VET applied research: driving VET's role in the innovation system

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Additional information relating to this research is available in *Explaining the VET applied research developmental framework* and *Developing VET applied research: steps towards enhancing VET's role in the innovation system*. They can be accessed from NCVER's Portal <http://www.ncver.edu.au>.

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About the research

VET applied research: driving VET's role in the innovation system

Francesca M Beddie, Francesca M Beddie and Associates, and Linda Simon

Innovation has become an increasingly important concept for Australian businesses in enabling them to continue to compete in an international market, but where does vocational education and training (VET) sit in this?

To date, VET has been largely overlooked by the National Innovation and Science Agenda as a potential contributor in this field. This research investigates how and in what way VET can contribute to the innovation system. The answer, the authors suggest, is through VET applied research.

Key messages

- There is an opportunity for the VET sector to be a contributor to the innovation system through an applied research agenda. In this context, applied research refers to research with a focus on solving real-world problems. Through its ties to industry, VET can play a role in translating this knowledge to the workforce.

- Registered training organisations (RTOs) do not need to start from scratch to be involved in the innovation agenda: they can build on their existing business models to develop innovation within industries. Other possibilities include capitalising on their infrastructure, expertise and community connections or hosting innovation hubs or enterprise incubators.

- Many practitioners already possess the skills relevant to applied research projects, but these need to be further developed, either by practising them or by undertaking professional development. The proposed VET applied research developmental framework can help to determine the additional skills needed.

Independently of this work, the House of Representatives has recently released its report on innovation and creativity (*Innovation and Creativity — Inquiry into innovation and creativity: workforce for the new economy*), and some of its recommendations relate to specific elements of this research, in particular:

- expanding the National Innovation and Science Agenda to include the VET sector (Recommendation 16)

- adopting elements of the Canadian Applied Research and Innovation Services model to strengthen connections between VET providers and small- and medium-sized enterprises (Recommendation 29).

The accompanying documents, *Developing VET applied research: steps towards enhancing VET's role in the innovation system* and *Explaining the VET applied research developmental framework*, provide further insights into how the VET sector can be involved in applied research and the capabilities required.

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Executive summary

> Whatever the outcome, the pressures to advance our education system will
> continue to be intense. As the conceptual share of the value added in our economic
> processes expands further, the ability to think abstractly will be increasingly
> important across a broad range of professions. Critical awareness and the abilities
> to hypothesize, to interpret, and to communicate are essential elements of
> successful innovation in a conceptual-based economy.   (Greenspan 2000)

This project examines the vocational education and training (VET) sector's potential for applied research and innovation and presents a roadmap towards increasing the sector's participation in the national innovation agenda. Central to this participation is the capability to identify, nurture and impart the sorts of skills Greenspan identifies and which we have called 'applied research' skills. Our definition of that descriptor draws on terminology used in the innovation literature, as well as on Boyer's expanded ideas of scholarship (1990) and Stokes's depiction of use-inspired basic research (1997). In essence, we are talking about research with a focus on solving real-world problems. Such activity can create new knowledge, and/or use existing knowledge in new and creative ways.

In our explorations into how the VET sector could realise its potential in this area, the capabilities of its educators and other professionals emerged as a significant factor, in both pursuing opportunities and in sustaining them as part of the everyday work of the registered training organisation (RTO). We argue that increasing the applied research skills of VET professionals is also one way to revitalise VET's place in industry policy and workforce development.

Our primary focus was therefore on how to develop an applied research capability in the sector, one that could assist in securing a place for VET in the innovation system. To this end we have developed a framework for VET applied research, set out in the accompanying document, *Explaining the VET applied research developmental framework*. This report, whose findings underpin the framework, draws on the literature and our fieldwork – discussions with VET institutions, applied research organisations, industry bodies and policy-makers, mainly on the eastern seaboard.

Our hypothesis was that the current innovation agenda does not fully recognise the role of VET because the sector's latent potential is not well understood, either within or beyond the sector, and because many in the VET workforce first need to be equipped to play a greater part in the innovation cycle.

Our investigation confirms that, despite a strong commitment to professional practice and innovation in many VET organisations, the notion of 'applied research' as a part of that practice is at best novel and often alien. Beyond the sector, the idea of VET as a research partner hardly surfaces.

There is, however, a foundation on which to build. We outline what is already underway in this area, both in Australia and elsewhere, in particular, Canada. The rationale for these existing efforts is the place VET occupies between knowledge generation and its application in the workforce. This position opens up possibilities for improving Australia's ability to translate its good ideas into improvements in industry and into higher productivity. Productivity also depends on a skilled workforce. Again, VET's role in training should position it better than other education

sectors to align curricula and teaching methods with the fast-changing requirements of enterprises.

Our articulation of the nature and extent of VET applied research skills and their mapping against the Training and Assessment Training Package and other training packages indicate that elements of this capability are already present. Many VET educators and other professionals possess a measure of research literacy and a combination of other communication and management skills for contributing to any team working on an applied research project. But they may need to cultivate these, through putting them into practice, or by attending short courses and other professional development events, or by engaging in further formal education in the VET or university systems. All this activity requires release from other duties; it also demands strong institutional and research leadership to shape and endorse the research effort and to ensure that all members of staff have appropriate levels of research awareness and skills. The adoption of a systematic approach such as this will also lift the research and innovation skills of students, who are then more likely to graduate as the creative problem-solving workers that employers are asking for.

If VET is to take its place in the innovation economy, applied research should not be seen as only the business of educators; it must become part of an organisation's strategic direction and capability planning. From the literature, our observations in the field and discussions with practitioners, we have identified various ways in which this might work. Our report offers a scaffold of recommendations for RTOs to consider and adopt, depending upon the nature of their business and staffing profile.

RedSpace at TAFE Queensland or the Centre for Applied Research and Innovation at Holmesglen Institute, with their dedicated research units may offer one option. Alternatively, RTOs may see themselves as partners with other research organisations or better suited to be knowledge translators and brokers. Another model is to build on physical assets and existing partnerships to become a place-based innovation hub. The accompanying framework (*Explaining the VET applied research developmental framework*) outlines some of the skills this involves, for example, project management, grant writing, research dissemination. Another accompanying summary (*Developing VET applied research: steps toward enhancing VET's role in the innovation system*) discusses organisational capability, as well as the role of the system, in fostering VET applied research.

At the moment, much of the VET applied research effort depends on the enthusiasm, industry knowledge and contacts of individuals. Adding to this momentum requires — as does all innovation — a collaborative effort that sees national policy acknowledge the need to support a VET role in the innovation system. Where this has been recognised overseas, it has been accompanied by grants and professional development funding, as well as quality assurance processes and standards setting. The sector itself needs to further champion its achievements and invest in its capability. This would be facilitated by a coalition of peak organisations able to uncover and disseminate existing research and research resources; offer professional development, partnerships and mentoring; and represent the sector at external research, industry and policy tables.

The sector has already been exhorted to 'name and claim' its applied research. In so doing, it must look outwards and engage with industry to solve real-world problems in real time. Thus VET could become another driver of innovation in Australia.

VET applied research and the innovation system: the context

Applied research and knowledge dissemination are essential ingredients in innovation; however, currently neither are a systemic part of the VET sector.

Applied research and knowledge dissemination are essential ingredients in innovation. They are required to both create highly skilled and adaptable workers and support the commercialisation of ideas that can increase productivity. Neither are a systemic part of the current VET sector.

This project set out to build on a body of Australian and overseas research and experience with industry-driven applied research and scholarly practice in the VET sector. Our interest was in research with a focus on solving real-world problems and scholarly practice that moves iteratively between established ideas, practical activities and new ideas. Defining this type of research became a major exercise for the project, the results of which are explained below. The project's hypothesis was that equipping VET institutions to become part of the national innovation system is an important way to create and maintain a creative and adaptable VET workforce.

By exploring various models of applied research and identifying what is already being done within the VET sector, the project sought to reach a better understanding of the skills and capabilities VET professionals require to be practical scholars, knowledge brokers and innovators. We have translated this understanding into a developmental framework designed to help VET educators and other professionals to identify and build on their applied research skills. During the course of the project, it became apparent that registered training organisations, as well as the individuals within them, need an applied research capability. We therefore offer some suggestions about how to stimulate RTOs and the overall system to foster the potential of the VET sector to contribute to Australia's innovation system.

Innovation in Australia

Nick Fleming (2016), an enterprise strategist and promoter of innovation, makes the simple point that innovation is a team sport. Looked at in this way, it becomes easier to understand why Australia still lags in the innovation stakes. In Australia, collaboration between the research and industry sectors is the lowest of the Organisation for Economic Co-operation and Development (OECD; Department of Industry, Innovation and Science, 2016b) countries, while one of the missing players in the national innovation system is Australia's industry-led VET sector.

This is despite Australia being a country of small and medium enterprises (SMEs), where trades skills remain the most commonly used core business activities. The least common are scientific and research skills, with non-innovation-active businesses also less likely to collaborate or to have a web presence (ABS 2016).

It is widely accepted that today's knowledge-based, technology-driven economy needs to take more account of the skills developed for and at work. This has always been VET's bread and butter. But, as the Australian higher education landscape shifts, the place of

VET is becoming less certain, with funding and students moving to universities, and VET's expertise in work-integrated learning facing competition.

Yet, the pressure on education budgets, as well as the changing nature of industry, with its demand for constant on-the-job skills adaptation (World Economic Forum 2016), suggests that universal higher education is neither affordable nor the most effective solution to workforce development. The Australian Chamber of Commerce and Industry, for example, argues that a shift to higher education qualifications may not be in students' and employers' best interests because these would have less input from industry (Australian Chamber of Commerce and Industry 2016, p.8).

Australia needs a new form of higher vocational education, with a diversity of offerings to meet student and employer needs. Other countries are considering how to meet this requirement. In a UK series of think pieces on the subject, compiled by the Association of Colleges, Esmond suggests that higher education in VET colleges should:

> aspire to new heights; rather than offering inferior versions of higher education, colleges are well-placed to respond to emerging forms of economic activity in an increasingly fragmented world where new knowledge often emerges outside the academy. Their links with the workplace and with local communities can contribute to a clear, positive and higher vision of the future. (Esmond 2014, p.5)

Esmond argues that these colleges must define how they can provide meaningful learning experiences, at a higher level, to students who are closer to the workplace. He suggests this can be done by breaking down the boundaries between teaching and research (Esmond 2014, pp.6—7). Similar thinking is being expressed in Europe, where, for example, researchers (Burchert, Hoeve & Kamarainen 2014, p.145) are talking about 'interactive research', which they define as 'cooperation between practitioners and researchers with the goal to implement new, useful and significant changes in the practice which also aim to enrich the state of research'.

