential product-country combinations, it helps export promotion officials to prioritise and plan their various initiatives. Already, the dti and several trade promotion organisations e.g. WESGRO (Western Cape Destination Marketing, Investment and Trade Promotion Agency), TIKZN (Trade and Investment KwaZulu-Natal) and the North-West Provincial Government, export councils and industry associations have been using the service to help them identify export opportunities for the regions and/or sectors within their jurisdictions. It can also deliver important input in bilateral or regional free trade negotiations.

The Technology Transfer Office at the NWU has been involved to provide support in the development of the innovation as well as to advice on the commercialisation strategy. Talks are currently underway between Prof Viviers and the dti regarding a proposed update to the DSM for South Africa, using the most recent international trade data and a refreshed software platform. The dti also recently commissioned Prof Viviers and her team to train the newly appointed foreign economic representatives on using the DSM to increase trade between their host countries and South Africa. A key focus area going forward will be to promote awareness of the value of the DSM and to market it to the private sector.

Other outputs of the collaboration

Taking export market selection to a new and more innovative level, the DSM has also given rise to numerous academic outputs, such as PhD theses, Master's dissertations, peer-reviewed journal articles and conference papers. In addition, Profs Viviers and Cuyvers frequently address local and international gatherings on the topics of export promotion and the DSM. A highlight for them both was the publication in 2012 of their book, *Export Promotion – A Decision Support Model Approach,* which has been hailed as ground-breaking and an invaluable reference for academics, government officials and export practitioners.

Challenges in the collaboration

As with many new initiatives, the refinement and adaptation of the DSM over the years has not been without its challenges. On the technical side, for example, a potential stumbling block presented itself in the mid-2000s when it was found that the original measure of trade barriers, which had been used in the Belgian and Thai DSM applications, could not be applied to South Africa. After a couple of attempts to circumvent it, the problem was eventually solved when the NWU's Dr Ermie Steenkamp devised an alternative measure of trade barriers that relied to a large extent on South African data rather than the hitherto broad international data. This was then combined with other market access indicators, paving the way for a DSM that is now fully adapted for the South African trading environment. While the South African-Belgian research partnership has always been characterised by a high level of cooperation and mutual respect, it has been difficult for the partners to meet on a regular basis. Fortunately, at the time they were writing their book on the Decision Support Model, both Prof Viviers and Prof Cuyvers were able to take a sabbatical from their respective universities.

The South African-Belgian collaboration has brought many benefits to the partners. From a South African perspective, it has given rise to much fruitful research and DSM spin-off projects, and made it possible for Prof Viviers to establish the TRADE research entity as the NWU's vehicle for conducting, and disseminating the results of, high level research in international trade. It has also formed the basis of a close working relationship between the NWU and the dti. In 2005, for example, the DSM was mentioned in the dti's *Draft National Export Strategy 2006 – 2009*, while more recently the model has been cited in papers delivered at various workshops and think tanks on South Africa's export strategy framework. Furthermore, the staff and students in the NWU's School of Economics and TRADE research entity have benefited from Prof Cuyvers' knowledge and expertise (particularly in the theory and practice of export promotion),as well as his willingness to act as a mentor. Prof Cuyvers has been appointed an extraordinary professor in TRADE in recognition of the valuable contribution he is making.

The Belgian team has similarly benefited from the partnership - notably, as the beneficiary

of the improvement to/refinements of the DSM for Belgium and Thailand, and the fact that the new runs of the DSM for these countries have spawned many journal articles. In addition, Profs Viviers' and Cuyvers' *Export Promotion* book has raised awareness of Belgium's trade policies and strong research ethic in international trade circles. Prof Cuyvers introduced the book and shared relevant results at both a seminar mostly for representatives of European organisations and Asian diplomatic missions convened by the European Institute for Asian Studies in Brussels in September 2012, and for representatives of the public, private and academic sector in Thailand at the residence of the Belgian Ambassador to Thailand in Bangkok in January 2013. He also incorporated a section on the DSM results into the course material he used for his lectures on International Business Marketing at the International College of the National Institute of Development Administration (NIDA) in Bangkok in May 2013. Based on this material, the Thai students then prepared product case studies, of which two appeared as ASEAN business case studies at the University of Antwerp's Centre for ASEAN Studies.

Key Success Factors and Good Practices

1. A partnership that is based on trust and commitment. Because of this kind of professional relationship, potential reasons for disagreements didn't arise, or were discussed and eliminated before they arose.
2. The partnership must be built around mutual benefit and shared passion for the work.
3. A strong belief in the power of multi-disciplinary teams to breathe life into new initiatives.
4. Focusing efforts around the development of the innovation e.g. through the establishment of an institutionally recognized niche area.
5. Having a cohort of master's and doctoral students who have made the DSM and its many manifestations pivotal to their research activities.
6. Involving other stakeholders including decision makers as partners in the research and further development was essential to ensure relevance, focus and buy-in.

7. Making use of institutional support structures such as the Technology Transfer Office to provide support and advice.
8. Partners to jointly set targets and time lines.
9. Clarify roles and responsibilities early on in the collaboration e.g. decide who will deal with the overall organization and management of the team's work.
10. Create opportunities for focused time to work together face-to-face e.g. through sabbatical leave periods.

