UNIVERSITY OF CAPE TOWN

eRESEARCH REPORT

2014

UNIVERSITY OF CAPE TOWN

IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

CONTENTS

01 MESSAGE FROM THE DEPUTY VICE-CHANCELLOR

Just as the telescope allowed Galileo to search the skies in the early 1600s, and the magnetic compass made it possible for Chinese explorers in the ninth century to traverse the oceans, information and communication technologies are pushing the boundaries of scientific discovery today. Computational science and data-intensive research are well established as the third and fourth pillars of scientific enquiry, alongside theory and experimentation.

An exciting period lies ahead for research: a period of acceleration and transformation, but also, as in all times of change, a period where the stakes are high. In this brave new world of big data, high-performance computing and technology-enabled research, it is clear that any university without a supporting strategy may continue to perform, but only for a limited period and not at the forefront of research.

At UCT we are unashamedly ambitious for our researchers and proud of the work they produce. What this means in practice, however, is that we have a responsibility to provide the best possible enabling environment to support innovative research. It is in recognition of this changing global research environment that UCT established Africa's first and only eResearch centre, UCT eResearch, in March 2014. UCT eResearch is the result of a partnership between Information and Communication Technology Services, the Research Office, the UCT Libraries and the Office of the Deputy Vice-Chancellor for Research and Internationalisation. UCT eResearch's mandate is to ensure that our university's researchers are equipped with the necessary support: not only in respect of facilities and infrastructure, but also skills and services. As the case studies in this publication indicate, great strides have already been made to meet this mandate. UCT eResearch, even in its infancy, has played a notable role in some of the university's important achievements of the year. These include the establishment of a Food and Drug Administration-approved clinical trial site in the Clinical Research Centre at Groote Schuur Hospital, assisting in the collaboration between the Department of Law and the World Bank in the African Mining Legislation Atlas project, and the partnership between the high-performance computing team and Dr Ramesh Govind's establishment of the first space geodesy analysis centre at UCT.

UCT eResearch has been finding its feet for just over a year, and it is now ready to realise its potential. We have therefore been fortunate to secure the former general manager of the Monash eResearch Centre in Australia, Anthony Beitz, who has taken up the reins at UCT eResearch for a year in order to bring the centre up to a world-class standard. I welcome Anthony to UCT, and look forward to working with him and his team as we continue to empower our researchers to solve some of the greatest problems faced by humankind today.

PROFESSOR DANIE VISSER
DEPUTY VICE-CHANCELLOR: RESEARCH AND INTERNATIONALISATION

02 BIRTH OF UCT eRESEARCH

Information and communication technologies (ICT) have become the lifeblood of research. In just the past 12 months, UCT researchers have more than tripled their use of central high performance computing (HPC) facilities for data-intensive research.

The need for research storage grows substantially every year and our specialist support and analysts are in constant demand. What this clearly demonstrates is that an effective eResearch strategy for any research-focused academic institution is simply non-negotiable. I am therefore proud that UCT is once again shining a light into the future with the establishment of Africa's first eResearch centre.

When I joined the university in 2009 as executive director of Information and Communication Technology Services (ICTS), there was a chasm between research and ICTS. This failure by IT to adequately support researchers stood out like a sore thumb in an aspiring research-intensive university like UCT. My primary focus, right from the first day, was to seamlessly merge IT and research at the university.

This process was not an easy one. As we began to move out of the space where IT was primarily geared towards administrative, finance and human resources support, to one where we could also enhance and accelerate research, I realised I needed to better understand the nature of eResearch. It was then that the close relationship between UCT and a number of Australian universities, particularly Monash University, was born. In 2011 Professor Ed Rybicki and I took our first trip to Australia to gain a better understanding of the potential for ICT-enabled research.

In many ways, the Australian experience shaped eResearch at UCT. We were lucky enough to be able to follow their model and learn from both their successes and their mistakes. By 2011, after much engagement with Monash and other Australian universities, I began to advocate actively for eResearch at UCT.

Fortunately my words fell on receptive ears. A key element to the success of any eResearch strategy is partnerships. Without a strong relationship built with both the Research Office and UCT Libraries, eResearch would have been no more than a lone spinning wheel within ICTS.

Right from the get-go we had complete buy-in, not only from our important partners – executive director of the Research Office, Marilet Sienaert, and executive director of UCT Libraries, Gwenda Thomas – but also from Vice-Chancellor Max Price, Deputy Vice-Chancellor (DVC) for Research and Internationalisation, Danie Visser, and the DVC for Teaching and Learning, Sandra Klopper.

In October 2013, the first ever eResearch Africa Conference, organised by the Association of South African University IT Directors (ASAUDIT), was held in Cape Town. By December of that same year, the first technical specialists dedicated to eResearch support were appointed within ICTS. Finally, in March 2014, the Senior Leadership Group formally approved the establishment of an eResearch centre, now known as UCT eResearch.

Today we have not only begun to break down that wall between research and IT, but we are leading the way for other universities in Africa as a model for eResearch.

SAKKIE JANSE VAN RENSBURG
EXECUTIVE DIRECTOR, ICTS

03 TRANSFORMATION AND ACCELERATION: THE ROLE OF UCT eRESEARCH

eResearch can be defined as the use of advanced computing and information technology (IT) to drive research and scientific discovery. UCT eResearch was established in March 2014 as a joint initiative between the Office of the Deputy Vice-Chancellor for Research and Internationalisation, Information and Communication Technology Services (ICTS), UCT Libraries and the Research Office.