The OECD (2016) argues for strengthening the interactions between the world of work and the world of education and training. Its report for the G20 Employment Working Group highlights 'the importance of policy coherence through a whole-of-government approach with full stakeholder engagement, including the private sector' (p.4). This policy coherence is lacking in Australia. The most recent statement on innovation, the National Innovation and Science Agenda (NISA; Commonwealth of Australia 2015), makes no mention of vocational training, concentrating on schools and universities. Yet it also highlights the importance of enterpeneurial activity in small business, of collaboration and increased STEM (science, technology, engineering, mathematics) skills in the workforce, areas that should point to engagement with the VET sector. In its review of the performance of the innovation system, Innovation and Science Australia (set up under the National Innovation and Science Agenda) found that 'compared to other countries, Australia under-utilises vocational education and training' in the innovation, science and research (ISR) system. Figure 1 (originally developed for the performance review of the system) shows how Innovation and Science Australia (ISA) conceptualises the various components of Australia's innovation, science and research system. The identification of skills as an important 'actor' in the system highlights a significant role for the VET sector.

Figure 1   Innovation science and research system
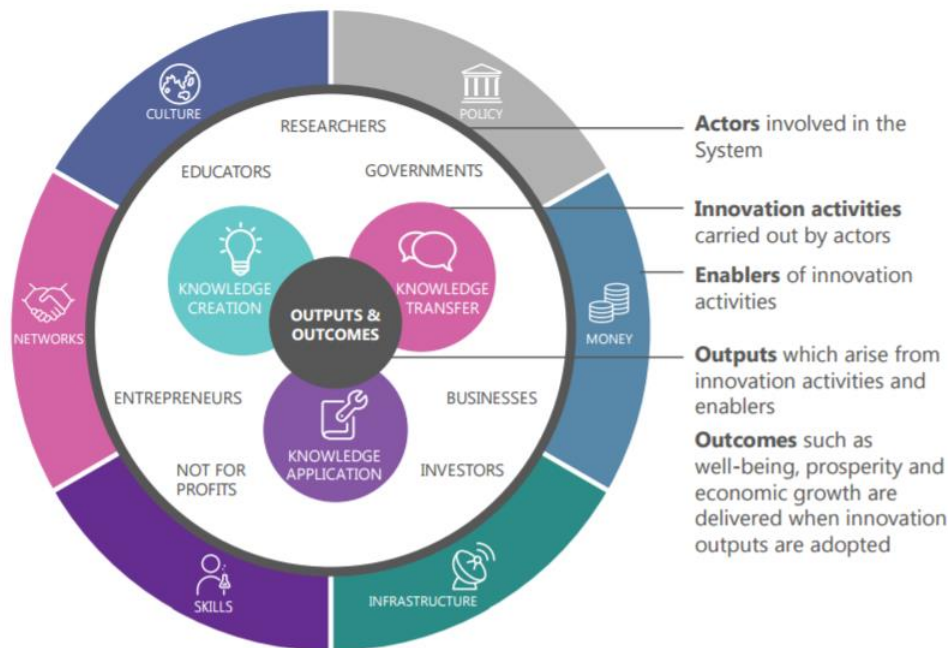
Innovation and Science Australia suggests that VET providers and people with VET qualifications can be innovators in their own right, through their developing products or services in collaboration with industry partners. Using their connections with industry, this group is also able to diffuse new ideas, technology and processes developed elsewhere, including through their role in the retraining and upskilling of existing workers (Innovation and Science Australia 2016, pp.76−7). This engagement is also apt in view of the incremental nature of much of today's innovation, which is reflected in the OECD's definition:

> Innovation is the implementation of a new or significantly improved product (good or service), process, new marketing method or a new organisational method in business practices, workplace organisation or external relations.   (OECD 2005, p.46)

Incremental rather than radical innovation is likely to be the solution for many firms searching for ways to remain competitive. Toner (2010, p.77) explains that such innovation typically uses existing technologies and standards and is in the reach of a broad range of businesses. Moreover, the innovations are often inspired by direct production workers on the shop floor or by suggestions from the final consumers of goods and services.

Box 1   Who are Australia's inventors?

According to the Australian Inventor Survey of 2007 (Melbourne Institute of Applied Economic and Social Research 2007), which surveyed all Australian patent applicants from 1986 to 2005, over half of the inventors did not have university qualifications:

No post-school qualifications:	501 or 15.47%
Apprentices:	786 or 24.27%
Diploma:	554 or 17.11%
Bachelor:	679 or 20.97%
Masters:	331 or 10.22%
PhD:	387 or 11.95%

While these data only reveal who applied for a patent, rather than demonstrating any success in commercialising an idea, they do show that creative minds occur across the population. The data also suggest that more attention to cultivating the innovative capacity of VET-trained workers might help in the quest to see greater commercialisation of ideas and innovative practice in small and medium enterprises.

Why is VET absent? Our research confirmed our hypothesis that the concept of VET as a player in R&D and innovation is alien, not only in the minds of policy-makers but also in the VET system itself. That led us to consider what a VET applied research capability looks like, where it exists and how it could be fostered.

In the next section we describe the methodology adopted for this project, after which we consider the notion of VET applied research capability. The following chapter discusses the question of who engages in applied research in Australian VET, while the chapter after that looks at models of applied research in the rest of the world. We then examine the skills and capabilities required by the VET workforce that enable them to conduct applied research. We conclude with a few observations on the future of applied research in Australia and its role in supporting innovation.

Methodology

Our initial research questions were:

- Why are scholarly practice and applied research important in the VET sector?
- How do they contribute to innovation in Australian industry?
- Who engages in such activity in Australian VET?
- What other models of VET research and scholarly practice exist in comparable countries?
- Would other models of applied research and knowledge dissemination offer lessons for Australian VET institutions?
- What research capabilities do VET teachers require, both in their initial qualifications and through later professional development, recognising the complexities of a highly casualised workforce?
- How do RTOs and their industry partners manage applied research projects and support their staff in scholarly practice?

We undertook a literature review to frame the project and discovered that we needed to spend considerable effort in examining the notion of 'applied research' and identify the activities encapsulated by this catch-all term. We arrived at a characterisation of VET applied research, which is explained below, and the idea of a research continuum. This informed a further stage of the project, namely, the development of a VET applied research framework, which also drew on semi-structured interviews and a mapping of the skills identified by our research against units of competency set out in several training packages.

The mapping exercise sought to more closely define the skills or competencies required for undertaking applied research in VET and to uncover which of these are already included in the training of VET educators. We investigated units in the Training and Assessment (TAE) Training Package, as well as units from other training packages that supplied electives for the TAE.

The refinement of these definitions and the framework were assisted by a reference group.

The criteria for choosing our interviews were:

- a sector with relevance to the National Innovation and Science Agenda, including identified growth industries
- a mix of providers and locations
- alignment with strong VET fields of study and learners
- a focus on relevant skills development and research activity
- funding sources.

We conducted 45 semi-structured interviews overall. Some were face-to-face; others over the telephone, with some email follow-up. These were with TAFE representatives in Victoria, Queensland, NSW, SA and the ACT, two private providers, three enterprise RTOs, VET peak bodies, government representatives, two employers, eight universities,

a cooperative research centre, the Rural Research and Development Corporation and the Office of Innovation and Science Australia.

The questions explored with these interviewees (see appendix A) were based on the questions that emerged from our literature review. We also ran workshops at two VET conferences. We found it difficult to uncover activity being undertaken by private RTOs. The project was conducted during a challenging time of regulatory change, particularly for private providers, who were therefore focused on their core business. And, as we discuss, even if that core business did include elements of research, scholarship and innovation, the providers would not necessarily label them as such.

When it emerged that we had to consider institutional capability, as well as individuals' research skills, we undertook an email survey (see appendix A). Thirty-five people responded, including four independent researchers, two TAFE research centre personnel, one private trainer, seven TAFE teachers/researchers, one casual teacher, four TAFE higher education personnel, seven university researchers, two dual-sector VET professionals, six representatives from peak bodies and one person from industry. The data from this survey are reflected in the content of the summary, *Developing VET applied research: steps towards enhancing VET's role in the innovation system*.

Are we talking about 'applied research'?

The absence of VET in Australia's innovation system could be attributable to a lack of clarity about the type of 'research' we are or should be talking about. How to distinguish applied research taking place beyond the academy became a strong focus of this research. Arriving at a term that resonates with the sector, and beyond, should encourage greater attention to VET's potential role in the gap between invention or innovation and its application in industry and the community.

Developing the term

We have used the term 'VET applied research' as shorthand, but we acknowledge this phrase may not capture the scope of activity we are examining. Furthermore, such a term may deter some VET professionals who do not see their work as teachers or their industry engagement involving research skills. They may be more familiar with the practice of trialling new things to solve problems, an aspect of professional practice aimed at improving their teaching. To borrow a metaphor from a Canadian leader in this field (Robert Luke, former Vice-President, Research and Innovation, George Brown College, Toronto), they might describe that work as being 'red' rather than the 'vermillion' of applied research, even if the activity is essentially the same. On the other hand, it may turn out that there is considerable variation in the types of activities or that one step is still missing in the process; namely, the dissemination of the findings from the process of building insights and introducing new ways of doing things. It is this step that turns knowing and doing into research. Perhaps the sector needs to start 'naming and claiming' (Jonas 2012) the inquiry, scholarship and applied research it is undertaking.

This is a big subject to examine. Our project's focus is particularly on VET's research and development capacity. To flesh out what this means, we turn to the OECD's *Frascati manual* (2015, p.45), which describes three types of R&D activity:

- *Basic research* is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

- *Applied research* is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.

- *Experimental development* is systematic work, drawing on knowledge gained from research and practical experience, and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

The manual notes that the order in which these three types of research and development activity appear is not linear, with many flows of information and knowledge in the R&D system. Experimental development, for example, might inform basic research rather than the other way around. A further consideration, highlighted by the Council of Rural Research and Development Corporations (RDCs) during a recent parliamentary inquiry

into agricultural innovation, is that the interplay between curiosity-driven and applied research continues through to the adoption phase, as outcomes and ideas are tested and refined (Council of Rural Research and Development Corporations 2015, p.6). Such interplays also inform Stokes's characterisation of research, which seeks to eliminate the dichotomy between pure and applied research. Stokes looks at research along two axes, the vertical one representing the quest for fundamental understanding and the horizontal axis referring to the use of knowledge.

Figure 2   Pasteur's Quadrant
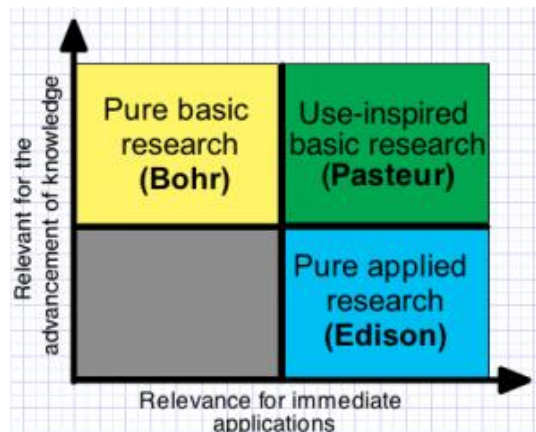
Source: cited in <http://blogs.oregonstate.edu/researchupdate/author/hotards/>.