South Africa

Case Study 3: Development of novel drugs and diagnostics for diabetes

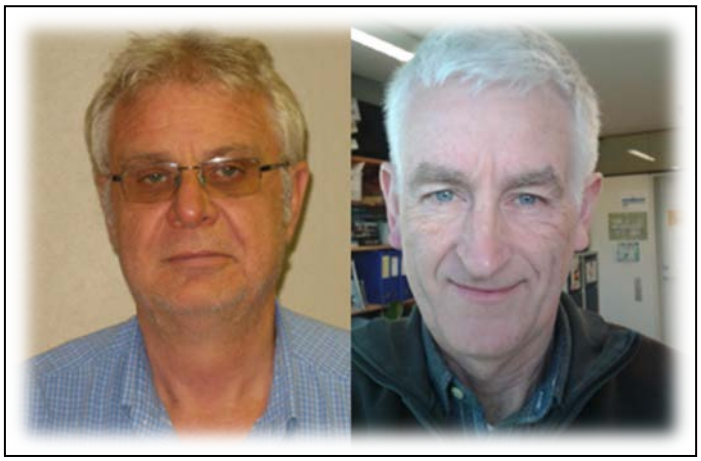
Denmark

The Partners

South African Medical Research Council (MRC), Cape Town, South Africa

University of Southern Denmark (SDU), Odense, Denmark

Biomedical Company, Denmark (anonymous on request)



Dr Johan Louw (Left), Director of the Diabetes Discovery Platform at the MRC (a statutory body that funds and conducts research into pressing health issues) in South Africa. Dr Louw is also a member of the Management Committee of the Global Alliance for Chronic Diseases (GACD) that is hosted by the University of Central London. Associate **Prof Stephen (Steve) Fey** (Right) is the Head of Research at the Tissue Culture Engineering Laboratory in the Department of Biochemistry and Molecular Biology (BMB) at SDU. The BMB possess one of the largest mass spectrometer facilities in Europe.

How it started

The collaboration was initiated in 2006 when Dr Louw met Prof Fey at a conference in Denmark. They realised that they had complementary expertise and skills. Dr Louw was working on both the development of biomarkers for the diagnosis of diabetes and the development of novel compounds from plant extracts for the treatment of diabetes. The

MRC also had facilities to do cellular work and testing in various animal models including a primate diabetes model. Prof Fey and his group at SDU had been working on diabetes using rat and in vitro models for many years and had developed expertise and state-of-the-art facilities in proteomics. Based on the data that they had available the partners jointly searched for funding to support their collaborative work.

Support for and results of the collaboration

In South Africa the Cape Biotech Trust was approached and initially agreed to invest approximately R5 million (€365,000). However, this funding was never ratified even though a matching investment was offered from Denmark by a private investor. At the conclusion of the negotiations, the private investor in Denmark agreed to setup a Biotechnology company to fund the research and development. The research plan had two primary goals. The first was to find a diagnostic marker which could diagnose diabetes at a very early stage (before irreparable damage is done to the insulin producing islets and thus before clinical symptoms become evident). The second was to explore novel plant-based or plant-derived compounds for the treatment of diabetes based on unpublished observations of the effects of indigenous plants made by Dr Louw and colleagues at the ARC.

The Danish company has invested a total of R87 million (€6,400,000) over the last seven years. Approximately 60% of the funding was spent on the research that was done in South Africa.

The research in diabetes treatment has delivered four patents on novel compounds from plant origin. These compounds work in a specific pathway that protects the pancreatic beta cells under diabetic conditions. The intellectual property belongs to the Danish Biotechnology company and a royalty agreement was set-up in 2008. Two scientists from the MRC and one from the Agricultural Research Council (ARC) in South Africa and three scientists from Denmark were included as inventors on the patents. The ARC produced the plant extracts that were used to isolate the novel compounds. The collaborative efforts were focussed and it effectively took 7 years from isolation to producing novel compounds that were patentable.

Although not directly involved in the innovation, Prof Luc Bouwens, Head of the Cell Differentiation Lab at the Vrije University of Brussels in Belgium, was also involved in the research. He specialises in cell differentiation and tissue regeneration in the pancreas beta cells and has access to human beta cells. This significantly reduced the time spent on testing the compounds since they could be tested on human cells at an early stage. Prof Bouwens and Dr Louw have been collaborating for over 20 years.

The Danish company is currently in discussion with an innovation-driven international biopharmaceutical company specialising in the discovery, development, manufacturing and marketing of prescription medicines to include one of the compounds in one of their programmes to develop it further. Another compound that is being considered as a potential anti-diabetic drug will be developed for application in South Africa and a first licensing agreement has been signed in this regard.

The research focusing on biomarkers for pre-screening and personalised treatment has not delivered any patents yet. Approximately 110 proteins and have been identified of which 30-40 proteins are currently being validated as drug targets and 15 candidate markers have been selected as for diabetes screening. Due diligence is currently in process to decide on the best options to move forward in this area of the collaboration.

Dr Louw only uses postdoctoral researchers in his projects. This is because they are experienced and able to deliver on strict deadlines. During the interview Dr Louw mentioned that he was impressed by the innovative mind-set of postgraduate students at the SDU and that he is of the opinion that we need to do more in South Africa to prepare our students to be innovators. SDU is an innovation driven institution and exposes their students from an early stage to innovation by including relevant modules in the curriculum, bringing successful entrepreneurs to the campus to talk to students, having innovation competitions etc. Students should be taught not only to be academically orientated but to be able to think differently about the knowledge that they produce and to question what it means.

Challenges in the collaboration

Even though the collaboration has been very productive there were some challenges. The biggest challenge for both partners was the geographical distance. This was particularly challenging during the first two years when relationships and trust had to be built. There were two to three face-to-face meetings arranged per year in either Denmark or South Africa that made it easier to deal with this challenge. At these meetings both the scientific steering committee and the business committees were present and team members had to give feedback, data were audited, issues cleared and the research for the coming months planned. In between these meetings technology (e-mail, Skype) was used to communicate.

