RESEARCH ARTICLE

Driving Digital Transformation: Addressing the Barriers to Engagement in University-Industry Collaboration

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ABSTRACT Collaboration between university and industry can improve knowledge exchange and innovation, which is required for driving digital business transformation in organisations. This paper discusses the results of a case study that was conducted to investigate the personal ('lived') experiences of both industry practitioners and academics from the STEM academic unit at the University of Enterprise in Australia, regarding the barriers to building trusting knowledge-related collaborative relationships. Semi-structured face-to-face interviews were conducted with sixteen academics and industry representatives to elicit their views. We found that university and business leaders must overcome barriers to establish higher numbers of University-Industry Collaboration (UIC) agreements, including limited resources, lack of capabilities and the absence of university support. However, they must also address the challenges facing individual academics and industry professionals, such as conflicting interests and expectations, and limitations to academics' career progression. The paper discusses how the recently established Enterprise Hub at the University supports collaboration and fostering healthy relationships between academic staff and industry partners. The findings will provide guidance to other universities and businesses to establish such supportive entities at their institutions to drive innovation and digital business transformation initiatives.

INDEX TERMS Collaboration barriers, DBT, digital business transformation, industry 4.0, open innovation, university.

I. INTRODUCTION

Most organisations today are on a journey of digital transformation, aspiring for digital excellence in their areas of expertise [1]. An important aspect of such a transformation is the principle of innovation [2] and specifically, open innovation, a term that was first coined by Henry Chesbrough in 2006. Open innovation means that companies move away from the principle of only creating knowledge inhouse, to also acquire knowledge from external sources, for example from academia. Collaboration between universities and the industry is therefore increasingly perceived as a vehicle to

enhance innovation through knowledge exchange between academics and practitioners [3]. University-Industry Collaboration (UIC) enhances research outcomes [4]. R&D collaborations with scientific and business partners contribute to the digital transformation of organisations)) [5]. Companies that use external resources can innovate and at the same time reduce the risk and uncertainty that are associated with the R&D process [6]. Universities actively encourage collaboration with industry to address a lack of time and other resources, as they face increasing pressure to impact society and generate new funding streams [7]. Collaboration between universities and industry partners has therefore been higher on university and business policy, research and innovation agendas.

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Collaborations with partners are at the centre of digital projects, but managing these collaborations is challenging [5]. Overall, Australia still performs relatively poorly in university–business collaboration towards commercialising research and innovation within the OECD countries [8]. According to the Australian Innovation System Report [9], there has been a decline in collaborative research activities between industry and the research sector. This constitutes a significant missed opportunity. Although the literature on university-industry links has begun to uncover the reasons for, and types of, collaboration between Australian universities and businesses, relatively few studies have investigated the nature of the barriers that exist in the STEM disciplines and the factors that might mitigate them [10]. It is especially crucial to understand the relationships between the individual parties and the barriers to their collaboration It is in the interests of governments, policymakers, researchers, and practitioners that such collaborations are successfully implemented [11]. Overcoming the challenges is key to economic and social development, especially in Australia.

The University of Enterprise in Australia fosters innovation and brings together experts in their field to generate ideas, build connections, and solve complex challenges. This is one of its strengths as an educational institution. In this paper we focus on the interactions between individual STEM academics and practitioners to provide rich insights into the barriers and challenges they face, as well as ways to overcome these barriers through university support provided by the newly established Enterprise Hub.

The research questions that are addressed in this paper, are as follows:

RQ1: What are the barriers to, and challenges of academic-industry engagement, as perceived by STEM academics and industry practitioners?

RQ2: How does the Enterprise Hub at the University of Enterprise encourage and support successful relationships between STEM academics and their industry partners?

The next section will refer to the literature about UIC and identify what has been done by previous researchers. This will be followed by the findings from the empirical study which describes the lived experiences of academics and industry practitioners. The findings will be framed in the context of the literature and further insights will be provided. The final section highlights a major contribution of the paper by discussing ways in which the University of Enterprise supports UIC by helping induvial role players to overcome the barriers to collaboration. The paper concludes by identifying limitations of the research and providing suggestions for future research.

II. BACKGROUND
This study is grounded in the literature about UIC and refers to previous research on UIC and the collaborative relationships between academics and practitioners. In this section, we will discuss how previous research refers to UIC as an important aspect of building innovation and supporting the digital transformation of organisations. We also refer to previous work on the different types of barriers to collaboration and engagement. Previous studies investigated the ways in which universities can help academics and practitioners to build trust-based, knowledge-related relationships and actively participate in collaborative activities.