This results in what Stokes called Pasteur's Quadrant (see figure 2), whereby the physicist Niels Bohr fits into the pure quadrant because his work on the atomic structure was undertaken from an entirely theoretical point of view, never anticipating its application in a bomb. Edison on the other hand applied existing theory to invent the electric light. Pasteur pushed the boundaries of knowledge about disease and the body's immune system, as well as successfully curing the patient, a very practical result from his scientific work on chemical synthesis. This is what Stokes (1997) calls 'use-inspired basic research'. Viewed in this way, pure and applied research need no longer be located in one particular type of research institution. Indeed, arriving at the right research questions and methodology for a VET research project may be assisted by a practical understanding of how enterprises operate and the challenges they face.

Others (Simon & Waters 2016; Williams, Goulding & Seddon 2013) have used the terms 'scholarship' or 'scholarly practice' to frame the discussion. They draw on Boyer's 1990 model. Boyer saw the traditional definition of scholarship — new knowledge through laboratory breakthroughs, journal articles or new books — as too narrow. He argued that scholarship also encompassed the application of knowledge, the engagement of scholars with the broader world, and the way scholars teach (Jaschik 2007). Boyer's model has four areas of scholarship:

- the scholarship of discovery, including original research that advances knowledge
- the scholarship of integration or the synthesis of information across disciplines, across topics within a discipline, or across time
- the scholarship of application or engagement that involves the dynamic interaction between theory and practice in service to the community

- the scholarship of teaching and learning (cited in Williams, Goulding & Seddon 2013).

A policy-maker, the recently departed Secretary of the Department of Foreign Affairs and Trade (Varghese 2013), characterised scholarship as follows:

> Scholarship, at its best, explains without simplifying; captures complexity without losing the thread of a narrative and most of all seeks to place the specific in the context of a wider insight.

We did not identify this type of scholarship during our study. Scholarship was more 'a more personalised interest — to meet the Standards rather than to evaluate and innovate'.[1]

A term more familiar in the education sector is 'action research', defined by Sagor (2000) as:

> a disciplined process of inquiry conducted by and for those taking the action. The primary reason for engaging in action research is to assist the 'actor' in improving and/or refining his or her actions.

Such a definition needs to become more outward-looking if the research is to contribute to improved ways of doing things in industry or to the practical application of new ideas in the workplace. Thus VET applied research must embrace both the spirit of R&D, as reflected in the Frascati model, and the four elements of Boyer's scholarship, as demonstrated in figure 3. Without this combination the opportunity to build on VET's industry focus could be lost.

Figure 3   VET applied research, a missing piece in the innovation system

Source: Developed from OECD (2015); Burchert, Hoeve & Kamarainen (2014); Stokes (1997); Boyer (1990).

In some cases the role VET can play in innovation matches more closely the notion of extension services, defined in the agriculture sector as 'the facilitation of change and

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1   Pre-publication comment on a draft of this paper by Berwyn Clayton.

innovation aimed at improving the productivity, sustainability and competitiveness of Australia's primary industries' (Council of Rural Research and Development Corporations 2015, p.4).

To ensure effective action and risk management, the definition also needs to capture the important activity of evaluation: reflection on what works or fails is an essential ingredient in incremental innovation.

Much has been written about how ideas are translated into innovations and then further evolve, and how we can describe these processes. Here, we borrrow from the health sciences (Estabrooks et al. 2006, p.28) the idea of 'knowledge translation':

> to encompass terms such as evidence-based decision making, research utilization, innovation diffusion, knowledge transfer, research dissemination, research implementation, and research uptake.

Broad (2016, p.144) makes a case for specific 'vocational knowledge', which can connect off- and on-the-job knowledge or the codified knowledge of college-based curricula and the tacit and often uncodifiable knowledge of the workplace. Another way of looking at this activity is to see it as explicitly striving to cross boundaries, which is how some European thinkers are looking at their dual system of vocational education. Schwendimann et al. (2015) argue that, to connect knowledge from different contexts, knowledge needs to be made explicit. This calls for an additional space between the classroom and the workplace, because, they argue, 'knowledge cannot be directly experienced but needs to be constructed through reflection processes' (Schwendimann et al. 2015, p.6). We discuss this further in the next section.

The research continuum

Research is not a straightforward concept. We argue that VET applied research should not seek to be the same as university-based research but rather should have a strong practical focus on solving problems. Such activity can create new knowledge and/or use existing knowledge in new and creative ways to 'generate new concepts, methodologies, inventions and understandings' (Australian Research Council 2014, cited in Waters & Sheehan 2016). And while in some university faculties, notably education, scholarship has a close link to pedagogy, we detected a stronger affiliation across VET disciplines.

Alex Zahavich (2016), in reflecting on the Canadian experience, describes the suite of activities that make up applied research:

- research: explore, gather, analyse
- innovate: look at things differently
- incubate: seed, nurture and terminate
- accelerate: advance quicker.

In their discussion paper for an LH Martin and TAFE Directors Australia (TDA) innovation and applied research roundtable, Waters and Sheehan (2016, p.10) showed that applied research takes place in various ways, including through the following:

- applied research partnerships with industry for:
  – developing and improving new products, services or processes, and/or
  – workforce development solutions

- applied research pedagogies or 'research-engaged teaching' (practice-based pedagogies), which directly engage students in applied research activities throughout their studies, with or without industry partners. This promotes inquiry-based learning, which is more likely to develop:
  - the cognitive skills of problem-solving and critical thinking
  - the interpretation, analysis and communication of complex information
  - the ability to apply this information in everyday work situations
- applied research that involves VET practitioners undertaking research into teaching and learning practices. This advances both the quality of VET teaching and the development of students' innovation capability because they learn critical inquiry and also gain experience in working with uncertainty. Research indicates that the informal practice-based knowledge acquired through experience is insufficient for the rigours of innovation. Ongoing inquiry and reflection using concepts, theories and knowledge from research is required (Nilsen & Ellstrom 2012, cited in Waters & Sheehan 2016).

The paper suggests that these points encapsulate 'the important link between practitioner research and the quality of educational outcomes' (Waters & Sheehan 2016, p.10).

The research projects conducted at the Canadian college where Zahavich is a member of staff involve the exploration of an idea or concept; the development of a model/prototype; testing; reporting; and scaling up; with further testing and implementing or commercialising. A similar continuum of research activity was also set out (figure 4) by the UK innovation foundation, Nesta, with the intention of encouraging British SMEs to partner with Chinese firms, particularly in the later stages of the continuum — to develop and scale innovation.

Figure 4   From basic research to commercialisation
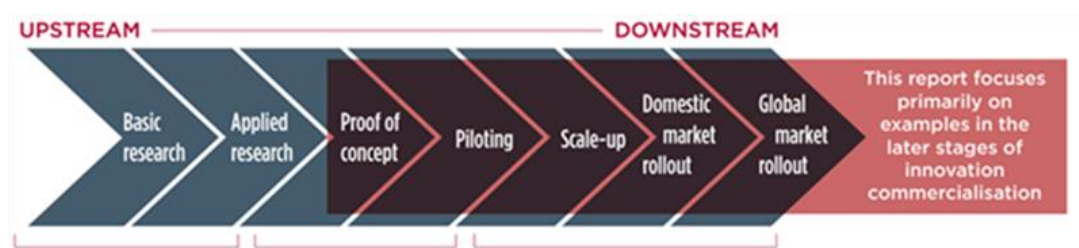
Source: Nesta (2015).

Case studies of current applied research projects and participatory action research have reinforced the view that one aspect that can and does make applied research in VET different is that it is tied to improved educational practices and is often most effective when students are also involved. The impacts from such research have increased value when they are cycled back through reflective and improved pedagogical practices (Jonas 2012; RedSpace 2016a).

Current practice suggests that applied research in TAFE (technical and further education) settings involves:

- the solving of specific practical problems in a systematic way with or without industry partners

- original work that generates new knowledge and understanding that is new to a business (not necessarily new to the world), with a specific practical application and/or new ways to use the findings of existing knowledge and basic research

- the use of research-based knowledge, including theories, empirical methods and techniques for a specific business or industry, or for teaching and learning purposes

- communication of the solutions obtained through applied research to others.

Applied research in an educational setting is not only concerned with producing the outcome of increasing understanding or solving problems in industry; it might also contribute to pedagogy and to involving students in research activity, thereby extending their skills and producing the sort of creative workers the innovation system needs. Here we draw on the Humboldtian idea of integrating learning and research. Healey, Jenkins and Lea (2014) explain that this requires seeing students as partners/producers of knowledge and engaging them early in their studies in research-type activities such as enquiry-based approaches to learning, critiquing research papers, generating research information and debating issues.

These elements also need to be taken into account when considering the professional development of the teaching workforce. Ellis-Gulli and Carter (2016) suggest it is possible to create opportunities for learners and teachers to co-construct and co-participate in knowledge-building activities.

Another way of looking at this is to adopt the phrase used by NZ researcher Karen Vaughan, 'knowing practice'. In a study of practice-based learning by GPs, carpentry apprentices and engineering technician cadets, Vaughan, Bonne and Eyre (2015) worked from the idea of vocational thresholds: transformational learning experiences that develop not merely knowledge and the ability to perform specific actions, but as a way to be a practitioner. For example, carpenters learn to integrate values and judgment with their technical skill, thus stepping beyond being a learner to mastery or being a skilled tradesperson. This requires time to reflect on practice and tie it to theory, assisted in the process by the teacher and the workplace mentor.

In 2009 the OECD's Centre for Educational Research and Innovation observed that research capability was underdeveloped in Australia's VET system. This is evident in the low status given to VET research and the lack of attention to promoting quality and innovation through scholarly activities (OECD 2009, p.52). We posit that without such activities to nurture both VET teacher and student engagement with innovation, the system is missing out, given that incremental innovation ('small i' innovation) occurs when workers at the 'grass roots' have the right kinds and levels of skills (OECD 2011) to engage in risk-taking and problem-solving activities.

Who engages in applied research in Australian VET?

Activity along the research continuum identified above is underway in the Australian VET sector, although it is not always named 'research' or 'innovation'. Sometimes it is explicitly labelled 'research' or 'scholarship'; sometimes it is seen as business as usual; more often it is activity that has yet to be articulated in ways that would fit with the idea of creating new knowledge or applying knowledge in a novel way, all of which point to both the lack of recognition of the place of research in the VET system and a deficit in some of the skills required to undertake applied research.

Things are changing, driven in the main by the higher education component in some RTOs, but also by the requirements to respond to the needs of industry partners and to produce creative and adaptable graduates. Embracing research and innovation also provides a means for VET to reinvigorate itself and to reclaim its place as a contributor to productivity.

In 2015, the VET Practitioner Research Network (VPRN; 2015) commissioned a stocktake of VET practitioner research in Australia. The stocktake uncovered a variety of organisations and mechanisms that support research activity in the VET sector, notably through the National Centre for Vocational Education Research (NCVER) building researcher capacity program and the VET Development Centre (VDC). It also referred to research conducted by Williams, Goulding and Seddon (2013) on scholarly practice in mixed-sector institutions and by Guthrie (2010) on the profile of the VET workforce. Guthrie's examination of the workforce, although undertaken some time ago, concluded that a large proportion of those undertaking VET teaching qualifications come with some form of post-secondary award, with many of these at bachelor degree level or higher — implying research expertise or skills (Guthrie 2010, p.39). While it remains very difficult to get an accurate picture of the educational profile of the current VET workforce, we do know that more VET professionals now have higher education qualifications and research experience. Even with these, the VET Practitioner Research Network stocktake identified the major constraints to doing research in the sector as lack of time and money.

