

From science to business

Teaching entrepreneurial
skills to the developing
world





Bridging the gap between science and business

Science doesn't exist in a bubble. In times of economic turmoil, it is vitally important to translate scientific knowledge into commercially viable enterprises, which can bring prosperity to local communities and, in the longer term, entire countries.

The Institute of Physics (IOP) knows this well – in the UK, we champion the invaluable contribution of scientific research and physics-based innovation and business to the growth of the economy. In many ways, countries in the developing world have even more to gain.

The shift from scientific research to business application is not a straightforward one, and it requires additional skills that are not automatically included in a scientist's training. IOP's entrepreneurship workshops actively address this knowledge gap, to the benefit of scientists and engineers all over the developing world.

Writing a business plan, understanding **issues around intellectual copyright** and the **requirements of business contracts** are some of the most essential components of the workshop, which delegates are expected to develop and apply to their own business ideas from the start. But above all, the workshop is a vehicle for scientists to interact and exchange information, contacts and experiences. Delegates have the opportunity to **learn first-hand**

from highly experienced scientists turned entrepreneurs – in recent years, speakers have included Prof. Peter Dobson of Begbroke Science Park, Oxford, an incubation centre for research-based spin-off companies, and Dr Regina Lutge, associate professor at the University of Twente, the Netherlands, who has been actively involved in the set-up of spin-off companies Medimate and MyLife Technologies.

The workshop's practical approach ensures that concepts and key processes can be absorbed in a lasting way. Other resources are made available to participants to consolidate the new skills and relationships that they will have established during the course. Delegates and speakers have access to a **dedicated online networking forum**, to help them keep in touch and continue exchanging ideas long after they attended the workshop. Participants are also granted access to IOP's **continuous professional development online resources**, to help them keep abreast of innovations in the business arena.

While the workshop helps professionals to combine their scientific expertise with business know-how, IOP also has a long-term aim to help **integrate entrepreneurial skills at key stages of education and professional development** in the countries in which we operate. By introducing entrepreneurship to the school and university curriculum, we can instil business skills into the next generation of scientists at an early age and help develop new science- and physics-based enterprises in developing countries for the long term.



IOP runs a yearly workshop in entrepreneurial skills for physicists and engineers at the AREA Science Park in Trieste, Italy. The workshop is also held locally in different countries, as interest and opportunities develop.

IOP also offers a more advanced entrepreneurship workshop for high-level managers; these are also held yearly in different countries around the world.

For detailed information on dates and locations, contact dipali.chauhan@iop.org



Abdul Mirza, South Africa

Using quantum cryptography for network security

“I live in Durban, the largest city on the east coast of South Africa. It was one of the first few cities in Africa with a fibre-optic communications network, and is focusing on becoming the IT hub for the entire continent. My company, QZN Technology, focuses on communication security, otherwise known as encryption.”



Presenting at the launch of QZN Technology

“Companies require encryption to protect their classified information during data transfer and storage, allowing them to expand their operations safely. Quantum cryptography solutions are a new method of data encryption, which shift the basis of a security system from mathematical algorithms, which are in principle reversible, to physical quanta – this means that a potential eavesdropper would have to defy the laws of physics to access any information!”



Abdul and his team

“Our sector, the Quantum Information, Processing and Communication (QIPC) industry, is rapidly growing in South Africa – the Department of Science and Technology is investing in this area to help South Africa gain global market share.

“QZN Technology is the commercial face of the Centre for Quantum Technology (CQT), a research group at the School of Physics at the University of KwaZulu-Natal (UKZN) – my colleague Charles Freeman and I are both PhD students and, respectively, COO and CEO of QZN; Francesco Petruccione is our head of research at the centre and director of our company. We are fully embedded in the research and development of quantum technology, and therefore at the heart of a budding sector of the South African economy that the government is keen to expand.

“My team and I are experts in our field, but not trained entrepreneurs. At the end of 2009, the CQT had tasked me to develop a concept document for

commercial ventures and put together a business plan for a company that we might form on the back of our research. It was perfect timing, so I signed up to attend IOP’s workshop on entrepreneurial skills.

“The workshop offered me an ideal arena in which to analyse case studies of scientists who have successfully marketed their research, as well as the opportunity to network with them. Learning through best practice was both inspirational and effective. The fundamentals of writing a business plan were something that I immediately applied to our funding applications, while creating a quantitative analysis of business opportunities and of the related costs, assisted me after that stage in my interactions with accountants and investors.

“QZN Technology was launched in May 2010, at the same time as the Quantum Stadium Project, which ran during the 2010 FIFA World Cup and secured the communication link between the Moses Mabhida Stadium in Durban and the municipality’s Joint Operations Centre. This offered us ample opportunities for pitching, development and networking, and we have now been operational since January 2011. We are currently negotiating with a few potential clients and investors, as well as securing solid international partnerships with companies such as

Senetas in Australia. While Senetas manufactures high-speed conventional encryption systems and our technology is still pre-emptive, this partnership will allow us to establish a firm market share in the information security market, which we will be able to bank on in the future.

