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Universities New Zealand
Collaboration between universities and
industry

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Collaboration between universities and industry

There is significant international research indicating that university-industry collaboration (**UIC**) is a powerful source of innovation. For example, World Bank (2013) found that UIC is critical for skills development, generation, adoption of knowledge, and promoting entrepreneurship. Similarly, Nelson (2017) found that UIC is a critical for the development of knowledge economies and societies.

It is in this context that Universities New Zealand commissioned Deloitte Access Economics to prepare a paper on UIC. This paper defines UIC, explores the key benefits of UIC, and provides insights into how to improve UIC in New Zealand and how to measure the outcome of UIC.

What is university-industry collaboration?

Collaboration means different things to different people. Perspectives of collaboration varies between company leaders, government and academia, and these views differ across disciplines.

Adler et al. (2011) wrote "collaborative communities encourage people to continually apply their unique talents to group projects - and to become motivated by a collective mission, not just personal gains and the intrinsic pleasure of autonomous creativity." Indeed, this approach fosters not only innovation and agility, but also efficiency and scalability (Deloitte Access Economics, 2014).

Collaboration is an activity that is widely spread across the economy. It is not only limited to a workplace, or between universities, but also occurs between universities and industry.

UIC can be formal or informal. Formal UIC includes formal contracts, collaborative research projects, patent licensing, co-development, and co-authorship, where both parties are expected to contribute to knowledge development. Informal UIC includes, among others, human capital mobility, interaction at conferences, and expert groups (Deloitte Access Economics, 2018).

Universities tend to participate in UIC for reputation enhancement, and to gain access to funding and industry empirical data. Comparably, companies tend to participate in UIC to gain access to knowledge, universities facilities and equipment, to influence the research agenda of universities, and to share research and development (**R&D**) risks (World Bank, 2013).

Understanding the benefits of university-industry collaboration

Little is known about companies' progression from informal UIC to more formal UIC. Literature suggests successful formal UICs deliver benefits to the economy predominantly through innovation and productivity. However, there is little literature to support the benefits of informal UIC.

Productivity

There are several international studies that establish a positive relationship between UIC and productivity, which ultimately contributes to economic growth.

For example, Mark and Norn (2014) quantified the economic impact of UIC based on formal collaboration mechanisms - but not informal collaboration mechanisms. The study was based on 6,338 formal collaborations between the University of Copenhagen – the largest university in Denmark – and 1,537 private companies. It compared the productivity of a pool of companies in UIC (the base case), with a pool of non-collaborating companies (the counterfactual).

The study measured the economic impact in terms of increased productivity, and established a positive causal connection between companies entering into formal collaboration with universities and productivity, but with a lagged effect. Two years after some form of formal collaboration, companies experience an average productivity return of 6%, which increased to 11% four years after the collaboration was established (Mark and Norn, 2014).

In a report by BiGGAR Economics (2017) for Oxford University, business innovation is regarded as having an "absorptive capacity"¹ that could benefit from collaboration with universities, by fostering greater productivity from innovative new ideas, insights, and practices. Networks and collaboration have been identified as having a strong role in the means to foster greater productivity. However, this fundamentally requires an open and engaged university.

Innovation

Collaboration is often thought of as the key ingredient to 'frontier' or 'creative' innovation ('new to the world' products/services) (Department of Industry, 2006). Collaborating with a group of open-minded people who can quickly validate the merits of an idea and help build upon them can accelerate the process of iterative thinking, and speed up the innovation process (Deloitte Access Economics, 2014).

UIC supports economic growth through innovation, resulting in new products, new patents and new solutions to problems (Federica et. Al, 2014). A study in Chile and Colombia showed that UIC increased the propensity of firms to introduce new products, and to patent them (Marotta, Blom and Thorn, 2007). Previous research also suggests UIC makes R&D less risky for companies (Baba et al., 2009; Woerter, 2012). This suggests UIC can stimulate additional R&D investment, and foster the commercialisation of public research.

¹ Absorptive capacity refers to the propensity and capability to engage, absorb, translate and exploit technology – whether obtained internally or externally (UK's National Endowment for Science, Technology and the Arts, 2008).

Research and innovation also helps to improve the practical competitiveness of companies, and may contribute to an increased standard of living in society. Collaboration in high-performance academic-practitioner research teams can lead to greater certainty that such outcomes are achieved (Cooper and Guthrie, 2017).