Since the VPRN stocktake, two dedicated research centres have emerged: RedSpace, the Centre for Applied Research and Innovation at TAFE Queensland; and the Holmesglen Centre for Applied Research and Innovation, with others also being considered elsewhere, for example, at William Angliss TAFE.

RedSpace's objective is to support business innovation and workforce capability building, as well as innovation in educational delivery. Partnering with industry to find solutions to, for example, workforce needs, new regulatory requirements or equipment failures, the organisation also has a strong focus on cultivating entrepreneurial and innovation capabilities in teaching staff and students (Redspace 2016b).

The Holmesglen Centre for Applied Research and Innovation operates differently, as a support to research hubs or centres of excellence operating across the institute. It helps to identify research and innovation opportunities; provides advice and administrative

support to research teams and their partners; offers training and mentoring, and fosters student involvement in applied research and innovation; and is currently developing policies on ethics and research integrity. The centre aims to capture the research activity, innovation and product development taking place across the institute and to foster collaboration between VET and higher education, the intention being to make Holmesglen's applied research capability more visible and expressed in a language appropriate for its various audiences. Projects that contribute to industry currency will have a link to RTO standards. Holmesglen also recognises that its research and innovation projects play a role in attracting and retaining staff (Interview, November 2016).

Box 2   Research teams at Holmesglen

One group we interviewed at Holmesglen TAFE had identified the teachers with the technical skills to work with South East Water Corporation to train plumbers to install the latest water innovations in a purpose-built replica house on campus and had separated this group from those with research qualifications, who would undertake research on the implications of these innovations for training products and disseminate their findings. This mixture of the discipline/technical experts and the research/managerial experts working together is not an uncommon practice in TAFE institutes (Interview, November 2016).

At another new centre in Victoria, Melbourne Polytechnic's Centre of Applied Innovation, David Martin, the executive director, is arguing for a new set of core capabilities to enable learners to 'engage purposefully' with the world (see box 3). Martin brings to Melbourne Polytechnic a resource that will help to develop these capabilities — the Global Innovation Commons (GIC), the world's largest archive of innovation. It includes patents and publications from over 168 countries, from the 1700s to the present, and is the repository of over $2 trillion of funded research on food and nutrition; infectious and tropical disease treatment; petroleum-alternative energy; and potable water management.

Other Victorian TAFE institutes are being encouraged to see the work they do as applied research, namely, work that enhances student engagement in problem-solving and ideas development and supports collaboration with industry to define and resolve challenges through research.

Those RTOs working in higher education are required by the regulator, the Tertiary Education Quality and Standards Agency (TEQSA), to meet threshold standards on scholarship, which TEQSA describes, as 'at its core … the maintenance of knowledge of current developments in the discipline, and transmission of this knowledge through effective, contemporary approaches to teaching and learning' (Tertiary Education Quality and Standards Agency 2014). It is not, therefore, surprising that research has a more prominent focus in these institutions.

Box 3   Rethinking capability at Melbourne Polytechnic

David Martin, Melbourne Polytechnic, presents the capabilities a student must attain to be a functioning twenty-first century citizen as follows:

Sensory acuity: engaging in applied, experiential learning, which will develop multi-dimensional and multicultural perspectives. This approach aims to avoid reductive thinking and ensure the social and cultural implications of an issue are considered. Students and teachers will learn to make the most of all their sensory abilities.

Contextual adaptation: expanding the aperture through which students and teachers experience and apply their learning, thus avoiding linear thinking and the trap of embracing untested assumptions.

Synthesis and critical thinking: using and interrogating multiple sources of data and discerning their credibility or bias.

Values and commerce: examining endeavour in terms of purposeful engagement. This can be measured by resource use and replenishment; community impact; return on effort and investment; and the wellbeing of students and ecosystems. Success will be judged by the plurality of yields per unit of effort or resource. Martin calls this performance optimisation.

Design, engineering and application: explicitly understanding and deploying design that addresses the risks of a system dependent on centralised utilities and infrastructure. In this context and applying this principle, Melbourne Polytechnic will strive to become a world leader in distributed power and the optimal use of resources.

Global citizenship: being explicitly global citizens, who see the world's inhabitants as collaborators and not competitors for scarce resources (Interview, January 2017).

Box 4   William Angliss TAFE

As part of its longer term aspiration to become a University of Specialisation, William Angliss has developed a research strategy to 2020 to build capacity and research across the institute, which includes $600,000 of funding for research initiatives including funding for early career researchers and for projects working with industry, as well as to support staff studying their PhDs. Staff in VET and higher education are eligible to apply. William Angliss has also established a College of Eminent Professors to mentor staff (Interview, September 2016).

TAFE NSW Higher Education is introducing applied research projects as part of its Higher Education Learning and Teaching Framework. The projects aim to encourage students to engage with 'hands on' industry-related work, build research and inquiry-related skills, and extend connections with business and industry. TAFE NSW Higher Education recognises that this will also create opportunities for academic staff to develop their industry and scholarly teaching practice. The newly established Skillspoints in TAFE NSW may also provide opportunities for collaborative research projects with industry.

Box 5   TAFE NSW higher education and Hunter Water: applied research as team-based pedagogy

A team of three students is undertaking an applied research project as part of an Associate Degree of Applied Engineering. They were brought together in a team to combine their mix of managerial, technical and organisational skills and knowledge. The students acknowledged that this approach enabled them to challenge each other's thinking and broaden the scope of their knowledge in relation to assessing sites for the installation of solar panels. This teamwork extends beyond the students to include managers at Hunter Water, who were involved in choosing the research topic and who are being kept informed about the progress of the work and will advise on next steps, including the write-up — to be in the form of a board paper. The team also includes the TAFE's engineering teachers, who are there to help tackle technical and other questions as they arise (Interview, January 2017).

We were unable to uncover much explicit research activity in the private RTO field, although one instance is the not-for-profit Academy of Interactive Entertainment (AIE), which has campuses across Australia. The academy is both an innovator and supporter of innovation.

Box 6   Academy of Interactive Entertainment: an innovation incubator

The Academy of Interactive Entertainment's Incubator program, funded with government R&D money, supports graduates from the Graduate Diploma in Management (Learning) to start up commercial enterprises. These incubator start-ups research the market to determine where the gaps in technology and gaming exist and then test and trial new technologies. Participants are taught to apply rigour to these trials (Interview, February 2017).

The Academy of Interactive Entertainment also undertakes research and development activities in association with industry suppliers and commercial developers. This ensures that teachers continue to bring their own industry knowledge and a range of other industry expertise to the academy.

Box 7   Surf Life Saving Australia

Surf Life Saving Australia uses research, generally commissioned from universities (VET researchers not being on the radar), to help drive changes in their training. A recent example involved research which showed that an increasing number of patrolling members are being forced to deal with mental health issues while on patrol. The study was undertaken by postgraduate students from a Western Australian university, with the results quickly put into operation. Lack of funds is the main constraint for commissioning more research (Interview, March 2017).

Enterprise RTOs tend by their nature to be inwardly focused on evaluation and the development of new courses to meet changed workforce requirements in their enterprise than on engaging with outside organisations as innovation partners.

We do however consider that, if the VET sector were better informed about the R&D funds available (a two-way process involving RTOs and the funding agencies) and if there were greater recognition of the importance within the VET funding regime of the need to

subsidise training to create innovative paraprofessionals, more private RTOs would be able to draw on their expertise to become partners in the innovation system.

Box 8   Innovation dollars in the system

The Australian Government's Entrepreneurs' Programme aims to drive growth and competitiveness in small and medium businesses. This support includes advice, funding and collaboration opportunities. Businesses operating in an identified growth industry are able to apply for an Innovation Connections Grant up to the value of $50 000. The grant helps to fund a research project identified as the way to pursue innovation in the company, which it does by paying for a researcher to be placed in the business, or a researcher from the business to be placed into a publicly funded research organisation, or by employing a graduate or postgraduate in the business (<https://www.business.gov.au/assistance/entrepreneurs-programme>).

AusIndustry also offers Accelerating Commercialisation guidance and grants: <https://www.business.gov.au/assistance/accelerating-commercialisation>.

Funding could also be potentially accessed under the Australian Government's R&D Tax Incentive in cases where RTOs are registered by Innovation and Science Australia as research service providers. This would be a further expansion of their current role and enable them to provide R&D support to small- and medium-sized businesses.

What other models of applied research exist?

This section discusses models of applied research operating within VET systems in Canada and Europe. We focused on initiatives that offered realistic options for the Australian context. It also explores two Australian models, the rural research and development corporations (RRDCs) and the cooperative research centres (CRCs), to see what lessons they offer the VET sector, or whether they might be potential partners for RTOs engaged in applied research and innovation. Most of the activity we uncovered was in publicly funded organisations, operating in close partnership with industry.

Canada

An advanced model of applied research for industry innovation exists in the Canadian vocational education (college) system and has already inspired activity in the Australian VET sector. Canada's publicly funded colleges, institutes and polytechnics have a mandate to support local economic and social development, and for more than a decade this requirement has been partly fulfilled through college support for innovation in small- and medium-sized enterprises and community partners (Colleges and Institutes Canada 2015a).

This applied research function is supported by the Tri-Council College and Community Innovation (CCI) Program, established in 2008 and administered by the Natural Sciences and Engineering Research Council, in collaboration with the Social Sciences and Humanities Research Council and the Canadian Institutes of Health Research. The College and Community Innovation Program is interested in applied research and collaborations that facilitate commercialisation, as well as technology transfer and adaptation and adoption of new technologies. Only colleges declared eligible to administer research grants may apply to the program. As the program has matured, private sector investment in college research has increased – over the past five years by 59%. In 2014—15, the private sector was the largest source (Canadian $80 million or 40%) of external investment for college and institute applied research. The federal government contributed 38% or Canadian $74.6 million (which is just 2.4% of annual federal Canadian funding for research conducted by the higher education sector; Colleges and Institutes Canada 2015b, p.iv). Provincial governments also provided support, as did the institutions themselves (Colleges and Institutes Canada 2016, p.20).

An essential ingredient in the success of the Canadian model is funding to enable time release for teachers, who, as in Australia, are typically expected to teach full-time. This allows the teachers and other professionals to conduct collaborative research and participate in projects as co-researchers, partners or associate scientists. The Tri Council College and Community Innovation Program is the only federally funded program that recognises time release as an eligible expense, providing up to $7000 per 'faculty release' to hire a replacement teacher to enable the staff member to contribute to research through College and Community Innovation projects. Further information about College and Community Innovation Program grants can be found in appendix B. Other approaches include internal funding, reorganisation of work load and study leave

(Colleges and Institutes Canada 2016, p.15), all interventions that are being used or are feasible in, at least, larger Australian providers.

One of the premises of the Canadian approach is that engagement in applied research has the capacity to enhance student learning, with 31 346 students involved in applied research projects in 2014—15. The colleges are increasingly including capstone projects as a requirement for program completion. These large, intensive research projects are often designed to address specific problems identified by business, industry or community partners. These applied research partnerships provide students with work-integrated learning opportunities, for example, through research assistant positions, summer job opportunities, internships and work placements (Colleges and Institutes Canada 2016, p.16).

