UTS Insearch
UNIVERSITY OF TECHNOLOGY SYDNEY

Inspired Potential

Research and Innovation collaboration between Australia and Vietnam

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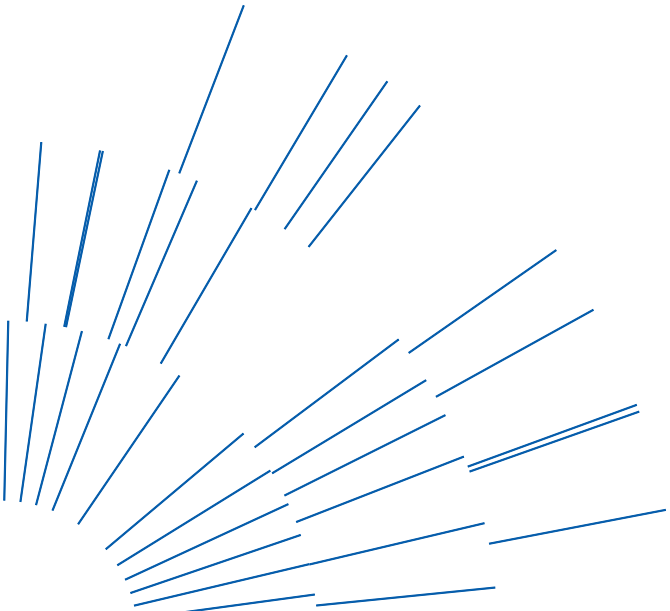


Executive Summary

Background

Australia and Vietnam have had increasing engagement in many areas, especially in education and training. The Australian Department of Education recognises the active research collaboration between Australia and Vietnam through formal academic research partnerships and faculty exchanges. The Department of Education commissioned UTS Insearch (Insearch) to conduct research to identify three case studies of outstanding successful research and innovation collaborations between Australia and Vietnam. This report is the result of that research and has been written by Cat Thao Nguyen, with research support from Thu Tran, Phillip Allen and Sameer Mittal.

Methodology

An initial desk top research scan collated public information regarding research and innovation collaboration between Australia and Vietnam. However, results from the desk top scan lacked sufficient research examples, so the author drew on various networks and relationships in Vietnam and Australia to supplement the desk top research. Research examples were reviewed in discussion with Department of Education and three examples were selected as case studies for this report, taking into consideration the mode of collaboration, demonstration of innovation, and research sector. The three case studies featured in this report provide a cross-section of innovative research with varying forms of collaboration and in different fields of research. Interviews were then conducted with various stakeholders in Australia and Vietnam.

Case studies summary

Disrupting agribusiness

Stage: Concept

Partners:

Edifies Pty Ltd and various partners including RMIT Vietnam, and various Vietnamese provincial governments

Edifies Pty Ltd is an Australian start-up founded by entrepreneur Joel Gage. Vietnam faces major issues with climate affecting its agricultural sector including salination of the soil. Australia has massive areas of unused land. Joel found a way in Australia of growing fruit and nut trees in porous bags above ground ensuring they are mobile and not dependent on the ground soil. By utilising blockchain[2] for traceability and the Internet of Things (IoT) for optimising farming, he envisages a trading platform that can allow investors to purchase trees as assets, monitor yields accurately and trade their asset just like stocks on the stock exchange. With technology, transparency is created between landowner, farmer, investor and consumer. So revolutionary is this concept, four provincial governments in Vietnam have offered Edifies land to pilot the concept. Success can mean scaling this idea not just across Vietnam but also Australia and beyond.

2 Blockchain is a technology that assists to ensure transactions are verifiable and transparent. According to IBM "As each transaction occurs – and the parties agree to its details – it's encoded into a block of digital data and uniquely signed or identified. Each block is connected to the one before and after it — creating an irreversible, immutable chain. Blocks are chained together, preventing any block from being altered or a block being inserted between two existing blocks." https://www.ibm.com/blockchain/what-is-blockchain

Joint technology, innovation and research centres

Stage: Ongoing

Partners:

University of Technology Sydney (UTS) and Vietnam National University (VNU), University of Engineering and Technology (UET), Ho Chi Minh City University of Technology

UTS has established two joint technology, innovation research centres in Vietnam – one in Hanoi in 2015 with VNU-UET and one in Ho Chi Minh City (HCMC) in 2017 with Vietnam National University HCMC University of Technology. These centres were the first of their kind in Vietnam for any Australian university. The model links university, government and industry to address national strategic priorities through agile teaching, research and technology collaborations. The model facilitates access to Vietnamese talent while keeping research and PhD talent in Vietnam, allowing UTS to co-supervise Vietnamese PhD students in country and Vietnam to benefit from the outcomes of this research. Today, research is being conducted at the centres in areas such as cyber security, data visualisation, and application of Artificial Intelligence among others.