UCT eResearch aims to create a world-class environment to support 21st century discovery at UCT. It also seeks to provide leadership, both nationally and on the continent, to raise both the facilities and capacity for eResearch in Africa.

UCT eResearch will partner with key research groups across the university to connect them to the most appropriate hardware, software and services in order to accelerate and transform research. UCT eResearch is not a service provider but will engage with researchers as a broker for the appropriate services, be they institutional or external, to achieve the best possible research outcome. Our performance will thus be rated according to research outcomes, including the publications we are involved in, the quality of the researchers we draw to the university and the national and international research infrastructure investment we attract.

UCT eResearch will connect researchers with world-class expertise and facilities in the: collection and management of research data; modelling, simulation and data processing through high-performance computing; comprehension of big data through visualisation and data science techniques; dissemination of research outcomes (including data and workflows); promotion of collaborative research through virtual labs and cloud resources; and the development of customised research software, hardware and services.

In 2015, as UCT eResearch enters its second year, the governance, structure and processes will be formalised. The centre will establish a governance committee and begin to build links with strategically important universities and commercial organisations, both within and outside of Africa. A big priority for the year is also to strengthen the partnerships with researchers at UCT to transform and accelerate research at the institution.

It is an exciting time for research, and I wholeheartedly welcome all researchers at UCT to begin engaging with UCT eResearch to expedite their research.

ANTHONY BEITZ
INTERIM DIRECTOR
UCT eRESEARCH

04 ACCESS AND VISIBILITY: LIBRARIES ROLE IN eRESEARCH

The eResearch support strategy of UCT Libraries took shape in 2014 in two major areas – that of enabling access to and the visibility of UCT scholarship – and in the research data management domain.

An Open Access Policy was approved in June 2014, and the institutional repository, OpenUCT, launched in August 2014, in the culmination of a three year project funded by the Andrew W Mellon Foundation, and led by Associate Professor Laura Czerniewicz. The repository was transferred to the UCT Libraries on completion of the project, and currently hosts more than 10,300 scholarly outputs comprising journal articles, conference papers, research reports, and open educational resources. More than an online platform, the repository supports research evaluation and performance measurement.

UCT Libraries provided leadership in the development of a research data management policy, tabling a preliminary draft to the University Research Committee in January 2014, and continues to coordinate this effort. Further responsibilities include the provision of user support services in the compilation of data management plans in compliance with increasing data sharing mandates of funding agencies; and to ensure the citability of datasets.

eResearch support also took the form of contributions to a number of exploratory institutional discussions. Libraries hosted a research data management workshop in March presented by David Groenewegen of Monash University, Australia, followed by a digital curation workshop presented by Joy Davidson and Sarah Jones of the Digital Curation Centre at Glasgow University. A contribution on research data management and curation was made to the Big Data Research Indaba held in May. UCT Libraries participated in the organisation of the national eResearch Conference in November. Joint papers were presented in November to the eResearch Australasia Conference in Melbourne, Australia, outlining the positive synergistic collaboration of UCT eResearch partners at UCT.

GWENDA THOMAS
EXECUTIVE DIRECTOR
UCT LIBRARIES

05 EXTENDING THE eRESEARCH REACH: THE ROLE OF THE RESEARCH OFFICE

The long labour in giving birth to UCT eResearch has crystallised, for the Research Office, the importance of building bridges between the partners in this venture: The Research Office, UCT Libraries, ICTS and the Office of the Deputy Vice-Chancellor for Research and Internationalisation. This construction work has already begun, and we look forward to seeing our ever-closer partnerships strengthen the support we offer the research community.

One of the responsibilities of the Research Office within UCT eResearch is to communicate the support and services it can provide for our researchers. Some of this is already happening through the creation and renewal of websites, including the UCT eResearch website, the portal and a streamlined research support hub.

We are building knowledge of UCT eResearch into the training we offer to postgraduate students and researchers through our development programmes – for instance, helping people to understand how they can cost the ICTS component of their research. UCT eResearch is also offering our researchers new and crucial eResearch skills, such as the basic and advanced courses in high performance computing that have just been promoted through the Research Office's Emerging Researcher Programme.

A relatively new venture for the Research Office is a cluster of activities around supporting research partnerships, particularly those that extend into Africa. UCT eResearch can play a crucial role in positioning UCT as a preferred partner with research institutions.

Where our collaborators in the Global North have eResearch facilities, we need to share those and work on our complimentary strengths. For instance, one of our most important collaborations is around the Square Kilometre Array telescope, which requires extensive support for the kind of data-intensive research it entails. Where our researchers work with teams at key partner institutions, such as the University of Western Australia and the University of Calgary in Canada, our eResearch services must speak to what our partners can offer on their side.

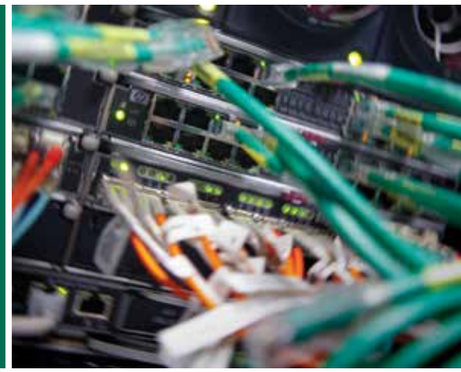
On the other hand, where our partners do not have such facilities, we hope UCT eResearch will help to provide access to research and data sets that would otherwise not be readily available.

The research landscape has changed significantly in the last five years. If we don't improve our systems and the support we offer researchers, we will see a falling off across all performance measures, creating a vicious circle of decline. UCT eResearch will enable us to respond positively and effectively; if we get it right, it should push us instead into a virtuous circle of continued growth.