One specific feature of the Canadian model worth highlighting is the network of 30 technology access centres (TACs). A technology access centre is affiliated with a Canadian college and provides local industry with access to specialised technology, equipment and expertise, with the goal of enhancing their productivity and innovation. These centres can also help to connect business to external expertise and funding sources. The network is coordinated by Tech-Access Canada, which facilitates the sharing of best practices between member technology access centres; works to harmonise service models across regions; and promotes college applied research to external audiences (Tech Access Canada 2017).

Typically, projects conducted in the Canadian college system have shorter timeframes than other research. For instance, in 2014—15, 86% of new or improved products (for example, wireless sensors prototypes, electric vehicle technologies, a probiotic dental product) were developed in less than one year, and 66% of new or improved processes (for example, patient data delivery services, mushroom cultivation) were designed or delivered in a similar timeframe (Colleges and Institutes Canada 2016, p.26).

The Canadian experience tells us that it took 10 years for the public investment in the R&D capacity of its college system to be rewarded. As with most new enterprise, it required seed funding to develop expertise and to support demonstrator projects.

United Kingdom

Much of the activity within the UK's further education sector has concentrated on scholarship about teaching and learning (see Hillier & Gregson 2015), although this is broadening to also embrace industry. For example, the Scholarship Project, which will run from 2015 to 2018, aims to develop and embed a distinct scholarly ethos across the sector. The project will explore different forms of scholarship, including student scholarly activity, and wider community and employer engagement. The goal is to create a 'scholarship framework' (Association of Colleges 2016).

Overall, however, it appears that, as in Australia, VET institutions in the United Kingdom are under-recognised partners in innovation. A recent venture sponsored by the UK Commission for Employment and Skills (UKCES), the UK Futures Programme, saw the commission and industry co-creating projects to research, develop, pilot and/or scale innovative solutions to the identified current and emerging workforce development issues restraining business performance. The evaluation of the program notes:

Engagement in applied research has the capacity to enhance student learning.

Students can diffuse knowledge in the workplace and in the classroom to employers and to teachers.

Further Education (FE) Colleges were not represented amongst the successful projects and there was interest in testing whether they might have more productive relationships with local small businesses, by being better able to engage and more 'approachable' than universities for example. This could be explored by researching how FE Colleges currently engage with local communities, or developing another challenge aimed specifically at FE Colleges.

(UK Commission for Employment and Skills 2016, p.77)

A major effort is however being expended on developing the capacity of the further education sector to deliver higher qualifications. Healey, Jenkins and Lea (2014) argue for including the idea of research in the curriculum from the start: they see students as partners/producers of knowledge able to diffuse knowledge in the workplace and in the classroom to employers and to teachers. This can lead also to employers identifying research topics aimed at solving industry problems and issues that arise in the workplace. As shown in the TAFE NSW example (p.24), incorporation of applied research into the Australian curriculum is not only possible but can result in the student becoming the creator and diffuser of knowledge, in partnership with teachers and employers.

The Netherlands

The Netherlands has asked the question of whether a country (especially a small one like the Netherlands) should seek to remain in the lead, in terms of world research rankings, or whether it should ensure that the whole country understands developments in science well enough and is connected to the networks in which new knowledge circulates. This means having a lifelong education system, one that fosters people's ability to absorb new knowledge quickly and make it productive (Netherlands Scientific Council for Government Policy 2014, pp.22—4).

And it also means a focus on a broader research capability in the universities of applied sciences (UAS), which have evolved from the schools for higher professional learning in that country. Since 2000, various schemes have been introduced in the universities of applied sciences, including new staff positions called 'lectors', as well as 'knowledge circulation' grants. The aim is to produce professionals equipped for the modern economy and more practice-oriented research. The lectorate initiative had four operational goals: knowledge development; staff professionalisation; renewal of educational programs; and knowledge circulation from and to the economy and society. The knowledge circulation grants were designed to improve knowledge development and exchange between the universities of applied sciences and industry (from 2005), and also between these universities and public sector organisations (from 2006). A further funding program for practice-oriented research was launched in 2008, with the first 'centres of expertise' established in 2010. These centres are public—private partnerships, partly subsidised by the government, in which universities of applied sciences work with industrial partners to enhance knowledge development and knowledge exchange.

The introduction of lectorates aimed to change the institutional culture and to develop a research attitude. The positions, which saw lectorate-holders acting as brokers between the universities of applied sciences and the regional economy, particularly SMEs, were also endorsed by the employers' organisation (VNO-NCW).

To assure the quality of the practice-oriented research, in 2007 a Sector Protocol for Quality Assurance in Research was adopted. An independent validation committee periodically reviews the research conducted by the universities of applied sciences, using scientific, impact and relevance indicators.

The European Commission's case study (2016) of the practice-oriented research approach adopted by the universities of applied sciences points out that it took time for the lector positions (which attracted better pay) to be accepted and for institutions to take up the opportunities for grants, the uncertainty of continued funding being a deterrent. Now that these are a permanent feature of the funding landscape, more of these universities are undertaking research, but they also feel the need to take on more students to keep afloat. For some, this is stretching their capacity to perform well. Overall, however, the consensus is that the research function of the universities of applied sciences is now an indispensable part of Dutch tertiary education, with a growing number (albeit still small percentage of the overall Dutch research effort) of collaborations between lectors and their university counterparts. While young PhD-holders are beginning to start their careers at one of these universities, staff need further professional development to become research collaborators. This is being encouraged by including qualifications as one of the indicators in performance agreements between the education ministry and the individual university. In terms of the reach of the projects under the knowledge circulation program, since the introduction of the first projects in 2005, almost 4600 companies and 6000 professionals have been involved (European Commission 2016, p.9).

This Dutch experience underlines the importance of a sustained commitment to building a research capability in institutions lacking an existing research culture. This is essential for effecting a shift in business models and inspiring staff to commit to building new skills. Research leadership and industry endorsement are also essential ingredients.

Germany

Germany is often consulted for inspiration when it comes to technical skills training and innovation in manufacturing. It is a leader in translating research into new technology, thanks to its strengths in both producing STEM graduates from its higher education system and combining practice and theory in its vocational education system (Parilla, Trujillo & Berube 2015, p.7). Furthermore, the close cooperation between vocational schools and industry ensures that workers are able to improve production processes and implement innovations as technology changes.

A recent study of the potential of the dual system to respond to Industry 4.0 (that is, the trend towards automation and data exchange in advanced manufacturing) asserts:

> Both economic performance indicators and the results of qualitative innovation research show that innovation does not stop at the doors of R&D departments. It arises in the interplay between a wide range of disciplines and departments, right across the product lifecycle. And here we find not just employees with academic qualifications, but also those trained in the dual system. Thus employees with technical or science-oriented vocational qualifications play a key role in innovation projects, within R&D departments, as skilled workers in prototype building, in the

The research function of the universities of applied sciences is now an indispensable part of Dutch tertiary education.

> fields of testing or implementation, as draftsmen and draftswomen in construction, or as laboratory technicians in various specialist areas. (Pfeiffer 2015, p.18)

Pfeiffer (2015) explored the competencies workers will need to be able to perform in the face of automation and big data and in an environment where the attractiveness of vocational education is in decline. She found that, across the mechanical engineering sector in Germany, Switzerland, Great Britain and France, having more skilled workers with vocational training in production meant leaner management levels. Pfeiffer (2015) explains that the ability to master changed forms of organisation, and to act quickly and effectively within them, is fostered by learning in the workplace and methods of teaching that can develop individuals who can think on their feet and act independently. As Pfeiffer points out (2015, p.37), this means that trainers and vocational schools have to acquire new skills so that they can foster inter- and trans-disciplinary collaboration. Such collaboration with others, and above all with other stores of knowledge and experience, is the vehicle for acquiring a capacity for systemic thinking.

Pfeiffer's paper ends with recommendations to the various players in the system, these recommendations including: creating incentives to set up research groups and competence centres in vocational schools; offering staff training not only in IT, data security and new technologies, but also in new learning methods; and setting up 'fab labs' (equipped with facilities such as 3-D printers) and centres for the 'maker movement'. She also points to the importance of real transfer opportunities between the vocational and academic paths, and to ensuring that new entrepreneurs with academic backgrounds understand the advantages offered by the dual system (Pfeiffer 2015, p.42). Raising awareness of VET's potential to help university-educated entrepreneurs to top up their skills, for example, in management, and to establish industry networks and act as local innovation hubs is a marketing exercise Australian RTOs could also undertake.

Australia

Two Australian models of research with a strong end-user focus are the rural research and development corporations and the cooperative research centres. Neither engages RTOs as research partners, although representatives from both models interviewed for this project believed that, in theory, this could happen, with VET potentially playing a part in meeting the considerable challenge of knowledge translation and the adoption of research findings. The impediments to this are both cultural and technical: VET's strengths are invisible; the research field is highly competitive; and the funding system does not recognise RTOs as research organisations. We outline the two models to stimulate consideration of how the VET sector might intersect with these applied research efforts and/or consider features of the models that might shape the sector's own applied research activity.

Rural research and development corporations

Rural research and development corporations are a partnership between industry and government, funded through a co-investment model that involves levies on production and a matching government contribution. The corporations plan, invest in, manage and evaluate research and extension services for rural industries. They are service providers to industry: they do not own, manage or maintain internal research capacity (Council of Rural Research and Development Corporations 2015, p.4).

In its submission to the House of Representatives Standing Committee on Agriculture and Industry's 2015 Inquiry into Agricultural Innovation, the Council of Rural Research and Development Corporations argued (p.6) that the investment by industry in the research was important:

- to ensure that the industry had the capacity to translate research findings into productivity gains

- to mobilise that capacity to articulate their research needs and research questions.

The rural research and development corporations aim to strike a balance between addressing today's issues with 'short time to impact' studies and longer-term activity that prepares for over-the-horizon challenges. They are also adopting participatory approaches to R&D and to extension, the aim being to generate sub-regional and local-level data and experience and to help producers to make informed decisions on whether to adopt findings from a piece of research or a new technology or process (Council of Rural Research and Development Corporations 2015, p.9). Effective extension and adoption of research remains a challenge.