Efficient prototyping

Stage: Completed

Partners:

TMA Solutions with Professor Greg Knowles of CEQEO

TMA Solutions with the University of Adelaide

Dr Nguyen Huu Le is the Chairman of TMA Solutions, a Vietnamese software company employing over 2000 engineers. Dr Nguyen Huu Le, an Australian alumni, saw the opportunity for collaboration in research and innovation between TMA and Australian universities.

Professor Greg Knowles formerly of Flinders University, had developed a method in genome sequencing that would reduce the cost and increase the efficiency of existing solutions. TMA became the partner to work on the prototype in Vietnam with a dedicated team over 5 years, eventually achieving success.

Dr Hung Nguyen is a Senior Research Fellow - Teletraffic Research Centre, Faculty of Engineering, Computer and Mathematical Sciences at the University of Adelaide. He collaborated with TMA to assist with two research projects:

a) To study the application of Blockchain for IoT; and

b) To study Policy Routings in Software Defined Network (SDN)

Both these research areas have the potential for tremendous impact in how we work and communicate in almost every facet of life in this century and beyond.

Background and methodology

In March 2018, two agreements between Australia and Vietnam were signed including a Memorandum of Understanding (MOU) on vocational education and training and a broader education MOU. Concurrently, Australia and Vietnam officially entered a strategic partnership - the highest level of diplomatic partnership. Whilst Department of Education recognises the active research collaboration between Australia and Vietnam through formal academic research partnerships and faculty exchanges, there is also research and development partnerships occurring beyond academic collaboration. Against this backdrop and the increased potential of the bilateral relationship, Department of Education commissioned Insearch to conduct research to identify three case studies of outstanding successful research and innovation collaborations between Australia and Vietnam. Insearch was also to evaluate (where applicable) alumni relationships between Australian and Vietnamese universities and institutions that have led to fruitful research linkages.

The project, by identifying and reporting on the three significant existing collaborations, was to produce a final report that will be used to:

- provide information for governments, universities and research agencies about the three most successful past and existing research collaborations between Australia and Vietnam institutions (i.e. universities, research institutes, businesses)
- profile Australia as one of Vietnam's preferred research partners
- promote Australian excellence in research and innovation

Whilst there have been and continues to be successful research collaboration between Australia and Vietnam, the chosen case studies represent diversity in terms of discipline, size, type of innovation and stage of project. This was important to demonstrate the different and varying potential of collaboration between the countries.

A research team at Insearch conducted a desk top scan to collate public information regarding research and innovation collaboration between Australia and Vietnam. The resulting information lacked sufficient quality because detailed information about such research partnerships have not been widely published on the internet. The author drew on various networks and relationships in Vietnam and Australia to supplement the desk top research. Research examples were reviewed and selected in discussion with Department of Education representatives in consideration of mode of collaboration, research stage and sector. Interviews were then arranged between various stakeholders in Australia and Vietnam.

The detail contained within each case study is a result of completed questionnaires and interviews. Statements made within this report regarding the science or actual research related to the various research projects is neither validated nor endorsed by Department of Education, Insearch or the author. They are made by the case study partners and included to demonstrate the research context, significance and the compelling reasons behind the collaboration objectives. The purpose of this report is to demonstrate examples of the differing nature of collaboration and therefore potential, in research and innovation between Australia and Vietnam.

Detailed Case studies

Case study 1

Disrupting agribusiness

The Edifies idea

Joel Gage is an Australian entrepreneur, having successfully founded Upskilled, an online education company with over 4000 students every year. He has always been passionate about agriculture claiming that he is a 'farmer at heart'. Edifies Pty Ltd ("Edifies") is an Australian based start-up high tech agribusiness focusing on the production of Australian varieties of fruit and nut trees. Edifies is dedicated to developing a scalable and successful long term commercial organic agribusiness that has wide social impact.

In Australia, Joel saw vast amounts of unused land deemed unable to be cultivated. Joel came across the idea of growing fruit and nut trees above ground in special porous bags that would allow the roots of the trees to grow in a way that would generate good yield. But beyond this idea, Joel believed that there was a need to bring farmers into an ecosystem together with investors, landowners and consumers which would enhance value for all in the food production industry.