During the early days of the collaboration the South African partner felt as if he had to prove himself and the quality of his work. This notwithstanding the fact that funding, and by implication confidence in the expertise and quality of work, had been committed. Looking back this actually was not negative but instead provided a good learning experience and contributed to more stringent quality assurance measures on the side of the MRC to ensure integrity of data and other deliverables.

Particular challenges for European partner was that the complexity of running experiments involving monkeys had been seriously underestimated so that the initial work took about a year longer than initially anticipated. The importance of frequent communication was not fully appreciated by either partner. It was found that even in the situations where the research at either end was running according to plan, the need for frequent short meetings were initially neglected. Teams (often 2-4 persons) were sent from the Danish labs down to Cape Town for up to a month at a time. They were always very well looked after and Dr. Louw frequently assisted in making special trips for the personnel. This really was greatly appreciated and helped to build a terrific team spirit. These trips were not in the original budget but were an excellent investment because the teams were really dedicated and often put in 12-14hr long days when required. Looking back, the partners would have committed one person full time for project coordination and documentation as a ‘resource’ for the leading researchers of both groups.

The partners feel that they were extremely privileged in this research project: they had good funding over an extended time span and had unique experiences at both sites. It takes time to get to know someone, to learn the details of their research area so that the discussions can be real discussions and not simply presentations. The time needed for this depends upon the scope and complexity of the project. In this case both were very significant.

Other outputs/benefits of the collaboration

The collaboration benefitted the MRC and South Africa more broadly than the innovation and its potential applications. The trust and confidence that was built resulted in the MRC team being requested to contribute in other areas of the research, including pharmacokinetic studies that were not originally included in the scope of work. The CEO of the Danish Biotechnology company visited South Africa recently to amend the collaboration agreement so that the current collaboration can be expanded and more funders can be involved in further work. The laboratory infrastructure and facilities at the MRC were largely developed through the Danish investment and know-how. As a result of the state-of-the-art facilities and equipment at the MRC is much more productively used and is competitive with other laboratories. It is also envisaged that other units in the MRC will in future have the opportunity to do work for the Danish company in other areas.

The Biotechnology company is also in the process of drafting contracts with other private companies around the Western Cape. This will result in increased foreign investment in the country and will offer local companies the opportunity to collaborate internationally. The initial collaboration and the trust that was built during this collaboration therefore laid the foundation for many spin-off activities.

The benefit of the collaboration for the Danish collaborator includes access to facilities and expertise not available in Europe (e.g. the monkey colony and indigenous plants). Another advantage was that from the Danish side they were able to share the MRC expertise in primatology, while from the South African side, they were able to work at a cellular level using cutting edge technology. This is a valuable synergy – it has allowed the team to

'simplify the task' when needed (or ethically necessary) by carrying out work in vitro and then to 'return' to the whole organism to maintain the relevance of the research to human health.

Interestingly, the strength of the South African participants was built on close collaboration between the ARC and MRC researchers, which paralleled the collaboration established in Odense by bringing two leading Danish research groups together at SDU (in protein separation and in protein analysis). The most important benefit of all is that both groups have added 'strings to their bows' – or strengthened their scientific networks so that they know where to go to get a reliable answer to research challenges outside their own field. Another illustration of the benefit is that the collaborative research is continuing today. The intensity has increased and decreased as funding has been available but the research goes on.

Key Success Factors and Good Practices

1. Trust between partners. It is essential for this trust to be established as early as possible. Any collaboration is a union where relationships have to be built and maintained. When trust exists many issues that are potentially harmful to the collaboration can be solved.
2. Having long-term funding to support the work.
3. Ensure that you always deliver data of the highest quality and on the agreed time.
4. Investors do not want to fund merely a good idea. They want to see results that can convince them that it is worthwhile to invest. Build your case around promising data that already exist. By the time that the partners approached the Danish investor they already had worked together and had data that was produced from experimental work funded by grants typically from the government or research institutions.
5. Seek out people who have been successful in innovation in the area you are working in and learn from their experience.

6. Stay focussed on meeting strict milestones. Scientists are naturally driven by curiosity and can therefore easily be distracted. Scientists are also very optimistic and often estimate that things can be done faster than they actually can.
7. Train the next generation of innovators to think differently about their research results from the early stages of university life.
8. Younger scientists should be encouraged to work on major challenges: these are where the stiffest competition will be, but also the most exciting work will be done.
9. Exchanges should be encouraged: a single student can bring a new technology into a lab, or learn all the technologies at a host lab and then bring them home. These exchanges should be for at least 3 – 12 months (depending on the goals) so that the exchange candidates have the chance to establish lasting friendships with persons at the host institutions. These exchanges should be at all levels: from sabbaticals for mature researchers to the exchange of PhD. students who need a particular technique for their projects.
10. Technology breeds technology: science is a long-term investment and so there has to be a framework where the scientist can build up his reputation and which allows him to plan on a longer and longer timescale and be bolder and bolder. An experienced scientist's time should not be wasted on continually having to make short term grant applications, but on few longer term ones

South Africa

Case Study 4: Chemically modified siRNAs to inhibit Hepatitis B virus replication

Germany

The Partners

University of Witwatersrand (WITS), Johannesburg, South Africa

Johann Wolfgang Goethe-Universität (JWGU), Frankfurt, Germany

Professor Patrick Arbuthnot (Left), is the Founder and Director of the Antiviral Gene Therapy Research Unit in the Department of Molecular Medicine & Haematology, WITS, with expertise in the biology of hepatitis B virus (HBV) infection and the efficacy of candidate anti-HBV drugs. Professor Arbuthnot partnered with **Professor Joachim Engels** (Right), an expert in the field of nucleic acid chemistry and a Professor of the Organic Chemistry and Chemical Biology Department, JWGU. Professor Engels was the speaker of the RNA-Ligand-Interactions Collaborative Research Centre (supported by the German Research Foundation - Deutsche Forschungsgemeinschaft (DFG)) between 2001 and 2007, as well as the President of the International Society of Nucleosides, Nucleotides and Nucleic Acids during the period 2005-2006. He retired from JWGU in 2014.