MARILET SIENAERT
EXECUTIVE DIRECTOR,
RESEARCH OFFICE

06 RESEARCH + ICT = eRESEARCH: THE ROLE OF ICTS IN eRESEARCH PARTNERSHIP

We are seeing three major drivers for the programme of change at Information and Communication Technology Services (ICTS), influenced by both local and global challenges.



We want to deliver more; we want to deliver the right thing and we want to deliver it in the right way. These three goals may seem simple enough, but will require a revamped organisational structure, a greater focus on governance and improved internal processes. In many ways, eResearch is the flagship that allows ICTS to become more embedded within UCT, helping the institution to execute its strategy.

DELIVERING MORE

Operationally, our primary role is to provide infrastructure. We need to make sure there is enough network available for researchers to carry out their work and that infrastructure is upgraded regularly. We need to provide sufficient resources to meet the university's high performance computing requirements and make enough human capital available to ensure efficient management and use of this infrastructure. This goal to deliver more means we must constantly work to bridge that gap between researcher needs and IT infrastructure. It is, and always will be, a moving target. It is a target we can never become apathetic about, because without adequate cyber infrastructure and eResearch support, UCT will not be able to maintain its high-ranking position in Africa in the new world of data-intensive research.

DELIVERING THE RIGHT THING

We at ICTS need to ensure our priorities match not only the strategic goals of the university, but also researcher demand. Our infrastructure development must be researcher-driven. In order to do this we must break down the barriers between research and IT. We must move into a space in which scientists and IT specialists collaborate as equals to enable and enrich scientific discovery. UCT eResearch is the first step in that process as ICTS aligns itself with the critical needs of the university. We need to make sure the demand from within the university is understood not only by us, but also by our national suppliers, so we can be the interface.

DELIVERING IN THE RIGHT WAY

As eResearch becomes embedded in the university, it needs to be strongly supported by ICTS infrastructure. The role of the ICTS staff in bringing this about is key. If the staff working in this department had not, right from the beginning, understood the need for this change, we would not have been able to get where we are today. Within ICTS, the ethos of enabling people is very strong. It is this ethos that will allow for IT-enabled research to become deeply embedded within UCT.

SAKKIE JANSE VAN RENSBURG
EXECUTIVE DIRECTOR, ICTS

07 OLYMPUS VIRTUAL MICROSCOPE TAKING HEALTH SCIENCES TO THE NEXT LEVEL

In 2014 the Department of Clinical Laboratory Sciences acquired a state of the art Olympus VS120 virtual microscopy system. The acquisition of this relatively rare equipment will not only enhance teaching and research in the department and assist pathologists at Groote Schuur, but also, through the virtual database, open the rich data resource housed at UCT up to the broader community.

According to technical officer in the department, Jurgen Geitner, the acquisition of the microscope and establishment of the database gives UCT a global competitive edge.

"There are not many of these machines in the world and only three in South Africa," says Geitner. "One of the biggest challenges of the acquisition of the equipment was the IT component. It was not only a question of getting the microscope up and running, but also setting up the database and the network."

It was here that the collaboration between clinical laboratory sciences and eResearch proved vital to the process. The eResearch team worked closely with the laboratories to set up the servers and the database to house the images produced by the microscope. The Olympus VS120 system features a slide loader that can process up to 100 slides at a time. The images processed by the microscope are of an exceptionally high resolution, which means the server has to handle large file sizes. A single image can be as big as seven gigabytes. "Because of the requirements of the microscope, we needed a fast network and a very powerful server. Fortunately the eResearch team could step in to assist on the project," says Geitner.

He adds that, thanks to the in-house IT support in the set-up and configuration of the Olympus server software, not only did the department save a lot of money on the costs of a server, which they no longer had to buy, but their help was also invaluable from a technical point of view.

"It would have been impossible for us to set this kind of thing up. We needed someone with inside knowledge of the UCT network. On projects of this size, it is impossible to work in silos: we need somebody who has an idea of the bigger picture." In addition to setting up the server software and database, the eResearch team also configured the system for various access scenarios, including departmental, student, conference and public access.

VIRTUAL MICROSCOPY FOR TEACHING

The Department of Clinical Laboratory Sciences holds an extraordinary collection of pathology specimens that have been accumulated over more than 80 years. The specimens provide a learning resource for health sciences students and, thanks to the Olympus VS120 microscope, the specimens are in the process of becoming available for viewing via a website. This digitised system for teaching will be a far cry from the current system where students rely on old and out-dated slide boxes. When it comes to teaching, one of the challenges with the slide boxes is to ensure that, in a class of around 200 undergraduate students, all the students are looking not only at the correct slide, but the correct region of the correct slide. Soon students will be able to access their samples online from any location with a reliable internet connection.

"With this microscope I can literally look at thousands of images, something that was previously impossible."

A RESEARCH GAME CHANGER

For postdoctoral researcher Dr Collin Diedrich, the Olympus VS120 microscope has been a 'lifesaver'. Diedrich's research focuses on tissue inflammation, known as granulomas, in patients with a human immunodeficiency virus (HIV) and tuberculosis (TB) co-infection. The acquisition of the microscope changed the nature of Diedrich's work. He went from manually taking the images himself to digitising 100 slides at a time with the Olympus, and letting the technology do the work for him.