The farms would not only grow the trees above ground, limiting reliance on changes in soil quality and impact of natural disasters, it would use the IoT, utilising sensors to control irrigation, collect data and monitor yield. Blockchain technology will be employed to provide traceability and credibility to underpin a financial investment platform that will enable investors to purchase assets (trees) and provide liquidity to be able to trade throughout the life of the asset. Blockchain application in the business model can also ensure food safety for consumers. Annual yields are calculated on the age of the tree and paid in the form of dividends to the investors. The landowners are also stakeholders and would receive a share of the annual yields. IoT will enable each asset to be monitored and maintained to provide comprehensive reporting to all stakeholders enhancing transparency and tradability. The model adopts Australian innovation and technology in food production to advance the quality of fruit and vegetable production in Vietnam. Edifies' ultimate goal does not end at providing safe, high quality outcomes and "gold standard" for food but also provides employment opportunities and training for farmers and other stakeholders.

Local Social Responsibility: Growth Benefit Model

Background to Vietnam collaboration

Whilst on a visit to Vietnam in 2017, Joel met the former Australian Consul General to HCMC. The Consul General connected Joel to various people including from the Australian Chamber of Commerce, RMIT Vietnam, education and government representatives. After extensive conversations with different groups, Joel was convinced that establishing pilot sites for his concept in Vietnam would be possible and beneficial for many stakeholders both in Vietnam and abroad. The Vietnamese economy could be a place to prove the concept, commercialise the idea which would then lead to export of organic standard produce to the rest of the world.

Feasibility research - RMIT Vietnam

RMIT Vietnam and Edifies signed a memorandum of understanding in 2018 which allowed 13 Executive MBA students supervised by faculty, to work on feasibility, business models, processes, marketing and financial models. Business students worked with Edifies as a client and presented reports to Edifies in multiple areas in May 2018. The students worked on the project and received credit in various subjects. Time from the faculty was provided in kind.

The RMIT Vietnam student team did extensive research on the potential of macadamia nuts to pilot in Vietnam. Their research included looking into global market demand and consumption trends. Business models were explored from profit/revenue sharing to joint ventures. The work done by the RMIT Vietnam students provided the necessary insight to prove the feasibility of the concept as well as recommending business processes for the pilot. The financial model was comprehensive covering farm set up costs, technology, maintenance, training, compensation structures for farmers and external variables including price movements.

The Business Processes report delivered by the RMIT Vietnam team covered end to end business processes:

- Initial farmer recruitment
- Plant and equipment procurement
- Main tree nursery
- Farm setup
- Managing the pilot period
- Sourcing future farm sites
- Payment to farmers
- Logistics
- Initial and ongoing training

Product

Farmers

Needs & Wants

- Income
- Tech Support
- Commitment
- *ROI*

Core Product

- Maca Farming
- *Rental Income*
- Investment Opportunity

Landowners

Basic Product

- Grafted Trees
- Training
- Fertilizers, toold
- Compensation
- *Reliable Tenant*
- Shares

Expected Product

- Attractive Income
- Trust in maca potential
- % revenue
- *Rental Payment*
- Transparency

Investors

Augmented Product

- Hi-tech IoT
- Insurance
- Community
- *CSR*

Potential Product

- Block-chain

Case study 1

Disrupting agribusiness (continued)

Development collaboration in Vietnam – Vietnamese local government

The Australian Chamber of Commerce introduced Joel to the Vietnam Ministry of Foreign Affairs. In turn, the Ministry, following support for the innovative concept, introduced him to various provinces in Vietnam.

After meeting with People's Committees from six provinces, Edifies shortlisted four provinces to work with which have each offered Edifies land as pilot sites for no fee. These provinces are Khanh Hoa, Binh Dinh, Hue and Thai Binh. Each of the Chairmen of these provinces together with the relevant departments are very supportive of providing the land and necessary resources to conduct the pilot, including promoting the project to their farmers and land use title owners. Following the success of the pilot, further land and support will be made available. The People's Committee Chairmen expressed that if proven, the concept would revolutionise current farming and agribusiness generating higher value and return for their farmers, not just in monetary value but also in skills and training.

The purpose of conducting the pilot programs in each province prior to full commercialisation is to test, measure and select the specific fruit and nut types and growing methods suitable for each location. There are many varieties of each fruit or nut type that will be tested. The initial trees will be exported from Australia. Australian avocado, macadamia nut, finger limes, Kakadu plums and pecan nuts are few examples of what will be tested in the initial pilots.

The four selected pilot sites will be manageable in scale, but at the same time they will contain all of the essential features that will facilitate the scaling up of operations once the model is established. Each pilot site is approximately ten hectares in area and will grow approximately five thousand macadamia trees.

The revenue projections for each of the sites indicate that they will be operating in profit and self-sustainable within four years of commencement. The initial duration of the pilot period will be four years.

Each site will provide employment and training opportunities for the surrounding community. Given that Joel has a background in skills training, he is passionate to ensure there is training not only of farmers, but other staff involved in the project. Students will receive Australian qualifications. In addition to training the local community, Edifies intends that world's best practices will be applied through the use of the latest technologies via R&D guidance from subject matter experts in Australia, Vietnam and around the world particularly in IT. Edifies is currently in discussion with a leading Australian university to be the technology partner.