Figure 5   Australia's primary industries innovation system
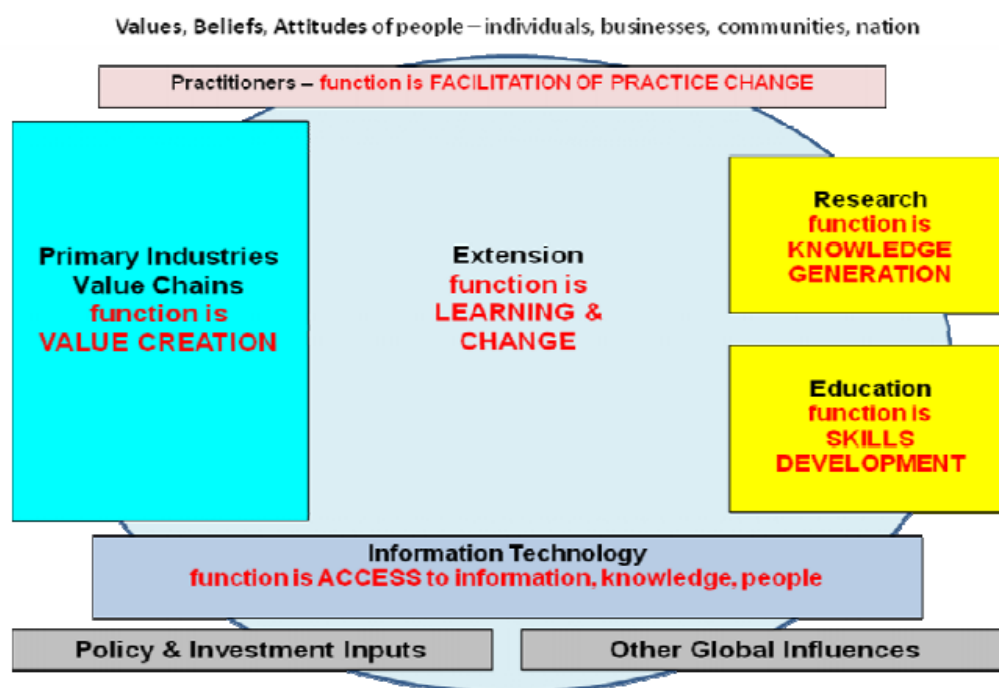
Source: National Primary Industries Research, Development and Extension Framework (nd, figure 3).

As the National Primary Industries Research, Development and Extension Framework (developed jointly between the Commonwealth, the states and Northern Territory, Rural R&D corporations, CSIRO and universities) points out, extension is no longer a linear model (from scientist to farmer), but a 'complex, iterative, multiplayer and multi partnership model' (National Primary Industries Research, Development and Extension Framework no date, p.1). The framework presents an innovation system (see figure 5) in which knowledge generation, skills development and the facilitation of change overlap. This is a system that RTOs could consider when developing their own systems of applied research.

The House of Representatives inquiry did find flaws in the current agricultural innovation system and the central role of rural research and development corporations, which, it said, encouraged 'a silo mentality among industry groups, and creat[ed] a disjointed and disconnected sector, at the cost of broader, cross-sectoral innovation'. It noted 'calls for further cross-sectoral collaboration within and beyond the agricultural sector' (Parliament of Australia 2016, p.41).

That silo mentality could partly explain VET's absence in this research effort, as well as the ignorance of VET's function in the education system among those involved, such as departments of agriculture, universities and the private sector. The latter has a prominent role in extension services. The interim findings (Rural Innovation Research Group 2017) from a three-year project on stimulating private sector extension in Australian agriculture in order to build the capacity of the commercial and private sectors to deliver extension services to Australian farmers suggests the need for greater collaboration in this area; it could also present an opportunity for both public and private RTOs to become part of the more coordinated/collaborative advisory and extension system the project is recommending. This would require the VET sector to take the initiative and present the agriculture sector with a value proposition for using VET to facilitate the adoption of research findings and changes in practice and skills development. While this is not entirely new territory for TAFEs, their focus has primarily been on training. For example, TAFE NSW works with Australian Wool Innovation, a not-for-profit company that invests in R&D and innovation, and also with the National Centre for Dairy Education (NCDE), an initiative of Dairy Australia, which supports VET practitioners to access current research for incorporation into VET delivery.

Cooperative research centres

The Cooperative Research Centre (CRC) Program was established in 1990. Linking researchers with industry and government, it has a focus on research application and end-users, who help to plan the direction of the research and monitor its progress.

The present definition of a cooperative research centre, according to the Cooperative Research Centres Association website, is:

> a company formed through a collaboration of businesses and researchers. This includes private sector organisations (both large and small enterprises), industry associations, universities and government research agencies such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and other end users. This team of collaborators undertakes research and development, leading to utilitarian outcomes for public good that have positive social and economic impacts.

The role of the cooperative research centres is explicitly to bridge the gap between discovery research and the requirements of industry for commercialisation-ready innovations. They also foster 'hands on' learning, with a strong focus on postgraduate education, but with involvement in other levels of the education and training system.

The website goes on to note:

> CRCs assemble multidisciplinary teams from across research providers to address end user driven research. They collaborate across all sectors (Industry, Academia, State Government, Consumers and Industry Associations) and create a critical mass in their field. No other Australian Government programme does that!

VET is not one of those partners, although it does sometimes have a role when a cooperative research centre identifies new skills required in their industry area. And, while the focus of the CRCs' research training effort is not prescribed, its focus tends to be on PhD programs to the exclusion of others as research trainees.

When we asked the Innovative Manufacturing CRC, whose office is situated on the dual-sector campus of Swinburne University, about the absence of VET in its work, the answer suggested that VET simply was not on the radar. It was acknowledged that workforce development had been identified as a crucial element in achieving industry transformation. The strong alignment between this cooperative research centre's interests in construction, agribusiness and manufacturing and VET indicates the potential for partnerships (Interview, February 2017).

What does the VET workforce need?

This question points to an important part of this project. We were interested in better understanding how the VET sector can build its capabilities to undertake applied research and consequently participate in the innovation system. As is the case across the economy, the effectiveness of innovative projects and applied research in the VET sector depends on the VET workforce's 'absorptive capacity … the ability to adopt, adapt and diffuse new or improved products, production processes and organisational innovations' (Toner 2011, p.8). This means the workforce needs both technical and generic skills and capabilities.

In attempting to elaborate more precisely what these skills are, we considered various issues relating to the incentives driving the VET workforce and the ways in which they might acquire these skills. We have situated these skills in a framework that includes understanding theory and undertaking research that leads to practice and experimentation. This reflects a typical applied research framework. The issues we examined were:

- the incentives for the VET workforce to become more involved in applied research
- the alignment of capabilities with professional standards in the VET sector, sector workforce plans and capability frameworks
- the social dimensions of capability development, meaning some skills may be acquired through a project team-based approach, a partnership between those involved in higher education and VET (both at VET and university levels) or a networking/community-of-practice approach (this influenced the circular shape of the developmental framework presented in figure 6)
- the various ways by which these skills and capabilities might be developed, both at an initial teacher qualification level and through continuing professional development.

Incentives

Incentives are important and can be diverse. Registered training organisations want to ensure their own commercial and political survival. This should include carving out a place for VET in the National Innovation and Science Agenda, which would be an incentive for developing an applied research function. RTOs also want to drive good pedagogical practices to develop workforce capabilities and ensure that students have access to 'cutting edge' learning opportunities aligned with their industries. The move into new roles and the development of expanded skills and capabilities are also recognised as a mechanism for 'future-proofing' the careers of those currently in the VET workforce.

The literature and our discussions suggest that staff members need more specific incentives to become involved in applied research. These may relate to career progression or to the professional satisfaction and excitement of being involved in innovative practices and research projects. At the moment, much of the impetus of

applied research is driven by individuals. To be sustainable, more concrete incentives are needed; for example, at TAFE Queensland, applied research is part of the organisation's staff capability framework.

Professional standards

Future-proofing the VET workforce relies on ensuring professional standards. The UK Education and Training Foundation (2014) includes scholarly practice in its standards for teachers and trainers in education and training:

> Teachers and trainers are reflective and enquiring practitioners who think critically about their own educational assumptions, values and practice in the context of a changing contemporary and educational world. They draw on relevant research as part of their evidence-based practice.

> (UK Education and Training Foundation 2014, p.1)

The standards recognise that teachers and trainers are 'dual professionals' — both vocational specialists and experts in teaching and learning. The 2014 professional standards (UK Education and Training Foundation 2014) see teachers and trainers as the users of research, in that their educational programs and decisions are based on it, but not necessarily as the researchers themselves, although the foundation does support practitioner-led research projects. At a knowledge and attributes level, they recognise the importance of evaluation and reflection to an individual's own practice, and applying the theory to enhance the practice of teaching and learning.

In Australia, RTO capability frameworks set out to establish professional standards. They provide both audit tools and professional development guidelines. In developing a VET applied research skills framework, we are starting to define some of the skills that might be required to achieve professional standards in applied research.

Capability frameworks

A current Australian trend is to use capability frameworks to outline skills development for VET educators. Precision Consultancy (2012), in its work for Innovation & Business Skills Australia (IBSA), defined capability (or ability) frameworks as describing (p.1):

> the skills and behaviours that people will demonstrate if they are doing high-quality work. These frameworks provide an over-arching list of the skills required in particular work settings or contexts. They are broad descriptions, against which specific skills can be mapped. Typically, they cover a range of job roles and/or work contexts.

In the context of VET, capabilities are referred to as:

> the aptitude or ability of VET staff to perform effectively in their roles … A well-structured framework can describe the broad capabilities needed to work in a particular industry, and provide a picture of broad capabilities against which professional development activities, formal and informal learning can be mapped.

> (Precision Consulting 2012, p.1)

At TAFE Queensland, applied research is part of the organisation's staff capability framework.

What is significant here is the use of such frameworks to map and possibly guide professional development activities.

The Innovation & Business Skills Australia VET Practitioner Capability Framework (2013) identifies three levels against which practitioners can map their skills, with four domains and six skill areas, of which innovation and evidence-based practice and research are two. In an options paper for the framework, Precision Consultancy (2012, p.11) proposes the following progression for the skill area of evidence-based practice and research:

- accessing and using information and research sources, to

- seeking out and critically analysing information and research, and undertaking research into one's own practice and within one's own environment, to

- identifying issues for further investigation, and working with others to carry out research beyond own environment.

The TAFE Queensland Educator Capability Framework (2015) covers seven principles, with principles 6 and 7 covering areas pertinent to applied research and innovation:

- Principle 6 outlines the practice of 'adopting an applied research/action learning approach to investigate new ways of doing things and improve outcomes for learners' and 'demonstrat[ing] scholarly practice and a commitment to lifelong learning and knowledge sharing'.

- Principle 7 outlines the skills needed to meet industry expectations and standards, including some of those already identified in this paper as being important for involvement in applied research programs, such as networking and collaboration, as well as communication skills and cultural literacy (TAFE Queensland 2015).

VET applied research – a developmental framework

Figure 6 illustrates the developmental framework we have created as a tool for VET educators and other professionals. The tool will help them to decide whether, or the extent to which, they are 'applied research literate', and whether they or their team members might need additional skills. The skills were identified from the literature on innovation and research skills, from other applied research frameworks, and by mapping these against the competencies listed in the Training and Assessment Package and other training packages. Given the current position of the Certificate IV in Training and Assessment as an entry criterion for teaching in VET, it was important to align the framework with this, as well as to higher qualifications in the Training and Assessment Training Package. The framework offers ideas for further professional development opportunities for the VET workforce based on current standards, as well as capabilities for the future. Further detail is available in the accompanying document, *Explaining the VET applied research developmental framework*.