A NEW ERA FOR DIAGNOSTICS

The acquisition of the Olympus VS120 microscope also led to an important collaboration between Dr Michael Otto, anatomical pathologist at Groote Schuur and Dr Brian Benetar, clinical director of pathology at the Pennine Acute Hospitals NHS Trust in Manchester. The aim of the collaboration is to validate whether or not the quality of the images taken by the Olympus VS120 are powerful enough to make an accurate diagnosis. Pathologists in Cape Town will look at the actual glass slides under a more traditional microscope, while the team in Manchester will use the digitised images from the Olympus to make a diagnosis.

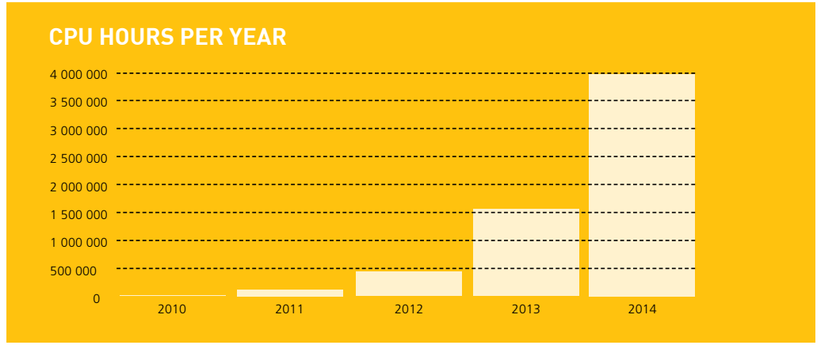
"Remote and rural centres generally face high workloads with limited access to secondary specialist consultations. Use of a courier service to transport glass slides is not only time consuming but also expensive," says Otto. "If this study is successful in proving the digitised images offer the same diagnostic capability as traditional glass slides this could lead to better diagnostic accuracy, reduced turnaround times and more effective and cost-saving consultation as digital images are rapidly transmitted."

The Olympus Microscope is a prime example of innovative technology accelerating research in areas previously believed impossible. Without a specialist eResearch team embedded within the university the department of clinical laboratory sciences would have faced far greater challenges in getting the equipment up and running at maximum efficiency.

Researchers at UCT have so far only scraped the surface of the potential of this system. In the future, the Olympus VS120 is set to enhance and accelerate not only microscopy-related research and teaching, but also open access to the resources to allow for greater access to, and sharing of, research data generated by the Olympus VS120.

08 GRAND CHALLENGE PROBLEMS AND HIGH PERFORMANCE COMPUTING AT UCT

How do we measure changes in sea level or assess what impact decreased carbon emissions will have on the earth? How do we determine the structure of a protein or decide which bacterial strains should make up a vaccine?



In order to help find answers to these and other questions, researchers have to do hundreds of millions of computations in a short period of time. It was these so-called grand challenge problems that drove the development of high performance computing (HPC) as we know it today in the 1990s. Today HPC is a must-have tool for scientific discovery.

HPC is a broad term referring to any computational activity that requires more than a single computer to execute a specific task. This includes the use of supercomputers and computer clusters. HPC offers researchers the capacity to handle and analyse enormous data sets at very high speeds.

"HPC is relevant to all fields of research," says Michelle Kuttel, associate professor in the Department of Computer Science. "If you are doing research with big data sets that require complex analyses, you quickly realise your most precious resource is time."

That the HPC facilities are located within UCT eResearch, as a shared resource, is immensely helpful, says Kuttel.

"Having a dedicated IT team just makes economic sense. The researchers can focus on their core expertise and let the IT experts take care of the technology."

The establishment of both HPC hardware and personnel services at UCT in 2010 has allowed researchers to tackle the grand challenge problems without having to sink time and financial resources into the acquisition of HPC hardware.

Climate change is undoubtedly one of the 'grand challenge problems' facing the world today. The foremost technique to measure global change such as climate change or rise in sea level is through space geodesy. Prior to the arrival of Dr Ramesh Govind at UCT nearly two years ago, South Africa had no space geodesy analysis capability.

Space geodesy effectively measures global changes from space using data collected from satellites. On a daily basis, scientists from around the world collect enormous data sets and analyse those in order to measure the motion of the earth's centre of mass, changing sea levels and changes in the earth's gravity field, amongst other things. Govind says he will regularly compute 26 years of data at one time: a task that is impossible without HPC.

Space geodesy is not the only field in which researchers are advancing in leaps and bounds through the use of HPC. Researchers in astrophysics, health sciences and economics, to name just a few, are working to answer some of the most complex problems in their fields in part through the use of HPC.

While HPC at UCT may be largely driven by the needs of key research projects such as the space geodesy centre or the Square Kilometre Array (SKA) and astrophysics, the spin-off effects for researchers and students are significant.

Use of the HPC facilities has almost tripled in the past year as researchers and postgraduate students increasingly recognise the value of HPC to accelerate and enhance their research.

HPC AT UCT

CPU: CORES	1300
NETWORKING: MELLANOX INFINIBAND INTER-CONNECT FDR	56 GB/S
MEMORY	4.5 TB
RESEARCH STORAGE	400 TB
GPU SERVERS	X8 NVIDIA TESLA M2090 GPUS, X2 NVIDIA KEPLER K40 GPUS
FHGFS HPC SCRATCH STORAGE	90 TB

300 RESEARCHERS USING HPC ACROSS CAMPUS

- 121 Science
- 73 Health Science
- 16 Law Mesh Projects
  30 Collaborators, 1 National and 3 International
- 40 Engineering & Built Environment
- 4 Commerce
- 2 Centre for Higher Education Development

HIGH PERFORMANCE COMPUTING (HPC)