Project status

Edifies is in the process of finalising a partnership with a technology partner and seeking funding to support the first pilot sites. The project is still in concept stage but various partners from state governments in Australia, industry associations and private investors have expressed endorsement of the concept.

Case study 2

Joint Technology and Innovation Research Centres (JTIRC)

Background

In 2015 the UTS Faculty of Engineering and IT identified Vietnam, one of the world's most dynamic economies, as a market partner in establishing agile teaching, research and technology collaborations.

The Faculty envisaged a model of engagement that would facilitate access to Vietnamese research and PhD talent while keeping that talent in Vietnam, allowing UTS to co-supervise Vietnamese PhD students in country and Vietnam to benefit from the outcomes of this research.

During 2016 a senior delegation of the UTS Faculty of Engineering and IT visited Vietnam.

UTS was subsequently invited by the VNU Hanoi, to become an institutional partner in the International Education Research and Development Zone (IERDZ) of the new Hoa Lac High Tech Park[2].

The intention of the partnership was to develop joint research centres in areas that have relevance to the Vietnamese context with potential to address key Vietnamese priorities such as water management and technological capabilities.

Vietnamese government ministries, city councils, national-level hi-tech parks and UTS Faculty of Engineering and IT identified key areas for collaboration: Industry 4.0, IoT, smart city, smart farming, and cyber security.

These discussions were built into a university partnership that would unfurl through joint PhD programs and research labs in Vietnam. The resulting model links university, government and industry to address national strategic priorities.

Professor Eryk Dutkiewicz, Head of the School of Electrical and Data Engineering at UTS, knew academics from VNU from previous visits around 2014. Dr Diep N. Nguyen, Senior Lecturer in the School of Electrical and Data Engineering at UTS, received his undergraduate education in Vietnam and had existing connections with VNU Hanoi, VNU HCMC, and others. These relationships strengthened the partnerships between UTS and VNU Hanoi and VNU HCMC.

2 Hoa Lac High Tech Park is located in Hanoi with the scale of 1.586 ha. It is developed to become a science city, a place that attracts investors in research & development; training and education; software development and the manufacturing of hi-tech products.

Collaboration objective

The objective of the collaboration between UTS and VNU-UET Hanoi, and UTS and HCMUT is to attract high quality higher degree research students and researchers, to build strong relationships with local industry in Vietnam and ultimately increase UTS' impact in Vietnam.

Funding

UTS supports the project jointly with the partner in-country. As the scope of the project is realised, industry research funding will support the JTIRCs to be self-sustainable by 2020.

In-kind funding for Professor Dutkiewicz and Dr Nguyen is about one month and three months per year, respectively.

UTS also contributes academics and scientists to supervise PhD students at the centres. There is a list of more than 50 professors and academics from key research centres at UTS who are ready to co-supervise PhD students.

Start date of the project

Discussions began in earnest in 2015, and the UTS-VNU JTIRC was launched in Hanoi in March 2017. The UTS-HCMUT JTIRC was launched in HCMC in May 2018. The partnerships are ongoing.

Case study 2

Joint Technology and Innovation Research Centres (JTIRC) (continued)

Process of establishing the JTIRCs

Stage 1 Partnership agreement

6 months

Lead academics, international team, counterparts

- Discuss potential collaboration
- Identify best model of engagement
- Negotiate draft agreement to facilitate
- Arrange signing event

Stage 2 Vietnam government support

6 months

Project partner in country, lead academic

- Establish links with local government
- Establish local support
- Explore areas of common/complementary interest where UTS can actively contribute
- Define research focus of partnership

Stage 3 Physical location and set up

6 months

Lead academics, international team, counterparts

- Identify appropriate location
- Develop plan for physical lab space in context of research focus
- Liaise with UTS operations to fit out space according to UTS specifics
- Liaise with partner and contractors to implement

Stage 4 Project launch

2 months

International team, counterparts

- Liaise with partner to identify date, location, invitations for launch event
- Coordinate marketing collateral
- Organise senior delegation to attend
- Promote project launch

Stage 5 Industry engagement

Ongoing

Academics from both partners

- Actively seek out relevant industry links
- Develop meaningful collaborative relationships
- Promote applicable research under JTIRC
- Secure industry funding

Outcomes

In its first year, the UTS-VNU JTIRC secured eight PhD students, two grant opportunities, and one major sponsor – FPT Corporation. FPT provides full scholarships for 3 PhD students.