How it started

The partnership between Prof Arbuthnot and Prof Engels was established in 2006 during a European Commission-funded Framework 6 (FP6) project, the “RNA Interference Technology for Human Therapy” commonly known as the RiGHT project, which ran for six

years (2004-2009). The project consortium consisted of approximately 23 European research groups (one of which was Prof Engels) as well as a South African group (Prof Arbuthnot's research group), which represented a developing country. The aim of the work of the RiGHT consortium was to develop RNA interference as a mode of treating human diseases in general.

The need to develop more efficient modes of treating the persistent Hepatitis B virus (which is of particular importance to sub-Saharan Africa, east and south-east Asia) was an interest held by both the South African and German research groups, as current therapy is inadequate. Treating HBV using RNAi became one of the major focuses towards the end of the tenure of the FP6 project. Thus, the research groups from WITS and JWGU decided to continue with this aspect of the research project after the tenure of the FP6 grant had run its course.

Support and results of the collaboration

The aim of the research collaboration between WITS and JWGU was to develop chemically modified siRNAs to inhibit the replication of the Hepatitis B virus. The project was supported financially by both South African and German government agencies during the period 2010-2014; WITS was supported by the National Research Foundation (NRF) and JWGU by the Deutsche Forschungsgemeinschaft (DFG). Both the NRF and DFG play similar roles in their respective countries, by supporting university research and fostering international research collaborations. The project received a total of R2 million in funding, of which the DFG contributed €10000.

The JWGU research group worked on the synthesis and characterization of cationic modified oligonucleotides. This comprised the series of 2´-modified guanidinoethyl and secondly guanidinopropyl derivatized building blocks of all 4 nucleotides. With these in hand they were able to synthesize the most promising siRNA candidates developed by the WITS group. The WITS group were then able to test the efficacy of the chemically modified siRNA in vitro and in-vivo. The nature of the new antiviral agents required rigorous characterisation using several models of HBV infection. The modification of the silencing molecules and their

application to disabling HBV infection were considered to be novel. The results showed that the chemically modified antiviral agents were less toxic, more effective, stable and specific than their unmodified counterparts against HBV.

The collaboration resulted in an international patent application being filed, with IP emanating from the project being jointly owned by WITS and JWGU. The Technology Transfer office at WITS i.e. WITS Enterprise was primarily responsible for filing of the PCT application on behalf of both universities. Favourable PCT reviews were received, however as the filing progressed to national phases, it was decided not to further pursue the application. This was mainly due to some concerns about the ability of the candidate drug to be an improved cure for HBV, as the silencing technology developed in the project was as effective, but not better, than drugs that were available on the market at the time. The other reason related to the high costs involved in the patent application process, as weighed against the likelihood that the technology could be viably commercialised.

The strength of the partnership was that the two groups had complementary skills from very different disciplines. Prof Engels and his team are chemists, while the SA team had skills in medically applied molecular biology. This was a synergistic relationship and the innovation equally derived from both the partners.

Challenges in the collaboration

The administrative aspect of the collaboration ran smoothly because roles, responsibilities and timelines were discussed and agreed upon at the outset of the project. The JWGU group expressed that in the beginning of the collaboration the main challenge was gaining an understanding of the depth of expertise of both research groups and developing a sound project proposal. As the project progressed the main challenges were of a technical nature. In particular, handling chemicals is the traditional expertise of big Pharma companies and the main challenge faced by the research groups was the delivery method of the synthetic siRNAs to the target liver cells (hepatocytes) where the virus causes the infection. In order to address this challenge research expertise were sought from Professor Daniel Scherman, the Class Director of the Centre National de la Recherche Scientifique

(CNRS) in France. Professor Scherman is a leading researcher in the areas of drug delivery and targeting, gene therapy, and non-viral gene delivery. He assisted the team with the delivery of the siRNAs using lipoplexes.

Other outputs of the collaboration

Further to the PCT application, the research collaboration resulted in three peer-reviewed research papers published between 2012 and 2015 in the Journals of Controlled Release and the Elsevier Journal Bioorganic & Medical Chemistry. Research presentations, in oral and poster format, were made at the annual American Society for Gene and Cells Therapy (ASGCT) and the European Society for Gene and Cell Therapy (ESGCT) meetings. The research on the South African side was mainly carried out by a PhD student (Mr. Musa Marimari), who is expected to graduate at the end of 2015. Valuable insights were gained from both research groups, broadening the scope of their knowledge and skills beyond their own fields of research expertise.

Whilst the collaboration between WITS and JWGU has ended (due to Professor Engels retiring), the WITS group have continued with the research, however they have shifted the focus of the research to gene editing as the means to eradicate HBV from carriers of the virus. This work is being carried out in partnership with large pharma in the United States.

Key Success Factors and Good Practices

1. Finding a research partner with the right level of expertise to match or complement your own skills.
2. Developing an understanding of your partner's expertise right from the outset.
3. Trusting in your partner's expertise and developing a good professional relationship is important.
4. Developing a sound proposal as well as commitment of both parties to meeting of milestones.
5. Mutual understanding and agreement of critical aspects of the project such as quality control procedures.