- 1.2 MILLION Jobs submitted
- 6.3 MILLION Computing hours

TOP 5 RESEARCHER GROUPS

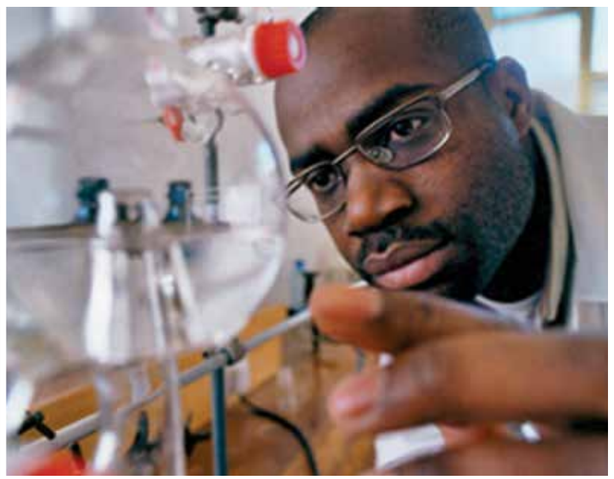
1. Chemical Engineering
2. Mathematics
3. Mechanical Engineering
4. Computer Science
5. Computational Biology

33 CITATIONS

- 17 Faculty of Science
- 7 Faculty of Health Science
- 5 Faculty of Engineering & Built Environment

09 ADVANCING CLINICAL RESEARCH AT UCT

World Health Organisation statistics continue to paint a tragic picture of a continent crippled by diseases such as malaria, TB and HIV/Aids. Yet drug development for these diseases remains concentrated in the developed world. The Drug Development and Discovery Centre (H3-D) has done much to change this status quo, and in 2014, with the capacity-building support of the Medicines for Malaria Venture (MMV), the Clinical Research Centre at UCT established one of the few first-in-human clinical trial sites on African soil.



First-in-human trials are the small Phase I clinical trials where drugs, which have so far been tested on several animal species, are for the first time tested on healthy human subjects. In Africa, established clinical sites to run these first-in-human trials are rare, in part, because of a lack of infrastructure and expertise to ensure clinical data management adheres to international regulatory requirements such as those of the US Food and Drug Administration (FDA) or the European Medicines Agency (EMA).

When Professor Kelly Chibale (pictured above right), H3-D director and executive committee chair, developed the anti-malarial compound, MMV048, the university wanted to keep the production pipeline of the drug as close to home as possible. This was achieved when UCT's Collaborating Centre for Optimising Antimalarial Therapy (CCOAT) led by Prof Karen Barnes was selected to conduct the MMV048 first-in-human clinical trial. This decision was taken by the non-profit research partnership between the MMV and the SA Department of Science and Technology's Technology Innovation Agency (TIA), which co-funded the development of MMV048 and provided most of the funding for its first-in-human clinical trial. In 2013, the Novartis Institute for Biomedical Research partnered with UCT to help the university put the necessary systems in place to ensure its clinical, laboratory and data management systems would pass an FDA or EMA audit.

The software and computational requirements of this project were immense and, for the CCOAT team responsible for the clinical trial, this task was daunting. Fortunately, the WWARN[1] scientific coordinator in UCT's Division of Clinical Pharmacology, Lesley Workman, had recently attended a talk by executive director of ICTS Sakkie Janse van Rensburg about eResearch and its role in scientific discovery. Workman and Barnes met with Janse van Rensburg to discuss a potential collaboration. This meeting took place in November 2013, before UCT eResearch was formally established. Technical specialists Ashley Rustin and Timothy Carr were seconded from ICTS onto the project.

"The eResearch team's involvement was critical for UCT to be able to take on these kinds of clinical trials," says Barnes. "While individual research groups can upgrade and validate their own data management systems, as well as ensure their hardware and software are compliant, the regulatory authorities also require that the IT platform on which we work is compliant with international standards."

The data management element is one of the greatest challenges in setting up clinical trials.

"No drug developer would sponsor an early drug development clinical trial unless it complies with stringent regulatory authority standards," says Workman. "So the clinical data management software needed to be installed, operate and perform according to strict specifications."

Novartis worked with Barnes and her team to help get the systems in place. They first ran a series of workshops on clinical trial management, followed a few months later by a mock audit of the CCOAT and relevant UCT systems.

The amount of work undertaken in those months by both the CCOAT and the eResearch team was sizeable.

"Not only did the infrastructure need to be validated, but we needed standard operating procedures for every aspect of the infrastructure," says Carr.

"What this meant in practice," explains Rustin, "was a huge amount of paperwork. You need documentation to show the system was properly installed; you need documentation to show the system is performing and operating as it is supposed to. Then because we at ICTS were hosting the server we also needed to validate our platforms. All this documentation needed to be submitted to the Novartis auditor."

The Novartis auditor was impressed with the standard of work achieved by the team and described the CCOAT clinical data management system as "on par, or even better than, some of the Phase I units in Europe and America."

Within a few months the CCOAT was given the stamp of approval to successfully run first-in-human trials at Groote Schuur Hospital.

"The eResearch team's involvement was critical for UCT to be able to take on these kinds of clinical trials,"

Today, the clinical trial ward in UCT's Clinical Research Centre (CRC)[2] is one of South Africa's biggest early phase clinical trial sites, boasting a 24-bed ward in the historic Groote Schuur Hospital Old Main Building and a similar paediatric facility at Red Cross War Memorial Children's Hospital. The CRC aims to support UCT Health Science Faculty staff in their conduct of high quality clinical research from an initial idea to the final report. The advantages of being able to run clinical trial data management in-house are significant. Previously, researchers had no option but to outsource data management, which can be extremely expensive and time-consuming. Now that the system is set up and running, not only do researchers have free access to this validated platform, but Novartis and others are exploring contracting some of their early drug development clinical trials to the university.