Two projects, funded via grants, are as follows:

A) Cyber-Attack Detection and Information Security for Industry 4.0, funded by NICT Japan through the ASEAN IVO grants (Trung Linh Nguyen, Hoang Dinh, Diep Nguyen, Eryk Dutkiewicz, Nguyen Viet Ha, Dusit Niyato)

B) Investigate and Develop an Internet-of-Things Dual Band Transmitter for Agriculture, funded by the Vietnam Ministry of Science & Technology FIRST Talents (Tran Xuan Tu, Pham Anh Vu, Diep Nguyen, Eryk Dutkiewicz, Yang Yang, Francesca Lacopi)

Individually, the partners completed agreed activities in their respective arenas: VNU identified three major industry contacts, and UTS facilitated scoping discussions with selected industry contacts.

All PhD students submitted high quality conference papers by the end of the first year including in:

- IEEE International Conference on Communications (ICC)
- IEEE International Conference on Image Processing
- IEEE Network Magazine
- IEEE Transactions on Communications

The positive impact of the JTIRC in Hanoi led to the development of a second JTIRC in Ho Chi Minh City, with a driving focus on cyber security and IoT for smart cities.

To date, two Research Schools have been held under the JTIRC, the inaugural Research School (RS) 2017 in Hanoi and a second RS2018 in concert with the launch of the JTIRC in Ho Chi Minh City. The Research School is now an annual event that attracts PhD students, academics, and research engineers from across Vietnam.

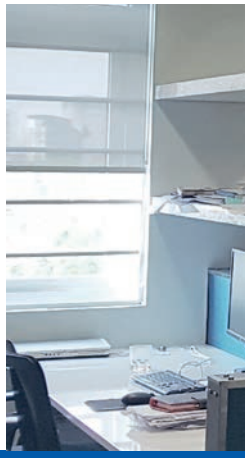
For the research schools (RS2017 in Hanoi and RS2018 in HCMC) each year, UTS trained more than 100 PhD students, research engineers and academics across Vietnam (from more than 20 universities and major industry partners such as Viettel, Samsung, VNPT, and BOSCH). UTS provided potential PhD students with travel allowances and accommodation support to attend the event.

In September 2018 VinTech, a new research institute established by leading business cluster Vingroup, signed a Memorandum of Understanding with UTS as the JTIRC's second major industry partner.

Projected outcomes include the establishment of Post Doctorate Fellows, a quota of 20 PhD students in each centre, and increased industry engagement and research projects.

Case study 2

Joint Technology and Innovation Research Centres (JTIRC) (continued)



Current research projects

Hanoi

Kieu Thanh Binh
- Data mining for scientific document analysis
- Data mining to identify techniques to recommend reading orders and citation lists for researchers, particularly new or inexperienced ones.

Nguyen Ngoc Tan
- Energy efficiency for 5G networks
- Solving pressure placed on energy efficiency by a group of mobile users moving at the same time by dividing and offloading the traffic they cause.

Nguyen Thi Hong Nhung
- Crack detection and classification of road pavement using digital image processing
- Finding ways to improve the use of automatic crack detection in pavement maintenance to maintain safety standards and usability in urban environments.

Phi Cong Huy
- Plenoptic data representation and coding for visual processing
- Improving data representation and coding methods in line with human perception to improve applications such as Virtual Reality, Augmented Reality, and 3D scanning

Nguyen Duy Anh
- Hardware architecture and solutions for efficient processing of deep neural networks
- Finding ways to efficiently process deep neural networks to reduce computational complexity and related power consumption while maintaining the standard of Artificial Intelligence that supports many modern applications

Luu Viet Hung
- Exploring the relationship between a 3D city model and air pollution
- Investigating crowd sourced geo-information to more efficiently develop 3D city models, and using these in environmental science to solve future environmental problems

Nguyen Manh Hai
- Application of Artificial Intelligence and Machine Learning into Operation Research
- Investigating ways to use Artificial Intelligence and machine learning in operations research to streamline organisational management

Ho Chi Minh City

Eric Hoang
- Security Analytics of Ethereum Smart Contracts
- Analysing data to assess the security of smart contracts in the Ethereum computing platform, for credible transactions without third parties, that can be used to support e.g. social media, financial exchanges and identity systems

Cong Nguyen
- Develop Consensus Mechanism for Future Blockchain Networks
- Developing a fault-tolerant mechanism that can clarify data values and network states in some processes and systems for future blockchain networks that will support e.g. self-driving cars and a secure internet

An innovative approach

The UTS-VNU Joint Technology and Innovation Research Centres are the first collaborations of their kind between Australia and Vietnam.

What sets the project apart is its consultative nature and emphasis on local partnerships for local impact – a partnership with a leading Vietnamese university and industry figures that play a key role in the growth of Vietnam, galvanised by support from both Vietnamese and Australian governments.