6. The partnership should be developed on the basis that there is mutual interest and benefit as well as involve development of different but complementary skills.
7. Effective and frequent communication is essential. Travel exchanges between partners' institutions are necessary especially in the beginning when establishing the foundation of the research programme. Furthermore, the use of programmes such as Skype is an effective tool to communicate long distance.
8. The partnership needs to be open and free of any discord. Managing these aspects is essential for productivity.
9. Efficient running of the partnership from an administrative perspective. Roles and responsibilities of individual partners need to be clearly understood from the beginning.

South Africa

Case Study 5: Biocidal Product Registration for the European market

Netherlands

The Partners

Biodx, Johannesburg, South Africa

TNO Triskelion (TNO), Utrecht, Netherlands

Mr. Humberto Rodrigues (right) is the CEO of Biodx, a South African biotechnology company that develops biological control products' for the food & beverage, industrial, agricultural and pharmaceutical industries, using a patented technology. Mr Rodrigues was initially introduced to TNO Triskelion, based in the Netherlands, through **Mr. Richard Artsen** (centre), Commercial Manager, and later, **Ms. Franziska Schurz** (right), Project Manager for TNO. TNO provides detailed studies on product corrosion, efficacy, environmental and safety testing and consulting services to the food, drug and chemicals industries in Europe. TNO reports are used to build the product dossier for the technology recently patented taking into consideration the requirements of various biocide Product Types intended for registration in the EU.

How it started

The partnership between Biodx and TNO was established in 2012, when Biodx was looking to enter the European market. In order to sell their products on the European market, they needed to meet the European Union's stringent regulatory requirements for product registration in the Biocides Product Directive. In particular, they needed to produce a complete Material Safety Data Sheet (MSDS) and carry out scientific studies to prove that a new compound has been developed as part of the Technical Dossier. In search of a European partner to assist with the necessary laboratory testing of Biodx's products as required for the Dossier, Biodx decided to approach TNO. TNO was chosen because their analytical testing services are widely accepted across all member countries of the European Union, with Sweden being the only exception. TNO also has strong links to the Board for the Authorisation of Plant Protection Products and Biocides (Ctgb), the Netherlands Regulatory Body that is evaluating the Biodx product dossier for approval. A number of professionals on the Ctgb panel currently accessing Biodx, are also directly involved in the working groups advising on legislative compliance.

Support and results of the collaboration

In 2005, Biodx joined EgoliBIO, a government funded technology incubator. It received R40K from EgoliBio for operational business start-up costs as well as access to the Incubator's international linkages and business coaching. Biodx graduated from the incubation programme in 2009. During this time however, Biodx managed to secure R500k in funding form the Department of Trade and Industry's SPII fund to establish a proof of concept for its products. Research and development of these products were outsourced (on a full cost basis) to the South African Council for Scientific and Industrial Research (CSIR).

Product development and testing took place between 2006 and 2009 and resulted in four products being developed:

- *Agridx* – used to decontaminate soil before planting, and as a postharvest disinfectant bath or spray for fresh produce.

- *Nutridx* - mild organic disinfectant, which can be used to sterilize food processing equipment as well as hard surfaces. It fulfils food grade specifications and thus can be used as a bath for fruit, vegetables and other hard- and complete-skinned foods.
- *Vitrodx*- suitable for disinfecting and sterilizing steel, vinyl, ceramic and painted surfaces, as well as medical and critical equipment on internal and external surfaces.
- *Industdx* - designed for use as a preservative in the production of formulated detergents, detergent-disinfectants or products prone to microbial contamination.

Laboratory and field trials were conducted in 2010 and 2011 with Tongaat Hulett, ESKOM, Just Lamb and Bull Brand. Biodx has registered *Industdx* in South Africa and started selling its product locally in September 2015. In order to sell its other products to the food and health industries in South Africa, a NRCS certificate is required. They are currently in the process of obtaining this certificate. Furthermore, a worldwide patent application was submitted in 2015 though Adams & Adams in South Africa for another formulated product and process.

Each of the products developed by Biodx requires a MSDS which is compulsory for chemical products to be registered in the country in which it is intended to be sold. In South Africa, the MSDS is also required, however the South African Bureau of Standards (SABS) does not have the capacity to carry out all of the testing required, in particular sections 8 (Exposure Control/Personal Protection), 11 (Toxicological information) and 12 (Ecological information) of the MSDS. A partnership with TNO was therefore critical to assist Biodx with the necessary testing required to complete the MSDS. Biodx received financial assistance (R6 million) from the Technology Innovation Agency in South Africa for the analytical testing required for dossier development and product registration in Europe. TNO was able to carry out the necessary testing through its *in-vitro* and *in-vivo* laboratories. TNO has completed testing for section 8 of the MSDS and is currently in the process of testing for sections 11 and 12. Once this is completed, the Technical Dossier can then be submitted to the necessary regulatory authority for approval.

The Technology Innovation Agency did not only assist Biodx with financial assistance but also with providing strategic guidance to the company through its requirements for good

governance. Biodx has now established the necessary policies and procedures to run its company more efficiently and in line with a code of good governance using KING III as a basis.

Challenges in the collaboration

The key challenges experienced during the collaboration by TNO were: (i) Promoting the understanding of the European Union system of registering biocidal substances to Biodx (ii) Dependency on timely shipment of materials from South Africa to Europe, and (iii) Communication with a company from South Africa with a different business culture. On the South African side, Biodx indicated that communication distance was a challenge in establishing a good relationship and understanding the Dutch business environment. The cost of doing business in the Netherlands was a further challenge and very different from South Africa. Of note was (i) application costs to the Ctgb (the SABS equivalent in the Netherlands) is approximately €25000, whereas in South Africa submission to the SABS is free, and (ii) complex and stringent regulatory requirements in Europe - this was indicated by the number of pages in the Technical Dossier i.e. approximately 100 pages required in South Africa versus 1000 pages in Europe.