1. WWARN Worldwide Antimalarial Resistance Network (www.wwarn.org) 2. UCT's Clinical Research Centre (www.crc.uct.ac.za)

10 CONNECTING SCIENCE: CERN AND VIDYO CONFERENCING

The European Organisation for Nuclear Research, or CERN (Conseil Européen pour la Recherche Nucléaire), may be based in Geneva, Switzerland, but it is a thoroughly global institute. Tens of thousands of physicists and engineers from around the world collaborate on a range of projects as they seek to better understand the fundamental structure of our universe.

Very little of CERN's research is done on-site in Geneva, says outreach and education coordinator of the ATLAS experiment at CERN, Steven Goldfarb. Only about 10% of CERN researchers actually work on location in Geneva. This makes communication and connectivity vital: collaborators need to be able to share their work, share presentations and communicate their results. To meet the needs of this massive globally dispersed community, CERN uses a software package called Vidyo, which allows hundreds of people to participate in a single meeting at any given time, and multiple meetings to be run simultaneously. In total, thousands of people within CERN – including administrators, scientists, technicians and managers – use the Vidyo technology on a regular basis.

In a country like South Africa, where overseas connectivity remains a constraint, researchers face particular communication challenges. There are about 80 CERN collaborators at various institutions in South Africa. At UCT, Dr Andrew Hamilton (pictured above) and Dr Tom Dietel in the Department of Physics are collaborators in the CERN ATLAS and ALICE projects respectively.

"There are 3 000 collaborators in the ATLAS project," says Hamilton. "And on any given day there are dozens of meetings scheduled within my project alone. Those meetings could include anything from 10 to 100 people."

"The quality of the connection within those meetings is critical," explains Hamilton. "With so many meetings running in a single day, and so many members participating in each meeting, a few small connection problems can easily translate into hours of time wasted."

South African collaborators in CERN limped along for a few years. The Vidyo conferencing worked, says Hamilton, but not with the efficiency required for this level of collaboration. Finally, in 2014, Hamilton and Dietel reached out to the newly established UCT eResearch to find a solution to their critical communications challenge.

Part of the eResearch mandate is to reduce barriers and connect researchers to the relevant service providers. As the eResearch team began to investigate Vidyo for CERN communication requirements, it quickly became apparent this was a problem that required a nation-wide solution.

"We realised we were not just serving UCT researchers, but the whole community of CERN collaborators in South Africa," says Ashley Rustin, eResearch specialist.

The eResearch team first reached out to CERN. The global videoconferencing services manager, Joao Correia Fernandes, suggested

MORE ABOUT CERN

At CERN, scientists use purpose built particle accelerators and detectors to study the basic constituents of matter. The most famous of these is the Large Hadron Collider (LHC). Seven experiments use the LHC, including the ATLAS and ALICE experiments.

ATLAS

The ATLAS experiment investigates a wide range of physics, including the search for the Higgs boson. More than 3 000 scientists from 174 institutes in 38 countries work on the ATLAS experiment.

ALICE

The ALICE experiment seeks to understand the physics of strongly interacting matter at extreme energy densities. This experiment uses the LHC to recreate, in the laboratory, conditions similar to those just after the big bang. Over 1 000 scientists from over 100 physics institutes around the world are involved in the ALICE project.

CERN provide a VidyoRouter to the South African collaborators – something they had done to improve connectivity in a number of other countries. This VidyoRouter is the engine that enables video calls; it is an efficient way of sending video and audio streams to users. Once CERN agreed to pay for the software, eResearch contacted the Tertiary Education and Research Network of South Africa (TENET). TENET is a national network established to secure, for South African universities and associated research and support institutions, internet and information technology services.

The team from TENET readily agreed to assist on the project. They procured and set up the necessary hardware in Cape Town and reserved the required international bandwidth. Meantime, CERN set up and configured the software to ensure it connects seamlessly with the infrastructure in Geneva.

"This was a prime example of the eResearch team joining the dots," says Rustin. "We knew who to reach out to and what to ask for. Once we began knocking on the right doors, everything really just fell into place."

With the new video conferencing software installed, anyone connecting from a South African academic address to CERN will go through the Cape Town VidyoRouter. This ensures a consistently reliable connection, effectively plugging the South African collaborators in to the global CERN network.

"Since the VidyoRouter was installed in Cape Town, our video conferencing has been much more stable and reliable," says Hamilton. "This is one of the many important steps we need to take as a research community to ensure we can have effective international collaborations."

TENET, in the meantime, is working to expand the local Vidyo infrastructure to further support the collaboration needs of the South African research community. Other research groups have been quick to get on board. The Square Kilometre Array (SKA), another massive global research project, has also begun to use Vidyo for its collaboration needs.

"Traditional video conferencing approaches can no longer meet the needs of the increasing number of global scientific collaborations like the SKA and CERN," says Rob Bristow from TENET. "Thanks to this collaboration the whole South African research community can now benefit from the CERN experience with Vidyo."

11 EMPOWERING THE CONTINENT: THE AFRICAN MINING LEGISLATION ATLAS

It is no secret that Africa is the richest continent in the world in natural resources – it holds nearly three quarters of the world's platinum supply, a fifth of its uranium and nearly half its chromium and gold – but this has not been translated into economic wealth for its citizens. The World Bank has identified the effective management of natural resources as a development priority for the continent.