In Vietnam, the JTIRCs are the first Australian linked research institutes that offer PhD students the chance to carry out their research full time and at a world-level quality. UTS JTIRCs in Vietnam commit to excellence in both research and industry impact. They bring the unique strength of UTS in engaging with industry to VNU in Hanoi, and VNU in HCMC. UTS applies the high-quality research processes and standards employed in Australia to the research activities under the JTIRCs.

The reciprocal nature of the JTIRC model actively contributes to the development and employment of a highly-skilled workforce in Vietnam. JTIRC partners are together building the next generation of researchers for academia and for industry. The partnerships are ongoing relationships underscored by mutual commitment.

The Faculty will engage up to two post-doctoral research fellows in each of the centres. The fellows will support PhD supervision and research projects and support the JTIRC Co-Directors in the operational management of each JTIRC.

UTS is exploring a doctoral model (through the JTIRCs) with industry partners to build human capital and research in-house. Rapido, the signature advanced technology development unit of UTS, has great traction as a concept in Vietnam. Rapido focuses on supporting universities to deliver hardware and software prototypes and solutions to industry.

UTS is working with both JTIRCs and hi-tech parks in both Hanoi and HCMC to establish a local model (Rapido Vietnam), consisting of research projects that have practical application in commercial sectors, and technology transfer.

UTS is also exploring the integration of Sydney research and activity to Vietnam by incorporating the use of pioneering new facilities such as ProtoSpace and Tech Lab in Sydney.

Case study 3

Efficient prototyping

TMA & University of Adelaide

Dr Nguyen Huu Le is a Colombo Plan scholar and graduated with a PhD in Telecommunications Engineering from the University of Adelaide. After a successful career in Australia, Canada and Japan he returned to Vietnam to join a small software technology company with a handful of staff. As Chairman, he has overseen the growth of TMA to now employ over 2400 engineers with clients in 27 countries and offices all around the world.

At the end of 2015, Dr Nguyen Huu Le visited his alma mater, specifically the School of Electrical and Electronics Engineering at the University of Adelaide. He made a presentation on the opportunities to collaborate in research and development. Through this event, Dr Hung Nguyen, Senior Research Fellow - Teletraffic Research Centre, Faculty of Engineering, Computer and Mathematical Sciences was introduced to TMA. Dr Hung and Dr Nguyen Huu Le agreed to start collaborating on small R&D projects with the purpose of understanding each other's research capabilities, strengths and weaknesses. Dr Hung Nguyen proposed a list of his on-going and new research he was taking part in. Together, two projects were selected.

Project: To study policy routing mechanisms in Software Defined Network

Research context

Software Defined Networking (SDN) is widely seen as the future of internet technology and models. It is changing the way that the internet is built and managed. The current technology is based on distributed protocols where every network device such as a router, makes its own decisions about internet traffic. Many internet service providers presently use proprietary hardware equipment such as routers. In SDN, the approach is completely different and not based on proprietary hardware equipment. With SDN, decisions about internet traffic are centralised and controlled by software. Network operators or internet service providers such as Telstra would run assets with several controllers. SDN aims to build a network that is resilient to failure and robust against different traffic conditions. For example, during the day, internet use in the central business districts would be high, but in the evening, it would be low. SDN centralises decision making on routing internet use to manage changing internet use traffic. With SDN, users of network hardware can fully control their networks in the way they want without being blocked by the proprietary controls

traditionally contained in the networking hardware sold by mainstream vendors of networking equipment. Current internet service providers buy bandwidth and sell to enterprises in fixed units. With SDN, bandwidth can dynamically be allocated to those that need it depending on usage. It offers greater efficiency and flexibility. However, if the SDN control is down, it is unclear how it can recover. Building a highly reliable SDN control plane is critical for the success of SDN systems.

Collaboration objective

The research project between TMA and the University of Adelaide looks at a particular aspect of the way SDN is used. In the event of a failure of the SDN, the project looked at how best to place the controllers in an SDN in the right place within the network to achieve best performance for low latency and resiliency. Resiliency means what would happen if for example, one of five controllers fail and how to activate the other controllers. The project involved mathematical modelling and simulation to test policy defined networking to study the reliability of SDN networks in practical failure situations.

Partner contribution

Dr Hung Nguyen from the University of Adelaide provided expertise in internet technology & topology of the internet which is the result of his cumulative research over 10 years. Through his research, he developed a data set pertaining to network topology, which is essentially a graph of the network worldwide. This data set is one of the most widely used data sets of internet topology in the world and was essential to the research collaboration. Dr Hung Nguyen and Duong Nguyen, a University of Adelaide PhD student, developed theories, including mathematical models/ algorithms for trial to simulate failure situations and evaluated the experiment outputs. TMA software engineers used these algorithms and the data set to develop software packages/codes to simulate test scenarios which involved high level simulated placement of controllers within the internet topology. As a result, predictive activity within a failure situation could be determined. Dr Hung Nguyen and Duong Nguyen evaluated the test results.