“The IOP workshop has given me, and therefore QZN Technology, relevant first-hand information for business development through carefully chosen case studies. I would certainly recommend it to someone considering attending, as it will also offer them a great networking opportunity and a platform for mentorship by experienced entrepreneurs.

“Since attending the workshop, my colleagues and I have presented talks at entrepreneurship workshops, offered internships to students in our labs and several of us have been involved with a Science Expo run by the Department of Education with a regional and national presence. Finally, QZN Technology will serve as an incubator for future commercial ventures in the field of quantum-based devices. We are championing the take-up of IOP’s entrepreneurship curriculum as an integral part of the training of post-grads at UKZN – we know first-hand what a difference it will make.”

“We are experts in our field, not trained entrepreneurs. The timing was perfect to sign up for the workshop.”



Rosula Reyes, Philippines

Mobile applications and hardware design, globally and locally

“When three fellow academics from the Ateneo de Manila in Quezon City and I decided to launch our own company, Blue Chip Designs, as a spin-off from our research group at the Department of Electronics, Computer and Communications Engineering, we knew little about starting or running a business.”



Dr Reyes with a few members of her team at the Blue Chip Designs offices

“We studied and learned the process of incorporating a company by ourselves, liaising with the Department of Trade and Industry, the Board of Investments, the Bureau of Internal Revenue... All without legal counsel, as we couldn’t afford one!”

“We began operating as a company in 2003, initially developing hardware design using HDL and firmware development using Field Programmable Gate Array (FPGA). We’ve now expanded into software development, and web and mobile applications, and are starting to be known in the telecommunications industry. We have recently developed a range of applications for the new Android platform, including RemoteDroid, which allows you to access your phone and several of its main functionalities remotely, and MyGreeterDroid, which synchronises with your online calendar triggering SMS messages for those important dates in everyone’s life.

“Major providers have been in contact for contractual projects, and we have an expanding network of mostly foreign clients. There are 12 of us in the team altogether; the four founding members, plus a team of design engineers and one clerical staff member. We are proud of the fact that 90% of our employees are pursuing or have obtained a doctorate degree in electronic engineering, electrical engineering or physics.

“Blue Chip Designs is based just opposite the university campus, which is convenient for us all. Most of our clients are in the US or Japan, but it’s easy to run our operations. With meetings on Skype, and information and communications via e-mail, distance is not an issue at all. As far as competition goes, we virtually don’t

have any in our hardware design work in the Philippines, as we cater for small- and medium-sized companies without R&D departments that must outsource their projects at least partially. However, in our software development work, competition is fierce. The comparatively low cost of labour and development mixed with English-language proficiency and solid creative skills mean that international companies find what they want easily in the Philippines.

“I attended IOP’s workshop on entrepreneurial skills in 2010, and it has proved enormously useful. Negotiations on intellectual property, contract development, marketing, operations and strategic planning, aside from all the technical aspects of running projects, were all tasks that we continuously need to enhance our skills in, and in which all of us at Blue Chip Designs lack formal training. The workshop has meant that we have now implemented business plans when proposing and developing new projects to clients, as well as the general management of the company.

We have also applied human resources management principles to how we work with our employees, which ensures that everyone is happy and can be as productive as they need them to be.

“I would really encourage others embarking on new physics-based business ventures to experience everything that I did at the workshop. Having access to the expertise of international lecturers is invaluable. The material covered is all essential knowledge for anyone setting up a company, and the hands-on development of a real business plan, under the supervision of highly experienced professionals, is a real eye-opener. And it was all so affordable – I was amazed at how much we got for our money. It goes to show how aware IOP is of new businesses’ financial capability and that they really do care about improving skills for the benefit of as many people as possible.

“Personally, I have now become a bit of a champion of the entrepreneurship curriculum here in the Philippines, and I have collaborated with IOP in the organisation of an entrepreneurship workshop in Cebu City in 2011.”

“The hands-on development of a real business plan was invaluable – a real eye-opener.”





Vardan Gevorgyan, Armenia

The many applications of absolute-position sensors

“Our company, PSI (Precision Sensors/Instrumentation) was launched in 2008 as a result of our team developing a new type of technology – what we call an absolute-position sensor – and proving that it could yield exceptionally high performance compared with other sensors. Several lab and field tests have given us irrefutable proof of this.”



A discussion with Singaporean partners at PSI's laboratory in Armenia

“Since then, our goal has been to develop our prototypes into deployable products and marketing them to a growing international client base. Our sensor (a single-layer, flat-coil oscillator) has numerous applications, but the most obvious and immediately marketable are systems for terrorist and ‘enemy’ detection, recognition and location identification in mountainous areas, as well as in battlefields with poor or no visibility; and products for border security monitoring, including for the policing of over- and underground illegal activities along national borders.”