In 2014, the Legal Vice Presidency of the World Bank partnered with Professor Hanri Mostert of the Mineral Law in Africa project (MLiA) in the Department of Private Law at UCT, and the Africa Legal Support Facility of the African Development Bank, to develop the African Mining Legislation Atlas (AMLA). This project, which is still ongoing, aims to collect and process all of Africa's mining laws and regulations into an online database. The database will be open source and provide easy access to anybody with an interest in mining and mineral law in Africa. It will also provide comparative data on mineral law legislation and regulation across the continent. Lastly, a guiding template for the development of new legislation will also be released in future. This will strengthen the ability of countries to produce good and transparent law in the important field of minerals and mining.

The AMLA aims to help address the information asymmetry between the various stakeholders in the mining sector. This includes not only governments and mining companies but also local communities in mining areas. Information is power, and African governments and citizens have been operating with a dearth of information regarding mining laws and international best practice. At the same time, legal uncertainty inhibits further investment in this very important sector to all African countries and creates conditions for corruption and ineffective allocation of scarce and extremely valuable resources.

The AMLA aims to provide quick access to the current mining laws and regulations of all African countries for comparison. It is imperative that the database is accessible, user-friendly, comprehensive and accurate, as it has to offer a one-stop resource for African governments, citizens, mining companies and investors.

In order to achieve this, Professor Mostert contacted UCT eResearch for technical advice and support, and to host the software for the project at UCT. The intention in the medium- to long-term is for UCT to take over the hosting and maintenance of the database. eResearch will play an important advisory and support role in the AMLA.

An important component of the project is to build capacity on the African continent. A network of African universities has been established to work on the AMLA. Key to this will be effective use of the electronic research environment. The project will work with emerging researchers as part of a capacity-building intervention led by UCT. To further this, the AMLA project hosted inaugural training for law students and supervising law professors at the end of 2014. The training was held at UCT and was attended by 24 law students and five professors from across the continent, all sponsored by the AMLA.

A second component of the capacity-building aspect was to use a continental vendor for the development of the database. A Kenyan-based web development company called Farwell Consultants was tasked to develop the software, and UCT eResearch to host the application on its server.

"The eResearch team was instrumental in providing critical advice in a range of aspects, including facilitating contact with key stakeholders and advising on technical specs, user requirements, future developments, value and user enhancing additions, as well as technical training during the AMLA training at UCT," says Herman Meyer, member of the AMLA project team, and research coordinator in the Department of Private Law.

The AMLA aims to support transparency and help create the right environment for the sustainable use of mineral resources for shared prosperity.

If used in the right way, information technologies today offer the potential to level the playing field, democratising the most precious resource of all: information.

CENTRE FOR IMAGING AND ANALYSIS

The University of Cape Town plans to establish a world-class visualisation and analysis centre, built largely around electron microscopy.

The Centre for Imaging and Analysis will offer a variety of instruments and techniques to serve the needs of engineering, biological, earth and physical sciences and medicine, among other disciplines. The centre will also be the only facility in the country possessing high-level capacity for the determination of the three-dimensional structures of macromolecular assemblies. It will be staffed by subject experts who will work closely with users at all levels from student training to project completion. The goal is to establish a centre in which scientists, engineers and medical researchers wishing to gain insights into scientific problems through visualisation will get the necessary support.

UCT eResearch has been working with Professor Trevor Sewell, director of the new Centre for Imaging and Analysis, to design and implement user data, and facility management systems within this world-class facility. The centre is also providing centralised data storage for backup and collaboration and access to high-performance computing resources. Finally UCT eResearch will work with the new facility to adopt the latest automated image acquisition software for unattended and remote user data collection.

PROGRAMME FOR IMPROVING MENTAL HEALTH CARE

PRIME (Programme for Improving Mental Health Care) is an international group of mental health researchers and policy makers committed to improving mental health in low-resource settings.

It consists of a consortium of research institutions, including UCT and the Centre for Global Mental Health as well as the World Health Organisation, and the ministries of health in five countries in Asia and Africa (Ethiopia, India, Nepal, South Africa and Uganda). PRIME aims to generate world-class research evidence on implementing and scaling up treatment programmes for priority mental disorders in primary and maternal health care contexts in low-resource settings.

UCT eResearch is working with the Department of Psychiatry and Mental Health to move the PRIME database from the London School of Hygiene and Tropical Medicine, where it has been hosted and managed to date, to UCT.

The project also requires the development of a system to allow country coordinators to upload their datasets to a central facility where the datasets are transformed and collated.

THE ELECTRONIC TRAUMA HEALTH RECORD

Traumatic injuries are among the world's top health problems.

Traumatic injuries account for more deaths globally than HIV, TB and malaria combined, according to a report by the American College of Surgeons. Ninety percent of trauma deaths occur in low- and middle-income countries where injury surveillance is not accurately performed. While electronic health records have become standard practice in the Global North, in developing countries like South Africa clinicians are still collecting data on paper. Groote Schuur Hospital has been working with surgeons from British Columbia, Canada to use an iPad app, Electronic Trauma Health Record (eTHR), to collect and analyse trauma care data. Using the eTHR application, the Groote Schuur Hospital trauma department aims to develop an injury surveillance database and program for hospitals in the Cape Town area.

"People think injuries are accidents, and nothing can be done," says Dr Morad Hameed from the University of British Columbia in the *Journal of American College of Surgeons*. "But most injuries are preventable. With the right data and the right health care standards you can make a favourable impact. "But in order to get the right data, it is necessary to have the right tools. Using the eTHR, clinicians at Groote Schuur Hospital can now record and capture important information such as past medical history, residence, demographics, cause of injury, injury severity score and the patient's drug and alcohol use.