If the simulation was done in Australia, the cost and time would have been significantly much more compared to the collaboration with TMA. TMA contributed 2 engineers full time to the project valued at $100,000 AUD.

Outcomes

The smart algorithm and code was developed and is publicly available. It is unique and innovative. A joint journal paper is being submitted to the Elsevier Transactions on Computer Communications Journal which will academically validate the approach and final algorithm. There is great potential for the algorithm to be used to design highly resilient SDN networks.

Case study 3

Efficient prototyping (continued)

Project: Study the application of Blockchain for IoT

Research context

In 2016 when the research collaboration was envisaged, blockchain technology was not as developed as it is now. Blockchain is the technology that underpins the crypto-currency system and allows for traceability and transparency with transactions. Its application has been envisaged and deployed in many industries such as agribusiness to help consumers trace the source of food.

The IoT network comprises of many connected sensors. Communication among devices needs to be light and simple but also secure. Presently information transferred between devices such as wireless closed-circuit television cameras, is not necessarily secure. It was contemplated that blockchain's security features would be applicable for IoT but when the research project began, Blockchain protocol was quite complex and too heavy to deploy for IoT.

Collaboration objective

The project focussed on improving blockchain performance and distributed registration for the IoT by building a lightweight blockchain protocol using limited processing power and energy. An example of the application would be a smart fridge ordering milk from a supplier when the milk is empty but that the transaction to purchase milk is built on blockchain.

Partner contribution

Dr Hung Nguyen asked TMA to build a prototype of a blockchain IoT simulator that he developed. TMA committed a team of three software engineers to develop the software and their time is valued at $100,000 AUD.

Outcomes

A package of open source software simulating Blockchain protocol in an IoT environment was successfully developed and tested. Dr Hung Nguyen will review the results to examine what the next steps are with this project.

TMA & CEQEO

Background

Dr Nguyen Huu Le and Professor Knowles were friends in Adelaide when they were both doctorate students in the 1970s. They kept in touch through the years. In 2011, Dr Nguyen Huu Le met with Professor Knowles in Adelaide and Professor Knowles shared what he was doing with CEQEO Pty Ltd as the founder. The collaboration started from there with TMA also subsequently becoming an investor in CEQEO.

Research context

Professor Greg Knowles, is a retired Professor of Mathematics from Flinders University. He is founder and CEO of CEQEO Pty Ltd, an Australian bio-informatics technology company.

DNA sequencing is used to find variances in DNA bases that can be used in personalised medicine as well as medical research. Looking at how DNA has changed under certain treatment for example, when a patient experiences cancer, can help medical professionals to treat the patient in a more effective way. DNA sequencing can help researchers look for patterns in various genetic diseases but also mental health, to better understand the illnesses and therefore develop effective treatment. There are vast applications that have significant implications.

In DNA sequencing, raw DNA data extracted from blood samples passes through a DNA machine to sequence it. There can be quite a lot of errors when this process happens due to the complex process. Therefore, many copies of DNA are processed to correct for the errors. For a typical human genome, there is about 100 giga bases of raw data.

The explosive growth of DNA data and researcher's demands were being solved by ever increasing usage of inefficient data processing centres based on generic architecture. In 2011, the market was generally using software from standard platforms to process sequencing data. Professor Knowles' idea was to use programmed hardware instead of cloud software, in the form of a special chip called Application Specific Integrated Circuits (ASIC). In the same way that a personal computer has dedicated chips for dedicated functions, such as a graphic chip, Professor Knowles believed that with an algorithm he developed to be programmed into an ASIC, the cost and speed of DNA sequencing would be dramatically lowered.

Collaboration objective

The objective of the collaboration was to use Professor Knowles' algorithm and apply it to create physical chips that could be inserted into servers for DNA sequencing. Users would then be able to log into the servers and process DNA data more quickly and cheaply than existing solutions.

Partner contribution

TMA's team of engineers working of the project for 4 years is valued at about $720,000. Professor Knowles contributed extensively his time in guiding and supervising the team in addition to his algorithms.

Case study 3

Efficient prototyping (continued)

Collaboration process

The team of 8-10 engineers were new graduates led by Director at TMA, Dr Thai Bui. Professor Knowles travelled extensively to Vietnam to train the team. He was impressed with the dedication, hard work and talent of these young engineers. The team had initial ideas of chip design from their education in Vietnam. But with Professor Knowles' supervision and training, the young engineers achieved a lot. After the first chip was created and tested, they went to work on a second chip then a third.