Figure 6   VET applied research – a developmental framework
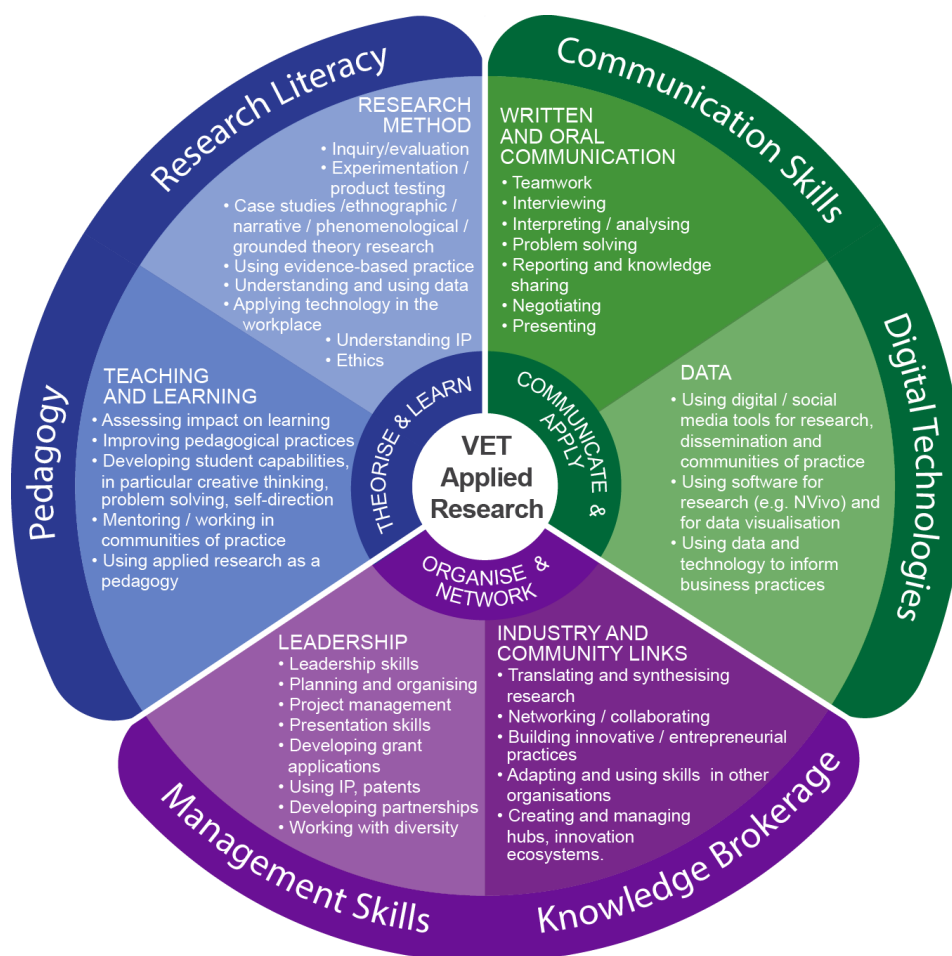
In keeping with the idea that VET applied research is a collaborative effort, it may transpire that different skills/capabilities are developed across an organisation and within or across the three domains (the three coloured segments in the diagram), which embrace more generic skills in communication, organisation and pedagogy and which can be honed to build research capability.

Given a specific goal to undertake applied research of relevance to end-users, VET educators and other professionals need to be knowledge brokers. This calls for skills in translating and synthesising the research so that it is relevant to others; in networking and collaborating with industry and community groups, as well as with colleagues; in building innovative practices to remove a project from the realm of the ordinary; in adapting and using these skills in other projects; and creating sustainable practices through hubs and innovation ecosystems. None of this is achievable without effective leadership, planning and work organisation.

VET applied research is important in changing both VET pedagogical and industry practices, with many projects involving students or having an impact on future training. While a full range of academic research skills are not necessarily required for work on applied research projects, VET educators and other professionals should have a measure of what we are terming 'research literacy'. This includes inquiry, evaluation and reflection at an entry level, with people working towards being able to apply evidence to change products and processes; having some qualitative and quantitative research skills;

experimenting with and testing products where necessary; ensuring that work follows ethical guidelines; and having an understanding of intellectual property requirements.

Continuing professional development of the workforce

One of the strengths of the VET sector is its ability to coordinate and develop teams of experts and communities of practice who share and develop knowledge, a critical element of undertaking applied research projects. This has implications for the skills and qualifications required of VET educators and other professionals, especially in the context of the applied research that connects to workplace innovation. Wenger-Trayner et al. (2015) suggest that networking, creating new social learning spaces and acting as learning citizens can add to the potential of a social learning capability. They see a focus on a 'landscape of practice', an extension of single communities or networks, as being key to this success.

While some of the applied research skills we have identified can be learned through practice, the Canadian experience (Colleges and Institutes Canada 2016, pp.14−15) demonstrates that deliberate investment in staff will also increase research capacity. The colleges offer activities such as workshops, presentations, mentoring and release from teaching. Training sessions cover ethics, intellectual property and the preparation of grant requests, as well as project management, development of a work plan and research project, analysis of qualitative and quantitative data, health and safety, technical report writing, team building, dissemination of research results, methodology and networking.

Although there is as yet no specific national recognition of the importance of VET applied research to the innovation system in Australia, or a national approach to VET workforce development, individual RTOs are undertaking developmental programs. These include:

- access to time in which to work on applied research projects and participate in communities of practice
- a commitment to scholarly practice, especially in the higher education sectors of VET
- scholarships/bursaries to fund higher qualifications, including doctorates
- funding to attend study tours or conferences, nationally and internationally
- mentoring and networking opportunities
- workshops, training and formal professional development
- membership of professional and industry associations and involvement in events such as the Australian Vocational Education and Training Research Association's (AVETRA) OctoberVET.

Box 9   Current approaches to developing research skills through professional development

Canberra Institute of Technology (CIT): at CIT, staff receive training entitlements to support the organisation's continuous improvement in teacher quality. CIT wants to encourage evidence-based practice and evaluation and the ability to share critical thinking with industry, including through applied research. Staff receive an annual allocation of professional development (PD) funds and can use this to buy time for research activity. The enterprise agreement contains a provision of 250 hours to complete prescribed teacher qualifications, one of which is the Advanced Diploma in Adult Learning and Development. This contains a unit of competency called 'Conduct Applied Research' and is another mechanism by which people can access time for research. CIT's 2017 Capability Development Fund has allocated resources for three applied research projects on innovative teaching and learning. Incentives for undertaking this professional development include: promotion prospects, maintaining industry currency and being exposed to different projects (Interview, February 2017).

Design Centre on Enmore campus, TAFE NSW: in 2016 Todd Packer, head teacher of Interior Design, won a NSW Premier's TAFE NSW Scholarship to study applied research case studies in a range of European colleges. He intends to bring the messages home and incorporate them as part of the 'creative' qualifications. He recognises that a further challenge is to ensure that teachers in the field have the skills needed to support their students and to identify their requirements for further professional development (Interview, January 2017).

TAFE Queensland: in 2015, TAFE Queensland partnered with Griffith University to pilot the Critical Participatory Action Research program. Pods of educators were established at TAFE Queensland Brisbane and TAFE Queensland Gold Coast. The program provides professional development in research practice, including an opportunity for educators to undertake an action research project in a highly supportive environment. This program was aligned with Principle 6 — 'Critical reflection' — of TAFE Queensland's Learning and Teaching Framework (RedSpace 2016a).

Organisational capacity

Both the literature and our interviews point to the need not only to develop an individual's research capacity but also the research capability of the organisation. Similarly, innovation is achieved through a combination of individual and collective efforts. In its submission to the House of Representatives Smarter Farming inquiry, the University of Melbourne described it in the following way:

> innovation requires a focus not just on the 'hardware' (that is, the new idea or technology), but also on the 'software' (the skills and knowledge required to use and derive benefits from the technology) and the 'orgware' (the formal and informal relationships and arrangements between stakeholders that are required to support the successful and sustained deployment of the technology).   (Parliament of Australia 2016, p.29)

As well as the hardware and software, our project is interested in the organisational capacity of registered training organisations and the sector to bolster VET's place in the innovation system. The RTO needs to be able to recognise and articulate the value of applied research to its staff and community and adapt its business models and workforce plans accordingly.

RTOs could be the R&D departments of small and medium enterprises in their districts.

TAFE institutes in particular are significant organisations in their local areas. In the United Kingdom, the significant presence of the TAFE equivalent, the further education college, has been articulated as follows:

> Colleges are not just skills providers and planners; they are also a major part of the local economic infrastructure. They are large employers, and purchasers of goods and services. Their experience of working across the public–private sector interface means they are well-placed to advise other businesses on how to operate more efficiently and innovatively. (James & Unwin 2016, p.14)

Another way of putting this is to consider the potential for RTOs to become the R&D departments of small and medium enterprises in their districts. This was a suggestion put forward at the European Business Forum for Vocational Training in 2014 (Danish Technological Institute, Technopolis & ICF 2014). The implementation of such a suggestion means that better use could be made not only of the available human capital but also of the physical infrastructure in which governments have invested across the country's TAFE system. Such an approach would see local VET collaborating with business in new ways, with entrepreneurship permeating the business model and learning activities.

The Canadian colleges also pay attention to the dissemination of their research. As well as using social media, including specialised blogs, they maintain direct contact with partners from various industries. This enables knowledge transfer beyond their own colleges, through the media and events and publications. All these activities demand the cultivation of a variety of skills beyond those of the researchers and extend to those in marketing departments and beyond.

Universities and the higher education sectors of TAFE institutes recognise the value of building research capacity and establishing its links with innovation, but this practice is not generally spread throughout the VET sector. Moreno Marchal (2012) refers to the need for creative environment management to support and develop innovation competencies, recognising that innovation capacity is a 'social need in our society' at both a personal and an organisational level, the latter leading to competitiveness. As Australian RTOs move to broaden their scope of operations and to future-proof the VET workforce, their capacity for 'creative environment management' also needs to be explored and fostered.

Moodie (2006) developed six steps for institutions to follow in support of a research and innovation culture. The first was to emphasise innovation: eschew research, noting that 'vocational education's role should be to stimulate "the timely take up, modification, and marketing of knowledge solutions that already exist but need to be adapted to local environments" (Gibbons 2004, p.97) and not to conduct research in any of its pure or applied forms' (Moodie 2006, p.137). By contrast, our project suggests that, with an appropriate understanding of VET applied research, its nature and purpose, the sector could embrace the term 'research', especially as it relates to the innovation system. Accepting and understanding all that is implied by the term would enable the sector to carve out a niche that builds on its connections with enterprises and the dual personality of a VET educator — as an industry specialist and teacher. Emulating universities is not the answer.

Secondly, Moodie (2006, p.137) suggests that vocational education should develop a distinctive role in the national innovation system, by — his third step — 'act[ing] locally and learn[ing] globally'. To do this, 'vocational education institutions need to broaden the partnerships they already have with local businesses, service providers and industry

VET applied research: driving VET's role in the innovation system

associations' (Moodie 2006, p.137). This would be helped, he says, at step five, with the establishment of a national network of vocational education innovation institutes with, at step six, its eye to a long-term impact. Moodie's steps align with some of the recommendations outlined in this report, in supporting the VET sector to develop a distinctive role, which can also embrace the development of a VET applied research capacity.

