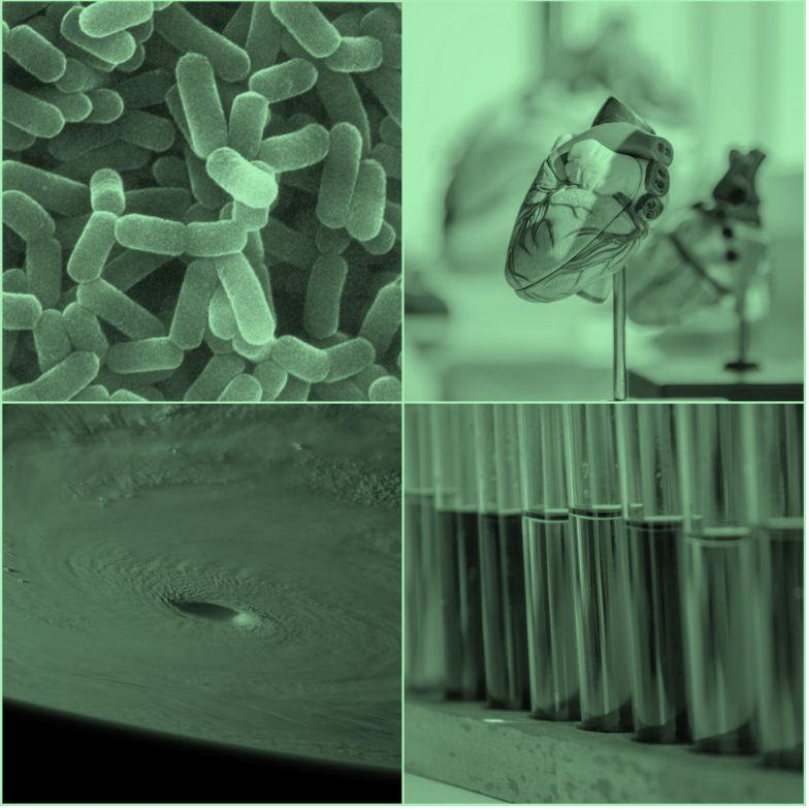

ESASTAP plus

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

CASE STUDIES

Good practices in innovation collaboration between South Africa and Europe

Southern African Research and Innovation Management Association (SARIMA) with support from APRE, KINNO and DST

2015

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

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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 South Africa's participation in Horizon 2020, but also by promoting reciprocal European participation in South Africa'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 South Africa, 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 South Africa. 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 results 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]).

[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)

Approach and methodology

A case study approach was selected to provide a descriptive, explanatory analysis of the innovation collaboration between partners in Europe and South Africa 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 South Africa. In addition the Technology Innovation Agency (TIA)[2], the National Intellectual Property Management Office (NIPMO)[3] and the Innovation Hub[4] in South Africa 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 excluded for the purposes of this survey. In other instances, the partners on either the

[2] http://www.tia.org.za/
[3] http://www.nipmo.org.za/
[4] http://www.theinnovationhub.com/

European or South African side did not respond to requests to participate within the time frame of the study.

The three case studies portrayed in the report were selected from collaborations that met the basic criteria and where partners in South Africa 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 is 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.

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.

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 three 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.

- **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.

- **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.

- **Funding.** For Case 2 the initial driver for the collaboration was a Belgian funding programme that 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. The joint research that was done in the context of this project was the foundation for further extended and fruitful collaboration. In the other 2 cases the collaboration started bottom-up, where two individuals met, realised that they had complementary skills and a shared vision for their research and development.

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.

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.

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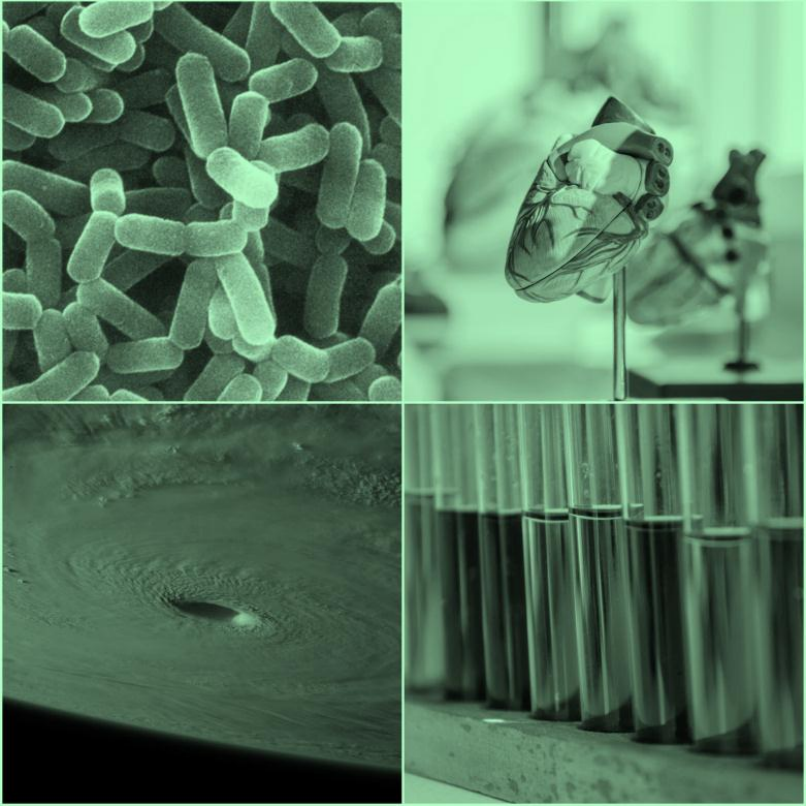

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