Outcomes

The TMA team with Professor Knowles developed a product that exceeded their expectations. They created hardware and firmware-based architecture for DNA sequence analysis where the design computational processing of DNA sequence data is fully optimised for performance and speed. The solution was able to sequence genes faster than any other product in the market at the time.

In DNA processing, different providers had different algorithms with varying accompanying claims about them. The United States' National Institute of Standards and Technology (NIST) developed a gold standard benchmark to compare algorithms. CEQEO successfully benchmarked against the NIST gold standard.

Initially, standard manufactured boards were used as the basis of the chips. As a side project, the team decided to design their own boards that would be specialised to address different user needs with variations in cost and speed. As a result, FPGA chip boards were created that could be implemented in machines, in a cluster and in the cloud - depending on customer requirements.

Unfortunately, the team was too late to commercialise the product. A competitor developed chips and with greater access to investment funding in the United States, launched the product earlier than CEQEO.

Next steps

The newest generation approach to DNA sequencing is called nanopore single molecule sequencers. Current widely used machines can only read about 150-250 bases of DNA. However, a human's DNA is about 3 billion bases. Given this, the DNA is broken down before sequencing and then reassembled in software. Nanopore technology allows reading of up to 100,000 DNA bases in one read but the processing is still quite slow. Given that it is quite new, there are inaccuracies. Applications are still limited to sequencing viral and bacterial DNA. CEQEO is looking at extending Professor Knowles' hardware-based algorithms to nanopore sequencing to improve speed and accuracy.

This will most likely involve the TMA team. As speed, accuracy and cost is improved for DNA sequencing, diseases can be better understood which can lead to breakthroughs in medicine and healthcare.

Lessons learned

Success factors

The case studies in this report exhibit critical success factors built upon principles that enabled each partnership to be effective. These principles include:

- Explicit mutually beneficial outcomes for both parties
- Shared vision as to the outcomes that are clear from the outset
- An alignment of priority areas that are vital to the development of each partner country
- Strong personal and professional relationships forming a solid foundation for the partnership

Shared priority areas

The research projects within the JTIRC focus on areas that are of great priority to Vietnam but also to Australia. Vietnam is grappling with the impact of technology such as automation on its economy, with issues of cybersecurity and telecommunications infrastructure. These areas of concern are not isolated to Vietnam.

Replicable lesson

- Focus areas that are priorities for both countries' advancement should be a foundation principle for any successful partnership.

Involvement of broad base of stakeholders

In the case of UTS, the involvement of stakeholders from across the spectrum of government and industry was important, rather than confining the stakeholder base to be purely academic institutions. This helped to shape the centres' focus areas and garner support within the partner institution, Vietnamese government and Vietnamese companies. Edifies connected with the Australian Chamber of Commerce in Vietnam as well as with the Australian Consulate General. These organisations facilitated connections to RMIT Vietnam as well as the Vietnam Ministry of Foreign Affairs. Engaging government and industry in early conceptual stages of the project allowed Edifies to build multiple local government partnerships to pilot the concept.

Replicable lesson

- Involvement of stakeholders including government and industry should be considered as the partnership/concept is designed.

Lessons learned (continued)

Strong personal and professional relationships

The case studies included in this report each demonstrate that personal relationships have either sparked the collaboration, nurtured and/or accelerated the partnerships. The academics at UTS, TMA & CEQEO had relationships that, in some cases, flourished over decades. Relationships with Australian alumni returning to Vietnam with professionals in Australia can foster research and innovation partnerships. Having opportunities that can facilitate these professional relationships can lead to impactful partnerships.

Replicable lesson

- Locate alumni or those with existing relationships with the partner to become involved in the partnership as key drivers. Foster relationships early on in a professional's career path and not just at senior levels. This will support an eco-system of relationships that can grow overtime as the professional advances in their career.

Collaboration between research institutions and industry

TMA, a private Vietnamese company, worked with the University of Adelaide to create an opportunity for TMA to present to researchers interested in partnering with TMA to create prototypes or extend their research with Vietnam-based resources. This initiative resulted in an ongoing partnership and two projects. Research institutions can also take the same initiative when it comes to potential industry partnerships in Vietnam. Research institutions can work with key industry associations, chambers of commerce and leading companies to showcase opportunities for research and innovation partnerships.

Replicable lesson

- Identify a potential industry association or leading corporate group in Vietnam to initiate an opportunity to showcase strengths facilitating open dialogue on possibilities for research and innovation including commercialisation.

Concluding remarks

The Vietnam and Australia bilateral relationship has strong foundations which continues to flourish through defence, trade, science and education partnerships. Given that Vietnam and Australia have now elevated their diplomatic partnership to a strategic level, it is hoped that further research and innovation partnerships can be instigated and propelled. Indeed, as this Report demonstrates, such partnerships espouse inspired potential to address the shared challenges facing each nation and the region.

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