Other outputs of the collaboration

The value derived for TNO from its relationship with Bidox included:

- Involvement in the development of an innovative biocidal product, resulting in a strengthening of TNO's business proposition. In Europe there are three categories in which one can register such a product. TNO assisted Biodx with arranging a pre-submission meeting with the ctgb to deciding which category was most suitable and developed the analytical methods required for testing the products for that particular category.
- Additional work for TNO as a company: both consulting and testing.
- A better understanding of the South African regulatory and general business environment. TNO currently has two clients in South Africa and understanding the South African environment will allow them to attract more South African clients.

For Biodx, its relationship with TNO has attracted commercial links in the Netherlands. Biodx intends to pursue these links once it has registered its products in Europe. Furthermore, the relationship with TNO has resulted in easier access to the European regulator which might not have been achieved by Biodx alone.

Key Success Factors and Good Practices

1. Open communication on both sides and establishing a good relationship. Face to face meetings are critical in building relationships. These should take place at least three times a year.
2. Understanding and accommodating cultural differences, especially how each country conducts business. It was notable that European partners are strict on protocols and good governance and will not step outside of the practice codes, setting a sound business example.
3. Establishing a good relationship with regulatory authorities to prevent legislation getting in the way of business development.
4. Communication of and adherence to clear targets for both partners of the collaboration
5. Strategic planning: ensure additional communication time and additional costs in the start-up phase to overcome communication difficulties and cultural differences.
6. Finding the right partner in Europe that is strategically networked to allow for access to regulators, potential commercialisation partners and one that can provide guidance in understanding the costs involved in registering products in Europe.
7. Ensure that you keep to contractual arrangements especially with regards to payments of services and other fees as may be required.
8. Ensure that you are thoroughly prepared for meetings to maximise value out of contact time between partners.

Summary of Innovation Collaboration Drivers, Success Factors and Good Practices

From the case studies the following factors can be identified as **drivers** for the collaboration:

- **Complimentary skills, expertise and facilities.** This was an important driver in all of the cases. As an example, in Case 3 the South African partner could work at cellular level using cutting-edge technology while the Danish partner had access to indigenous plants and facilities and expertise in primatology. In Case 5, development of products were undertaken in South Africa, however product testing took place in Europe as South Africa did not have the required in-vivo testing facilities or adequate appreciation of the regulatory requirements to launch the product in Europe.

- **The need to make the results of the joint research useful.** In Case 1 for example there was a drive to generate knowledge and expertise to develop technology for the manufacturing industry. In Case 2 there was a desire to continue the collaboration after the conclusion of other successful projects but to focus now on the development of a unique solution for the export industry. In Case 3 the vision was the development of novel compounds for the diagnosis and treatment of diabetes. In Case 4, the aim was to develop a chemically modified agent to treat and cure the Hepatitis B virus. In Case 5, the purpose of the collaboration was to ensure that the biological control products passed all the required testing in order for them to be registered in Europe, thus facilitating expansion into that market.

- **Advancing competitiveness.** In Case 1 for example the development of the FSW platform provided the South African partner with advanced capability to explore new applications for the technology and to facilitate the transition of the technology from

the laboratory to the industry environment. In Case 2 the ultimate goal of the DSM is to advance the competitiveness in the area of export for South Africa, Belgium and the other countries involved. In Case 3 the infrastructure and state-of-the-art facilities that were developed in South Africa through the collaboration made the MRC much more productive and competitive. For both research groups in Case 4, the collaboration resulted in broadening of knowledge and skills beyond their own fields of research expertise, enhancing their competitiveness as research groups and facilitating the building of additional collaboration relationships. In the last case, the goal of the South African company was to successfully register and export products to the European market and provided the company with experience in dealing with the stringent EU regulatory requirements. The collaboration also allowed the European partner to develop new analytical testing methods and provided them with an opportunity to gain better insights into the South African business and legislative environment enhancing their competitiveness to attract more South African clients.

- **Funding.** For Cases 2 and 4 the initial driver for the collaboration was existing European funding programmes, the Belgium programme and FP6 respectively. The Belgian programme offered access to priority countries that included South Africa. The South African partner, who was interested to explore this funding opportunity, was forced to seek out the best and most appropriate partner in Belgium. For the FP6 programme, over 23 European research groups jointly participated, with South Africa being the only non-European participant. In both cases, the joint research that was done in the context of the Programmes, was the foundation for further extended and fruitful collaboration. In Cases 1 and 3 the collaboration started bottom-up, where two individuals met, realised that they had complementary skills and a shared vision for their research and development. For Case 5, an appropriate European partner was strategically sought out and funding was then secured from a South African funding organisation to support the project, basis the complementarity of the relationship between the partners.

Below is a summary of the **success factors and good practices** in innovation collaboration from the case studies presented in the report. These could be grouped into four main dimensions that are interdependent:

Interaction, Behaviour and Conduct	• Sufficient trust between the partners helps to openly define and communicate interests, fosters the sharing of resources and encourage behaviour that are in the best interest of all involved. • Personal commitment and passion. • Regular and open communication. • Being reliable and delivering quality work within agreed time lines. • Socialisation fosters the development of new ideas. • Be prepared to learn from others who have been successful in innovating and share your success stories with others. • Proactively identify the innovative potential of the collaboration. • Understand and accommodate cultural and regulatory environment differences

Collaboration	• Sufficient common interest in the innovation. • Set joint targets, milestones and vision. • Build the collaboration around mutual benefit. • Build the collaboration around complementary resources including skills and expertise, funding and infrastructure. • Sufficient funding to support the research, development and early stage commercialisation.