A local server was set up by UCT eResearch to host both the database and the application. They have assisted with the migration of the data from Canada to UCT.

HUMAN HEREDITY AND HEALTH IN AFRICA

Africa carries a disproportionate burden of communicable diseases such as HIV, tuberculosis and malaria, along with a growing prevalence of non-communicable disease.

But while genomics is key to contemporary biomedical research, genetic research and genomics is limited in Africa. There are few collaborations and often African scientists do not return to the continent after they complete their training. Human Heredity and Health in Africa (H3Africa) is intended to encourage a contemporary research approach by African investigators to the study of the genomic and environmental determinants of common diseases with the goal of improving the health of African populations. Part of this project includes building the first Pan African Bioinformatics Network in Africa: H3ABioNet and the H3Africa Consortium. The Consortium consists of a network of research sites across Africa working together to foster pan-continental collaboration. H3ABioNet will provide the framework for integration and communication among its members as well as develop a core bioinformatics infrastructure including both hardware and human resources, to aid the study of human heredity and health.

UCT eResearch, in collaboration with ICTS and the Computational Biology Group, will be developing a data storage archive solution to house research data from the H3Africa Consortium. This archive solution needs to be located in Africa to form an African data repository. For now the data are to be kept here until the end of 2017 but there is discussion under way to extend this timeline. The data will include genomic data and access will be controlled according to internationally accepted standards.

DEPARTMENT OF MOLECULAR AND CELL BIOLOGY: THE NIKON Ti-E FLUORESCENT MICROSCOPE

The Department of Molecular and Cell Biology (MCB) now boasts a state-of-the-art mammalian tissue facility, the Tissue Culture Facility, to meet the needs of MCB researchers studying human health topics including HIV/AIDS and the human papillomavirus.

An important addition to this new facility is an inverted fluorescent microscope, the Nikon Ti-E, housed in a dedicated microscope room in the facility. Paired with a mini-incubator, this microscope enables researchers to visualise live mammalian cells directly.

UCT eResearch worked with Professor Nicola Illing from MCB on the setup and configuration of the microscope software and provided central storage for the data from the microscope. Images captured by the microscope on one of three cameras are then stored on a dedicated 10-terabyte server named ROSALIND, housed in the data centre. All data stored on this dedicated server are automatically backed up for six weeks from the date of acquisition. The eResearch team also worked on a solution to allow remote access to the imaging data on the ROSALIND data store. Users can thus download the open source OMERO software to view and manage their image data, or access the proprietary NIS-Elements imaging software as they require on demand.

UCT eRESEARCH: THE LONG-TERM VIEW

UCT eResearch was established to pioneer and facilitate the entrenchment of IT and advanced computing into research at UCT.

This is not to understate the large number of research groups who are already making tremendous progress through the use of cutting edge technologies. Researchers will seek and find the newest and the best tools to assist their research, but without the holistic view, the risk of duplication and inefficiency is high.

UCT eResearch's role is one of a broker, a connector and bridge-builder. By building strong links with researchers in every faculty across the university it is our role to identify eResearch needs and solutions. In some cases, the solutions will already exist and it is just a matter of building a bridge. In some cases UCT eResearch will have to work with researchers to develop sustainable solutions that will also cater to future research needs.

The development of cyber-infrastructure at UCT will be researcher-led. What this means in practice is that research groups with very specific infrastructure needs should start their partnership with UCT eResearch at the planning stage. We can then work with researchers to identify what they require and assist them to work these needs into their research grants.

As it stands at the moment a research group may require particular expertise (such as a software developer) then source this expertise themselves. This specialist will then most likely be operating in a void with limited awareness of institutional or national infrastructure. Instead we seek to build a network of expertise, which researchers can draw from, to expedite the resourcing of research projects to ensure more holistic, better-supported and more sustainable solutions for researchers. What this will likely translate into are a number of independent platforms operating as service providers that cater to specific research needs.

In order to become more entrenched within the university's research community, UCT eResearch will be moving out of the ICTS building to be closer to the 'research action'. The new space will not only house the eResearch team, but also serve as a hub for research collaboration. Interdisciplinary research is growing increasingly common as researchers seek multi-dimensional solutions to the challenges of the day. We hope to provide a space for that collaboration as a range of disciplines and advanced computing solutions connect to ensure faster, better and more relevant research.

eResearch effectively is research in the 21st century. Unless we embrace the new opportunities provided by IT-enhanced research we will be left behind. UCT eResearch strives to embed both the ethos and the practice of eResearch into the research community both at UCT and in the broader African landscape. We hope to learn from those who forged this path before us to leap-frog research in Africa to the next frontier.

ANTHONY BEITZ
INTERIM DIRECTOR
UCT eRESEARCH

THE CORE TEAM

Top left
Timothy Carr: Senior eResearch Technical Specialist

Top Right
Andrew Lewis: Senior eResearch Technical Specialist

Second Row left
Jason van Rooyen: eResearch Analyst

Second row right
Heine de Jager: Senior eResearch Technical Specialist

Third row left
Ashley Rustin: Senior eResearch Technical Specialist

Third row right
Anthony Beitz: Interim Director

Bottom left
Chris Mtshengu: Research Support Specialist

Bottom Right
Natalie Simon: Communications Coordinator

Produced by:
UCT eRESEARCH
ICTS-on-Main building
7 Main Road
Mowbray
Cape Town
South Africa

Email: eresearch@uct.ac.za

For more information and an online version of this report go to
www.eresearch.uct.ac.za

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