University-industry collaboration in New Zealand

To provide New Zealand context, Deloitte Access Economics conducted primary research into domestic examples of UIC. Chart 1 provides a summary of the research of various UICs, based on information available from four key universities in New Zealand. The research suggests the nature of UIC is wide-ranging across New Zealand – even if it is not always practical to quantify the extent to which they contribute to innovation.

Chart 1: Examples of university-industry collaboration in New Zealand



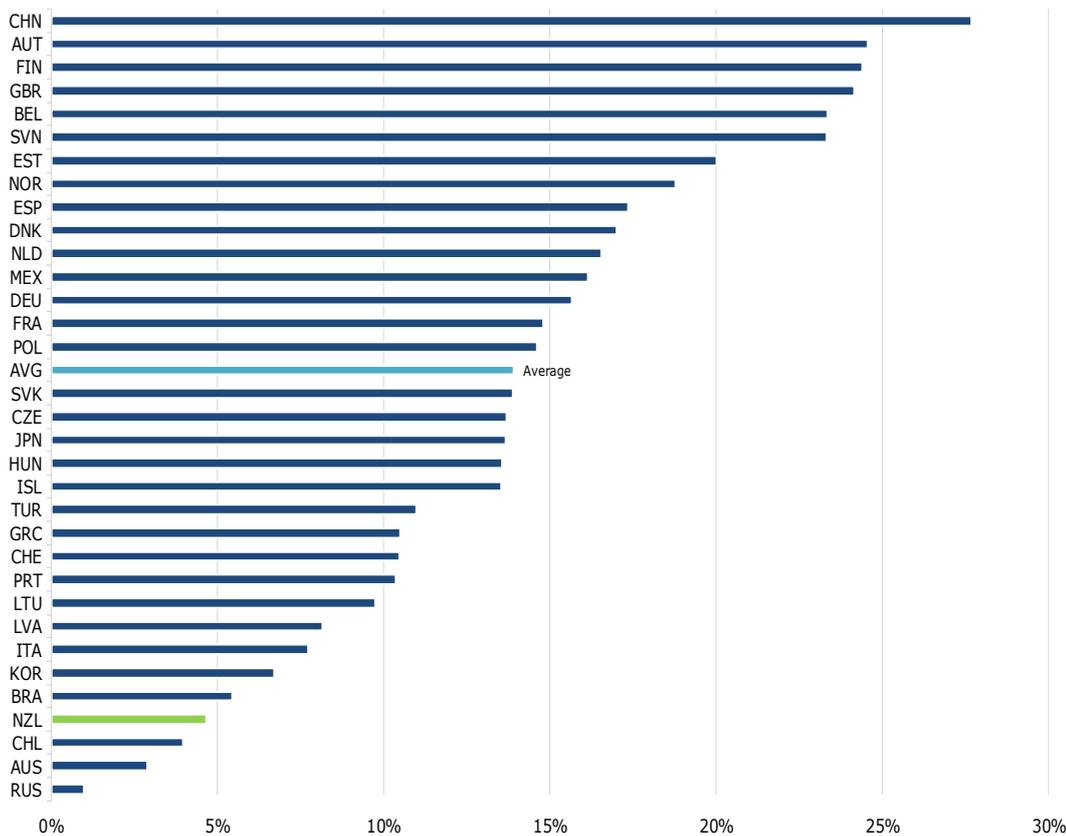
Source: Deloitte Access Economics; University of Canterbury (2018); The University of Auckland (2018); University of Otago (2018); Victoria University of Wellington (2018)

Despite the benefits of UIC recognised internationally, by international standards there is a low level of UIC in New Zealand.

The OECD (2017) defines innovation collaboration as the active participation with other organisations in joint innovation projects, with the aim of introducing a new or significantly improved product or process. This can involve the joint implementation of innovation with customers, suppliers, or the partnerships with other firms or organisations.

Based on the 2017 OECD survey of small and medium enterprises (**SMEs**) in the business of innovating products and/or processes, only about 5% of New Zealand firms are reported to be collaborating with higher education or research institutes, ranking New Zealand 29th out of 33 OECD countries. Increasing these levels of collaboration is central to translating New Zealand research output into something economically impactful.

Chart 2: Percentage of small and medium enterprises collaborating on innovation activities with higher education institutions, 2012 to 2014



Source: Deloitte Access Economics; OECD (2017)

What can New Zealand universities, industry and government do to further stimulate UIC?

Success factors of university-industry collaboration

Collaboration between universities and industry vary in size, scale and stage of collaboration.