	• Sufficient opportunity for face-to-face discussion and research. • Develop a network to support the innovation – the right people make all the difference. • Build cases for support towards the innovation on evidence. • Try to contribute wider than the planned innovation to develop and build the partnership.

Organisational	• An enabling environment for innovation including supporting organisational frameworks, willingness to take risks, expert advice on and support for innovation and technology transfer.

Technology Transfer	• Expertise and support to conduct a due diligence process to ensure that the technology is ready for commercialisation. • Assessment of the market potential of the technology/service. • Funding for late stage development and early stage commercialisation. • Taking the technology out of the academic environment through the creation of a spin-off company to take the technology further. • Understanding the costs and regulatory requirements associated with commercialisation of technologies

Framework Conditions for Successful Cross Border Innovation and related Policy Considerations

International collaboration is a key component of the concept of systems of innovation. It results in the flow and exchange of information, knowledge, technologies and capital as well as the development of critical skills and capabilities required for the creation and exploitation of Intellectual Property that fulfils a market and/or social need.

From the case studies above, and the success factors identified, the following framework conditions are identified as being key to supporting successful innovation, especially in terms of innovations where collaborative relationships were established between South African and EU based partners:.

1. Instruments to promote linkages that assist in identifying and consummating synergistic collaborative partnerships, based on a complementarity of skills, expertise and resources, where the outcomes of the collaboration are clear and directed towards new products and services in the market.
2. Focussed, well geared institutional support mechanisms - in the case of research organisations these include formalised technology transfer capabilities.
3. Funding support that spans the research through to commercialisation aspects of the innovation value chain.
4. A stronger emphasis on market-pull, rather than reliance on technology push. This emphasis should pervade instruments to support creation of linkages/partnerships, as well as funding instruments.

It is vital that governments ensure that appropriate policies are in place to promote and support such exchanges, and as such this leads to some key policy considerations and questions. What was insightful from the case study exercise is that there is a limited

number of case studies of joint research and/or innovation directed projects from which we could draw, yet the benefits of the collaborations is clear. Thus it would appear that there is a real opportunity to increase the impact of supportive policy instruments' focus on identifying and facilitating such collaborative initiatives. Specific additional policy considerations include:

Promoting linkages: Policies aimed at fostering linkages between research institutions and industry is essential for both developing technological capabilities (which is a driver for foreign direct investment) and creating more of a market pull instead of a technology push for technologies, should be strengthened. These will help to catalyse many more value adding, synergistic collaborative projects, yielding positive outcomes for the national system of innovation in each partner, but also collaborative innovation successes between the partners. Furthermore, the instruments supporting such linkages should be strongly promoted to ensure awareness amongst researchers and innovators. The South African landscape report (a deliverable of the ESASTAP PLUS project) provided a summary of key players in the South African landscape, and from a policy perspective, these should be analysed to identify which can be strengthened to promote the linkages as described here. The same should be done on the European end.

Funding: Appropriate mechanisms need to be considered to ensure that there is a sufficient pool of funds available for research and development as well as commercialisation activities from both South Africa and EU countries. The levels of funding for especially applied/directed research and early commercialisation activities need to be increased, to enable appropriate resourcing of collaborative projects. Funding instruments need to be analysed and if necessary revised/augmented so that they are well geared to well support these types of collaborative relationships, including ensuring that outputs funded, and reporting required, is aligned with the collaboration imperatives.

Strengthening the capacity of Institutional support mechanisms, e.g. Technology Transfer Offices (TTOs): From a policy perspective, a consideration would be to assess the levels of readiness and institutional capabilities, specifically in terms of TTO's, which play a

critical role in ensuring that IP emanating from research collaborations is adequately protected and managed and that maximum value is derived from the commercialisation thereof. It is quite possible that some of the above mentioned interventions could be better supported, if TTOs have sufficient capacity to advise and directly support researcher's and innovator's efforts to find suitably collaboration opportunities, funding, and regulatory players/bodies.

Strengthening linkages between local and international regulatory bodies: The EU has strict regulations on certain products entering the European market. This process is often viewed as complicated and onerous especially to South African SME's and can be a barrier to enter this market. Policies aimed at assisting SME's with meeting EU regulatory requirements could lower this barrier to entry. One way is to strengthen the linkages between regulatory bodies.

Annexure A

Establishing best practice in innovation collaboration between South Africa and Europe: Request for information towards the development of case studies on best practice in innovation collaboration

Background and Context: The Southern African Research and Innovation Management Association (SARIMA), has been requested to facilitate the development of case studies that are aimed at identifying, and better understanding, best practices in respect of ongoing innovation collaboration between South Africa (SA) and the European Union (EU). In particular, the studies are intended to provide information on SA/EU innovation collaboration commencing in 1996 to date, under the banner of the EU Framework Programmes and ESASTAP Plus. ESASTAP stakeholders are hereby requested to provide information to assist in the development of case studies on innovation collaboration between South Africa and Europe, over the period 1996 to 2013.

About ESASTAP Plus: ESASTAP Plus, (grant no 312015), is a project that aims to support the deepening of scientific and technological cooperation between SA and Europe, with a special focus on innovation. The project is supported by the European Commission under the Seventh Framework Programme, and builds on the results of ESASTAP2. The South African project consortium includes: the Department of Science and Technology (DST), SARIMA and the Academy of Science of South Africa (ASSAf). European consortium partners include: and the Agency for the Promotion of the European Research (APRE), Projekt trägerim Deutschen ZentrumfürLuft- und Raumfahrt (PT-DLR), L'Institut de recherche pour le développement (IRD), KiNNO Consultants Ltd and Euresearch in Europe. The project is coordinated by the PRAXI Network, (i.e. the HELP-FORWARD Hellenic Project for Wider Application of R&D), in Greece. Over the next 3 years, the consortium will work on various initiatives to, among other things, enrich the science, technology and innovation policy dialogue between South Africa and Europe; promote strategic cooperation primarily through Horizon 2020; better coordinate and exploit

synergy between EU and national programmes; as well as, to expand South African-European cooperation in addressing innovation partnerships.