Toner (2010, p.81) noted the importance of VET institutions to technology diffusion, because of their 'strong focus on meeting the particular needs of industry and of students in the region in which the colleges are located. Colleges, moreover, have a direct link to the investment activities of firms through their role in training employees'. The institution has the capacity to act as technology intermediaries and, in many regions, is the expert source of technical expertise. If VET organisations built this capacity, according to Toner (2010), they could support staff to further research and undertake innovative projects.

From his study of a Perth-based TAFE institute, Mitchell (2009, p.6) identified internal and external factors for success in innovation. In analysing a number of case studies, he outlined a range of critical success factors, which included the need for:

- advanced practice; Mitchell understood that innovation relied on advanced practitioners being able to adapt flexible customised training to suit client expectations
- enduring partnerships, developed over years of interaction
- continuous creativity and the generation of new ideas, in an environment that encourages initiative
- combined knowledge, which can lead to a broader knowledge base for future developments.

Drawing on the themes identified in the literature, we surveyed a variety of individuals who had participated in the discussions associated with our project and/or had been involved in research on Australian VET innovative practices and VET workforce development. We asked what capabilities they thought registered training organisations required to allow them to support an applied research capacity.

The views were remarkably similar in the priority capabilities selected. Many respondents pointed to the importance of not only a research culture, but also clear goals for applied research and innovation, set by the RTO and accompanied by the allocation of sufficient resources. This would enable the building of a research capability amongst staff and the embedding of an applied research approach throughout the education and training programs being delivered by the RTO. Applied research could thus become integral to the way the RTO did things, not just a special project for a few experts. (*Developing VET applied research: steps towards enhancing VET's role in the innovation system* contains a summary of RTO capabilities.)

Applied research could become integral to the way the RTO did things, not just a special project for a few experts.

⚖ Conclusion

Registered training organisations will have to aim high if they want to realise their potential as players in Australia's innovation system. They will have to recognise that their participation will necessitate a new orientation towards industry partnerships, different business models and greater efforts to draw upon existing expertise in the workforce or to cultivate talent. Naming and claiming what can be done in the sector is the first step towards establishing VET's applied research niche. Until the data demonstrating VET's contribution to industry innovation and the commercialisation of ideas are available, much of the sector's potential will remain unrecognised.

In our pursuit of answers to the research questions (see p.13), we uncovered a range of activities already underway in the VET sector that are contributing, or have the potential to contribute, to innovation in industry on a scale particularly suitable for enterprises who already engage with the VET sector. We also found that undertaking applied research builds new capabilities in VET educators and their students, and in RTOs. That capability can also generate new income streams. The project has resulted in the VET applied research developmental framework, explained in an accompanying document. The framework is intended to help VET educators and other professionals identify and build the necessary skills for undertaking research. A further output from the project was the development of suggested steps that the sector can follow to realise its applied research potential (*Developing VET applied research: steps towards enhancing VET's role in the innovation system*).

After much discussion, we decided to use the term 'VET applied research' to encapsulate the activity along the research continuum that RTOs do or could undertake as part of their engagement with the innovation system. While the term is not yet embraced by everyone in the VET sector, uncovering and explaining its many facets could lead to a greater consensus that the term describes legitimate VET activity. Language does matter here. It will be important that what is labelled 'applied research' meets the standards set and that it withstands external scrutiny. This points to a role for both regulation and professional development.

One of the strengths of the Canadian experience has been the involvement of students in applied research projects and the recognition that enhancing their learning helps to build an innovative workforce. Another is the unwavering focus on facilitating commercialisation and the adoption or adaptation of new technologies. We conclude that, by viewing both students and enterprises as partners in knowledge creation and dissemination, RTOs can develop their existing business models so that they have the potential to build innovation within industries. Some may, however, see advantages in operating differently to capitalise on their infrastructure, expertise and community connections. They could, for example, host innovation hubs or facilitate enterprise incubators.

Leadership from policy-makers, peak bodies, RTO and industry chief executives and research leaders is crucial to building a sustainable research culture across tertiary education and the innovation system. This will involve new collaborations between VET and government agencies, industry and other research organisations.

A place for VET in the innovation system cannot be achieved quickly or cost-free. Waters and Sheehan (2016) suggest that building systemic capability in Australia would require a five to 10-year strategy, with a national policy needed to support the professional learning and developmental needs of TAFE and, we would add, some other RTOs. Their paper advocates the development of a national TAFE applied research network to assist in the development of these capabilities.

Jodi Schmidt (2015, p.4), the CEO of TAFE Queensland, has argued for $50 million over four years to be made available to the VET sector, through a competitive process, to develop applied research and innovation services. This is a modest amount: the Canadian Government contributed Canadian $74.6 million in the financial year 2014—15 to the applied research effort for that country's colleges. Nevertheless, a funding amount such as this in Australia could seed demonstrator projects and support a national collaborative effort to uncover, collate and foster research activity. Another important contribution would be time release and other staff incentives, including professional development and research training. The system needs to cultivate research skills from the start of a VET professional's career.

A more entrepreneurial approach to research and innovation activities may also generate income from R&D funds from within and beyond government, the latter in the form of direct commissions or shared profits from patents and other commercialisation efforts. One obstacle remains the lack of recognition within the innovation system of RTOs as publicly funded research organisations or as research service providers under the federal government's R&D Tax Incentive. A change in policy to include those that otherwise meet the criteria of this definition would send a strong signal to the sector that excellence in research will be rewarded.

Developing a research culture in VET may take years, but the foundations exist. Stimulating the groundswell of interest in VET applied research will deliver dividends for the sector, its students and its industry partners, with economic and social benefits to the country more generally.

One remaining obstacle is the lack of recognition within the innovation system of RTOs as publicly funded research organisations.

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📎 Appendix A

Questions developed from the literature review and used in semi-structured interviews and for consultation with the reference group

1. Apart from formally acknowledged research, are there other activities conducted in VET which might accord with those practised by applied researchers and innovators across in universities and in industry? What terms would resonate with VET teachers and managers: applied research; scholarship; inquiry; knowledge management or application; innovation; experimentation; evaluation; reflection …? Where are such activities in VET organisations underway? Could these be fostered elsewhere in the system?

2. Should VET institutions build on their comparative advantage as industry-based training organisations by honing their ability to contribute particularly to the 'downstream' sections of the applied research/innovation continuum? What sort of partnerships with other research organisations would this involve?

3. What would a strategy to develop systemic capability for applied research in VET look like? Does the sector have the foundations for an applied research network in organisations such as AVETRA, NCVER and the VET Practitioner Research Network?

4. In considering the professional development needs of a VET workforce able to participate in the innovation system, do we first need to identify the roles people might play in fostering innovation? Some teachers may already do applied research, while others, for example, workplace trainers, may act as knowledge brokers, and RTO managers may be the facilitators of partnerships with universities and with industry. What skills do they need to acquire in their initial training and how should continuing professional development cater to a VET profession that is part of the innovation system?

5. Can you tell us about other significant activities in VET applied research and innovation?

6. What would it take to follow the Canadian lead and have funding support for VET research from Australian government/industry/VET institutions? Are there differences between the Canadian and Australian VET workforces (for example, is Australia more casualised and therefore less willing to invest in professional development)? How could Australian VET researchers be supported to undertake applied research and other scholarly activity?

7. How can or do Australian VET courses include research activities? Are VET teachers placed to deliver these skills to students? Should this be confined to courses at the higher end of the Australian Qualifications Framework? Is this more likely to occur within higher education programs in VET?

8. Does/could VET involvement in applied research stimulate greater uptake of research findings and innovations among its industry partners?

9. Could RTOS, particularly those working in the rural areas, collaborate with the Rural Research Development Corporations? If so, in what capacity? As researchers on short-term impact studies or as partners in the dissemination of research findings to VET

students and other industry clients? Does this model offer a template for some VET providers to become service providers or knowledge brokers rather than researchers in their own right? Do extension services have applicability beyond agriculture?

10. Why are VET institutions, at best, only bit players in the Cooperative Research Centre model? In what way could/should they be involved?

11. Should such a suite of qualifications include research skills and capabilities, and if so how are these articulated? In order to participate in research are there skills, knowledge and attitudes that must be gained, and more importantly developed?

12. How are (or could) VET institutions supporting teachers and students to convert their experience into new knowledge and improved practice?

13. Do all VET educators and other professionals need to develop all the skills and capabilities identified for VET applied research, or can this be done at a team or community level?

14. How can/do Australian VET institutions fund the effective development of their educators and other professionals, including as reflective practitioners and applied researchers?

15. What capabilities would it require for an RTO to become an innovation intermediary, a knowledge broker, a research manager?

16. Is the involvement of the learners in applied research projects a critical part of VET's contribution to the innovation system?

Email survey on RTO capabilities

As part of our research we undertook a short survey of a range of stakeholders in the VET sector including those involved in our earlier interviews as to RTO capabilities. We asked the following question:

What do you think are the three most important capabilities that an RTO would need to ensure it can effectively support an applied research capacity?

While I [Linda Simon] have identified three, you are welcome to have more or less. Suggestions might include: funding (grants/scholarships etc), staff capacity, recruitment strategies, Professional Development including a specific PD strategy around applied research, networks, communities of practice, mentoring, applied research in Capability Frameworks, support for conference participation, structures including research units, expert research staff, strong industry contacts and partnerships, ongoing industry projects and product development, community projects, working as part of an innovation/applied research hub, a research culture, support for flexible and innovative work practices, support for research as part of pedagogy, involvement of students in applied research, supportive management and leadership, partnerships with universities, time for research and scholarly practice, recognition of individuals, recognition through structures and promotions, rewards.

🖇 Appendix B

Canadian College and Community and Innovation funding grants

In 2008 the Government of Canada established the Tri-Council College and Community Innovation (CCI) Program. The program is administered by the Natural Sciences and Engineering Research Council, in collaboration with the Social Sciences and Humanities Research Council and the Canadian Institutes of Health Research. It has boosted the capacity of colleges and institutes to engage in industry-driven applied research. The CCI Program supports six types of funding grants (in Canadian dollars):

- Innovation Enhancement (IE) Grants enhance college applied research capacity and strengthen industry partnerships. IE grants are awarded for either a two-year or a five-year period. The two-year grants include funding of $100 000 per year over two years. The five-year grants include funding of up to $500 000 per year for the first three years, and up to $400 000 for the remaining years.

- Applied Research and Development (ARD) Grants provide companies with access to college expertise and student support for specific research projects that help solve problems geared to business goals. The grants range from six months to three years in duration and have three levels of funding — under $25 000; up to $75 000; and between $75 000 and $150 000.

- Applied Research Tools and Instruments (ARTI) Grants support the purchase of research equipment and installations to enhance college applied research with industry partners.

- Technology Access Centre (TAC) Grants provide companies with access to college expertise, technology and equipment.

- Industrial Research Chairs for Colleges (IRCC) Grants support applied research leaders in economic sectors that spark greater innovation in communities, enhanced teaching and curricula, and more opportunities for college-industry and college-university partnerships. IRCC grants range from $100 000 to $200 000 annually.

- College-University Idea to Innovation (CU-I2I) Grants develop and strengthen collaborations between colleges, universities and businesses to improve a company's technology or commercial products, processes or services. CU-I2I grants are valued up to $250 000 per year, for up to three years (Colleges and Institutes Canada 2015a).