There are various successful UIC with a focus on driving innovation cited in international literature (Edmosnon, et al. 2012; Pertuze et al 2010; UDIP 2013). A common and powerful success factor relates to trust, and the quality of relationship between universities and industry. These relationships determine the extent to which universities and firms understand each other and the desired outcomes for both parties. For universities, this means ensuring that research aligns with the company's strategic interest.

Appendix A provides a more detailed summary of examples of successful international UICs.

Overall, international literature suggests five success factors:

1 Long-term strategic relationships with on-going interaction

According to Pertuze et al (2010) and UDIP (2013), long-term university-industry relationships generate the most successful innovation. In examples that have extended over a long time period, collaboration is aligned with the strategic and tangible interests of firms, whilst simultaneously providing universities with research funding, improved curriculum relevancy, and experience for students.

2 Bi-lateral exchange and shared infrastructure

Findings from Larsen et al (2016) and from Edmosnon et al (2012) show that universities and firms can achieve greater ties by engaging in two-way exchange that goes beyond funding. This includes sharing infrastructure and equipment.

3 Encourage new avenues for innovation

A key generator of new innovative collaborations are individuals referred to as 'boundary spanners'. Boundary spanners are industry-side managers on an existing UIC that take on the role of linking the innovative needs of other inter-firm departments with the university. In doing so, they develop new avenues for innovation, and deliver impact for their company (Pertuze et al., 2010).

4 Strong communication linkage between university and company and/or industry

Pertuze et al. (2010) reports having university researchers regularly visit company personnel on-site bolsters these relationships, and consequently fosters the success of the collaboration. Maintaining university-industry contact, both during and after a project, positively influences the likelihood of future collaboration.

5 Streamlined negotiations to establish clear guidelines for intellectual property ownership early on

While contractual negotiations are important, they are time consuming, and delay research. Establishing terms early, especially those around intellectual property (**IP**) ownership, avoids conflicts that can delay research further on (UDIP, 2013 and Edmosnon et al, 2012).

Further research into how New Zealand stacks up against these success factors would be useful to understand the current success of UICs in New Zealand, and to identify target areas to improve both the level and success rate of UIC in the future.

Improving university-industry collaboration in New Zealand

In a recent study, Professor Nielsen provided a European perspective on UIC, which is just as relevant in the New Zealand context (Nielsen, 2017):

"We need to revamp academics' incentives to encourage more academics to engage in university-industry collaboration. We also need to educate academics on how to work with companies. Finally, we need to turn this company interaction into a resource by contemplating how to create reciprocal value creation between all the potential stakeholders. Then we will have genuine, meaningful university-industry collaboration."

To accomplish this, and to improve UIC in New Zealand, government support is necessary through policies that improve the propensity of firms to collaborate with universities.

Research and development grants

In New Zealand, there are a number of examples of R&D grants and funding:

- The Government currently provides funding through the Growth Grant to support private R&D funding; firms could be eligible for a 12.5% tax credit on eligible R&D expenditure
- The Endeavour Fund focuses on longer-term research that has high potential to positively transform New Zealand's future economy
- The Te Punaha Hihiko Vision Fund supports Maori participation in science and innovation
- The PreSeed Accelerated Fund supports early-stage technology commercialisation activity

However, there is no specific grant that is linked to UIC. A possible international example that could be investigated in New Zealand is an innovation voucher, which is an instrument used in the Netherlands, Ireland and the UK to promote UIC (World Bank 2013). Innovation vouchers are credit provided by governments to firms to purchase services from universities to introduce innovation.

Intellectual property rights

A common and important lesson from international examples is not to let IP become a barrier to innovation. Clear and mutual understanding of IP ownership from project inception is imperative. Failing to do so can result in disagreements later on, which has an adverse impact on the research being undertaken.

It is unclear from the information available how, and at what stage of the collaboration, IP rights are agreed in a New Zealand context. Guidelines on IP management could provide more transparency around this for universities and industry.

Performance-based funding of universities

Internationally, governments seek to stimulate UIC through their role in funding universities. World Bank (2013) suggests performance measures that determine funding include indicators such as the number of formal collaboration arrangements with industry. In this example, the World Bank referred to countries such as the UK, Canada and Singapore, where universities are offered additional funding research, conditional upon the university entering contracts with industry.

New Zealand has a Performance-based Research Fund administered by the Tertiary Education Commission. A measure specifically linked to UIC could be added as an indicator in New Zealand to assess performance-based funding of universities.