“Based in Yerevan, the capital of Armenia, our team is made up of highly qualified physicists with many years of experience in R&D centres in the US and Japan and in US military organisations. My father and scientific lead of the company, Prof. Samvel Gevorgyan, is a specialist in low-temperature physics and precision scientific instrumentation, particularly in the field of superconductivity. Between all of us we have published more than 40 scientific papers and presented at more than 50 international scientific conferences. Our expertise and business concept are unparalleled in Armenia, although we have considerable competition internationally.

“As a former republic of the Soviet Union, Armenia still faces serious economic and financial difficulties, which makes it imperative to develop and sustain national enterprises and nurture home-grown talent. PSI’s policy has always been to involve students and junior scientists in our research activity, so that we all can benefit from the collaboration. It is

“Our plans are diverse and we hope to move into new business areas in the future”

the only way to retain the brightest minds and progress Armenian science. To this aim, I also work as a research adviser at the Institute for Physical Research at the National Academy of Sciences (NAS) of Armenia and I collaborate as a scientific researcher at Yerevan State University.

“We are also confident that our unique prototypes – including seismic detectors, microphones, micro-weighing machines and differential manometers – can help develop the research interests of other Armenian scientists and catch the attention of industrial managers, in Armenia and abroad.

“I am personally responsible for the commercialisation and marketing of PSI’s products, so we all agreed that I would be the one to attend IOP’s entrepreneurship workshop. I attended the session in Trieste, Italy, in 2010. It was an easy decision to make; it was obvious that I would be getting so much out of it. I learned a lot about the steps involved in developing a commercial product from an invention, the process of patenting, the protection of intellectual property, examples of legal contracts with companies and institutions, and more. The workshop has already borne fruit – I travelled to Russia a few months after the workshop to meet potential investors



One of PSI’s sensors being tested

and take part in a Business and Innovation Summit. As a result, today we are in conversations with a few venture capital companies, so we hope to be signing some contracts soon.

“In terms of the future, we have many, diverse plans. While we aim to make the most of our more established routes to market, we plan to move the business into new areas, for instance, developing medical and diagnostic applications, such as devices for measuring fine peculiarities in blood pressure or non-invasive lung investigations, and other industrial purposes, including developing underground surveying instruments. Meanwhile, we do our bit to support Armenian science, and have recently been in talks with the Dean of Physics at Yerevan State University to advise take-up of IOP’s entrepreneurship curriculum. It’s been hard to progress this among all our other commitments, but with my involvement at the university, we are confident that we will be able to incorporate it in the physics faculty’s development plan in the not too far future.”

Physics for a better world

By stimulating entrepreneurship among physicists at all levels, IOP helps developing economies to capitalise on the skills of its brightest minds.

To make this work, encouraging students at all levels to embrace physics and training physics teachers appropriately is vital. This is particularly true in the developing world, where lack of equipment, funding and professional training have too often limited opportunities.

Promoting physics education

IOP's Physics for Development programme includes a growing network of physics education projects in some of the world's poorest countries, currently focusing on the sub-Saharan region in Africa. By setting up resource centres within existing local schools, IOP's model is to provide teachers with expert advice and support from a team of volunteer co-ordinators – also highly experienced physics teachers – and to support local institutions in developing the educational infrastructure to train future generations of physics teachers appropriately. In this way, we aim for the centres to become self-sustaining, best-practice models that can make a lasting difference to the way that physics is taught and learnt around the world.

Today, the Physics for Development programme in Africa includes education projects in Rwanda, Tanzania, Uganda,

Ethiopia, Malawi, Ghana and Gambia. Although they are at different stages of implementation, all of the projects aim to address the specific needs of the country that they are situated in.

Promoting local craftsmanship

IOP is also keen to develop the skills of local craftspeople to produce and maintain physics experimental equipment to be used in the African resource centres. Such items are often scarce, or when they are available, they are often considered too “precious” to be used in class. Sometimes, the teachers themselves don't know how to operate them. By training local carpenters, plumbers, or electricians to make the equipment, IOP ensures that

it can be soundly built and looked after, as well as offering another route for employment to local communities.

Access to physics experimental equipment is an essential part of IOP's idea of improving physics education standards. It is through hands-on, practical experience that students can truly engage with the subject, make it their own, and appreciate its many applications. Donating equipment to African schools continues to be a big part of our work – IOP's involvement in Rwanda first began in 2005 thanks to IOP member and physics teacher David Richardson organising a donation, evolving from there into a network of different projects spread throughout the sub-Saharan region.

The last few years have been particularly successful for the programme, and the number of the projects across the sub-Saharan region is growing fast, thanks to the hard work of our volunteers and our in-house team. To help sustain the expanding work of the programme, IOP recently launched the IOP for Africa fundraising campaign. From the proceeds, IOP has been able to fully fund the initial set-up of the new project in Malawi.

The campaign is still live, and additional donations will enable us to fund more projects in sub-Saharan countries. For more detailed information on our work in the region or to make a donation, visit www.iop.org/iopforafrica



Ghanaian schoolgirls studying electric circuits at an IOP-sponsored resource centre in Ada

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and any of IOP's other international activities, contact:

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