About SARIMA: SARIMA is a voluntary association of research, technology transfer and innovation management professionals that functions as a community of practice in the interests of professional development and capacity building of those involved in managing research and/or innovation. Among its core objectives, are the promotion of best practice in the management, administration and support of research and innovation to create value for education, public benefit and economic development in the Southern African region. One of the main ESASTAP Plus activities that SARIMA is involved in relates to supporting innovation collaboration between South Africa and Europe. One aspect of this activity is to support innovation collaboration through short-term exchanges between technology transfer (TT) Professionals in SA and Europe and input on this aspect was solicited from the TT Community earlier. A second aspect linked to this activity is to identify and share best practices in innovation collaboration between South African and European researchers. To do this SARIMA is to formulate case studies through engagement with stakeholders from which best practices can be extracted and shared, both in South Africa and Europe. The case studies should meet the following guidelines:

A long-term research collaboration that has led to specific research outputs OR a collaboration that was set-up to drive innovation. 2) The collaboration can be between different types of partners e.g. between public institutions, between public institutions and industry etc. We are seeking various examples of innovation collaborations. 3) The case study should reflect the perceptions of both the South African and the European partner(s) 4) In addition to providing some background on the partners from South Africa and Europe, the case study should ideally address the following questions:

(a) Why and how was the collaboration initiated (e.g. to solve a specific policy and/or industry problem)? When was the collaboration initiated?
(b) What was the nature of the collaboration initially and how has it evolved over time?

(c) How long did it take to develop the collaboration to the point that it resulted in an innovation?

(d) Have both partners participated in the innovation or has it been primarily one partner?

(e) What were some of the challenges in the various stages of the collaboration?

(f) What is each partner's view on the value that the collaboration has brought to each of them?

(g) What are the key success factors in establishing sustainable innovation collaborations?

(h) Please summarise the good practices from your own collaboration that can be used by others to successfully foster sustainable innovation collaboration.

Some TT relevant questions will be asked but please note that we do not want specifics, but rather "categories" where applicable.

(i) Which partners / funders / financiers provided financial resources for the research undertaken? How were these partners engaged?

(j) What were the IP outputs of the collaboration?

(k) Was there engagement with industry as part of the research efforts (prior, during, on completion)? If so, what was the nature of such engagements?

(l) Was any market information relevant to the innovation sourced / utilised during the collaboration? What kind of market information was used?

(m) Where market need (pull) factors considered when proposing and undertaking the research and if so what type of factors were considered?

(n) What due diligence steps (if any) were undertaken to assess the commercial prospects of the research outputs? What tools were used for the DD?

(o) What IP protection was utilised during the collaboration? Was there an IP management strategy developed for the research / collaboration?

(p) What tools were used to identify / assess IP developed during the research / collaboration?

(q) Which partners / funders / financiers were considered / participated in the technology commercialisation phase? How were these partners engaged?

(r) Which partners / funders / financiers were considered / participated in the commercialisation phase? How were these partners engaged?

Acknowledgements

SARIMA wishes to acknowledge the individuals who devoted time to share their cases. They are:

- Prof Danie Hattingh, Professor in Mechanical Engineering and Director of eNtsa at the Nelson Mandela Metropolitan University (NMMU) in South Africa.
- Jaci Barnett, Director of Innovation Support and Technology Transfer, NMMU, South Africa.
- Prof Neil James, Head of the School of Marine Science and Engineering and Associate Dean at the University of Plymouth in the United Kingdom.
- Prof Wilma Viviers, Research professor and Director of TRADE (Trade and Development) Niche Area at the North-West University (NWU) in South Africa.
- Dr Rudi van der Walt, Director of Innovation and Technology Transfer at the NWU in South Africa.
- Prof Ludo Cuyvers, Director of the Centre of ASEAN and Emeritus Professor at the University of Antwerp.
- Dr Johan Louw, Director of the Diabetes Discovery Platform at the Medical Research Council (MRC) in South Africa.
- Dr Michelle Mulder, Manager IP and Business Development at the MRC in South Africa.
- Prof Steve Fey, Head of Research at the Centre for Clinical Proteomics at the University of Southern Denmark in Denmark.
- Prof. Patrick Arbuthnot, Director of the Antiviral Gene Therapy Research Unit, Department of Molecular Medicine & Haematology at the University of Witwatersrand (WITS) in South Africa
- Prof. Joachim Engels, Department of Organic Chemistry and Chemical Biology at the Johann Wolfgang Goethe-Universität (JWGU) in Germany.
- Mr. Burt Rodrigues, CEO of Biodx in South Africa

- Ms. Ms. Franziska Schurz, Project Manager for TNO Triskelion in the Netherlands.

Acknowledgement is also given to:

ESASTAP Plus partners who contributed to the report. Members of the ESASTAP Plus External Review Committee who provided feedback on the report. They are:

- Dr. Erika Kramer-Mbula from the Institute for Economic Research on Innovation at the Tshwane University of Technology in South Africa.
- Christian Hansen, Programme Officer at the Swedish Governmental Agency for Innovation Systems (VINNOVA) in Sweden.
- Andy Cherry, Senior Science Officer at the Association of Commonwealth Universities in the United Kingdom.