Formalised PhD internships

To encourage UIC, and in turn innovation, formalised PhD internships could be considered by government. This could involve, for example, PhD students in science, technology, engineering or mathematics (**STEM**) subjects being encouraged to complete an internship with a relevant industry organisation and, wherever possible, to develop their research proposal jointly with academic and industry input.

By providing formalised PhD internship opportunities, students can spend time with an employer or industry group before they determine their actual research topic. This allows them to learn about an industry, and understanding that industry's challenges and needs, which could generate more relevant applied research with or for industry.

Measuring the benefit of additional funding to support university-industry collaboration

The estimated benefit of additional funding to stimulate UIC in New Zealand could be estimated based on a conceptual framework developed by Deloitte Access Economics to assess the benefit of collaborative research by universities across jurisdictions (Deloitte Access Economics, 2017).

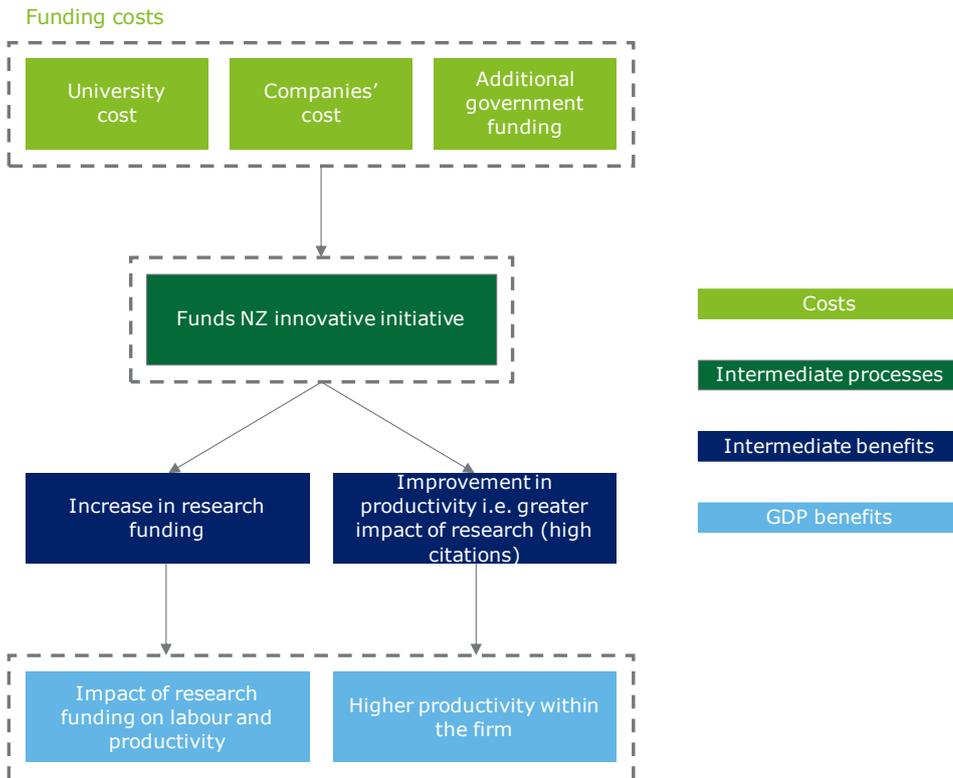
This conceptual framework was developed for Universities New Zealand to determine the average returns to the New Zealand economy in Net Present Value (**NPV**) terms over a period of 15 years, based on international research collaboration, academic staff exchanges, student exchanges, and work placements.

From modelling this framework, it was estimated that an investment of \$1.00 in each of the four initiatives would result in a cumulative benefit to the economy of up to \$10.00.

The same model logic could determine the benefits from UIC, relative to a counterfactual where no UIC has taken place. OECD data on UIC internationally, results of international studies on productivity gains, and R&D cost would predominately form the basis of this model.

The model logic is presented in Chart 3, and is based on the key benefits of UIC discussed in this paper – namely, productivity and innovation.

Chart 3: Model logic to assess the economic benefit of UIC



Source: Deloitte Access Economics

To the extent that data is available, it would also be possible to assess the distribution of benefits between the university, the firm and the wider economy - in particular, the regional economy. This conceptual framework, once developed, can also be applied to test what UIC would be the most effective.

As an alternative, the overall benefit of UIC to the economy could be estimated. The model developed by Deloitte Access Economics to assess the economic benefit of collaboration in the workplace could be used as a basis (Deloitte Access Economics, 2014). The value of collaboration to the economy was estimated based on the benefits of collaboration in terms of the time saved by collaborating, and the improvement in work quality, based on a survey data of businesses in Australia.

The survey data indicated that the level of collaboration within Australian firms was 10%. It was estimated that the overall benefit of UIC to the Australian economy was \$46 billion, comprising of \$22.6 billion for time saved, \$29 billion for quality improvement and \$5.4 billion costs associated with collaboration.

To estimate the overall benefit of UIC in New Zealand, it would be necessary to undertake a survey across universities and industry. The impact of UIC on productivity could be estimated based on the survey results within a computable general equilibrium framework.

Limitation of our work

General use restriction

This report is prepared solely for the use of Universities New Zealand. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of providing the causal link between universities and local innovation, and the economic impact of university research expenditure on the New Zealand economy. You should not refer to or use our name or the advice for any other purpose.

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Appendix A

Key lessons from international literature on successful university-industry collaboration were used to derive the critical success factors outlined in chapter three.

Table 1.1 Key lessons learnt from successful university-industry collaborations

University(s)/ Institute(s)	Industry firm(s)	Programme/ project	Lessons
ETH Zurich	IBM	IBM-ETH Zurich Nanotechnology Centre	<ul style="list-style-type: none"> • Establish contracts that cover a broad framework. • Dedicate time and devote leadership to projects. • Longer-term projects generate the largest benefit. • Partnerships should have a win-win approach.
University of Cambridge	SKF Group	University technology centres	<ul style="list-style-type: none"> • Strategic relationships with universities can lead to deeper research ties, and both parties deciding to innovate together. • Value quality over quantity. Be selective in developing strategic partnerships. • Encourage exchange that extends in both directions.
Technical University of Munich	GE Global Research	Corporate Research labs	<ul style="list-style-type: none"> • A good bridge to industry are corporate research labs. • Establish and maintain trust. • Choose the right people for the team. • Define an objective. • Collaboration is more than just sponsorship. • Encourage collaboration across disciplines. • IP ownership should not be a barrier to collaboration.
Syracuse University and JPMorgan Chase	JPMorgan Chase	New relational model for University- Industry relationships	<ul style="list-style-type: none"> • Collaboration between university and industry should mutually support each collaborator. • Appropriate long-term collaborations between universities and industry needs to be a focus. • Negotiations need to be streamlined as they are timely and delay research.
Technical University of Berlin, Massachusetts Institute of Technology	Siemens	Long-term strategic partnerships	<ul style="list-style-type: none"> • Understand the needs of both parties to establish a win-win situation. • Firms need to formulate a strong structure to cooperate with universities. • Ensure university commercialisation offices do not hinder strategic relationships. • Teaching soft skills as part of the collaboration can accelerate innovation.
University of California, Berkeley	Nokia	Traffic Works	<ul style="list-style-type: none"> • There needs to be a common understanding between company and university leaders. • Having the capacity to include cross-disciplinary research is key

University(s)/ Institute(s)	Industry firm(s)	Programme/ project	Lessons
Caltech	The Boeing Company	Strategic Agreement	<ul style="list-style-type: none"> • Senior executives at the firm should be given access to key faculty and administration at the university. • Encourage students to participate in internships with companies earlier in their research careers. • Interactions between company and academic scientists should be regular throughout their respective collaborations. • University faculty members should provide regular reporting and updates to their scientific partners.
University of Tennessee	Scintillation Materials Research Centre and Siemens Medical Solutions	Medical imaging	<ul style="list-style-type: none"> • Both parties need to understand that universities need to publish research, and that companies need to protect IP. • Coming to an agreement on the contractual legalities requires patience and flexibility by both parties.
University of Cincinnati	Procter & Gamble	Simulation and modelling centre	<ul style="list-style-type: none"> • There needs to be a willingness of faculty staff to do things differently from the traditional industry-academia engagements. • Company project teams need to be willing to fund students, train, and mentor them over a period. Locality is key to this. • Develop clear guidelines for intellectual property ownership, and on-site relationship ownership needs to be established.
Georgia Institute of Technology, Brigham Young University, Purdue University, University of Washington, and University of Southern California.	The Boeing Company	Design-Build-Test Capstone Course	<ul style="list-style-type: none"> • Integrate situated learning within a university-industry setting. • Create link between research and rigorous teaching standards with real-world practice. • Collaborate with practitioners to address complex problems in real, authentic contexts.

Source: Deloitte Access Economics; Edmosnon, et al. (2012); UDIP (2013)

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