A. A THE IMPORTANCE OF COLLABORATION BETWEEN UNIVERSITY ACADEMICS AND INDUSTRY PRACTITIONERS FOR DIGITAL TRANSFORMATION
Collaborative networks represent a core enabler of Industry 4.0 [12] and form a pillar of digital transformation [13]. Collaborating with universities is viewed as a major driver of knowledge exchange, innovation and competitiveness of a firm. Various innovation or product development initiatives within digitalisation can be counted to Open Innovation where academia is involved as one of the stakeholder groups to increase efficiency and effectiveness of new development projects [14]. Current literature lacks detailed understanding of the social, strategic, and managerial aspects of digital transformation [12], [14]. This is also observed by Yadykin et al. [15] who state that most of the studies on digital transformation focus on technological aspects in the form of innovations in products and processes, while economic and organisational aspects are overlooked. There is a need to clarify how organisations develop collaborative arrangements to obtain external sources of information, knowledge, and technologies to incorporate effective digital practices that may lead to competitive advantage [5], [16].

Literature clearly describes the need for academics and industry practitioners to collaborate. Academics are increasingly pressured to become involved with external research, do contract research and consultancy, and offer executive education. They are also expected to generate research and commercial income, achieve international visibility, and have a positive impact on society [17]. Academics who want to progress their career must balance the time they allocate to each of these activities. Businesses find it difficult to develop new innovations and cope with digital disruptions. They therefore realise the importance of gathering external knowledge from universities and public research organisations [18].

O'Dwyer at al. [11] suggest that University–Industry Collaborations (UICs) are characterised by three critical features that shape their nature and performance and that lead to barriers to collaboration; firstly, they are populated by people from different professions (academics and industry practitioners); secondly, the collaboration is between individuals and not organisations; thirdly, the collaborators are members of differing organisations. Kleiner-Schaefer & Schaefer [19] agree that there are significant differences between academics and industry practitioners that pose challenges and barriers to effective collaboration. For example, the differences in objectives between industry people and academics relate to the way they manage their knowledge, their motivation,

benefit, characteristics, role and how much they value commercialisation/patents [20]. It does not come as a surprise that the differences inject conflicts that create collaboration barriers. Despite these differences, the amount of collaboration between universities and industry partners has increased over the last number of years, resulting in an urgent need to overcome these barriers. However, the challenges of, and the barriers to, successful external relationships remain poorly understood [21].

B. BARRIERS TO COLLABORATION

Various factors impact the collaboration between academics and industry practitioners, also in the STEM disciplines. For example, Garousi et al. [22] investigated the low number of industry-academia collaboration in the Software Engineering field and found that the two parties have different objectives, that industrial problems lack scientific novelty or challenges, and that the solutions developed in academia are not always applicable and scalable in industry settings.

Other authors such as Bruneel et al. [23] and Tartari et al. [20] clustered the barriers to collaboration into two categories, namely *orientation barriers* that relate to the different viewpoints of academics and industry practitioners and *transaction barriers* that capture how the distance between academics and industry partners translates into additional transactions costs. Ramli and Senin [24] subsequently added *resources-related barriers* such as limitation of finance, infrastructure and human resources. These barriers also include the lack of motivation and incentives if individual researchers do not regard industry collaboration as part of their performance objectives. These three categories of barriers and challenges are discussed next.

1) ORIENTATION BARRIERS

There are various differences between universities and industry, for example the way they regard research [25]. Academics often regard research as separate from the practical knowledge held by practitioners, leading to a distance between pure and applied scientific research [26]. Practitioners don't always value research and are not willing to allocate resources to long-term research projects without a solid business case [20]. This distance is referred to as the 'rigour-relevance gap' [27], [28], [29].

The problem often lies in the inability or unwillingness of academic researchers to translate their insights for practitioners or involve the industry partner in the research activities. There is also a misalignment of knowledge transfer activities such as commercialisation [17], [30], [31] with the traditional KPIs of academics, such as the ability to publish, obtain grant funding for their research and teach [32], [33].

Academics and practitioners have distinct working practices and expectations. Practitioners are interested in improving productivity and they tend to focus on success stories, whereas academics focus on gathering evidence to support their theoretical framework [34]. There are also differences

in the language they use and developing a common language takes time. Establishing trust and long-term relationships are key to successful collaboration.

2) TRANSACTION BARRIERS

The impact of university research is often unrealistic or unclear. Industry has a need for specific deliverables and competitive advantage [35], which may result in conflict regarding IP or confidentiality arrangements. Universities are also increasingly seeking to create valuable Intellectual Property (IP) for themselves [23] and exploit it for financial gain [36]. Attempts by universities to capture the commercial benefits from research may lead to significant conflicts between universities and industrial partners over IP and when or how they publish the findings of the research [37]. Whereas researchers may be keen to disclose information in publications, firms may wish to keep the information secret [23] or disclose it through patents aimed at obtaining temporary monopolies [38].

Industry partners often experience frustrations in dealing with university administration due to incompatible rules and regulations, bureaucratic structures, and reporting requirements, as well as limited capabilities of universities' industry liaison offices [19]. A key issue in implementing knowledge transfer mechanisms is the perceived bureaucracy and inflexibility of universities [39].

3) RESOURCE-RELATED BARRIERS

Universities depend on financial support from both the government and industry sectors to conduct research activities. The funding received from the government is decreasing [40] and the funds from the industry sectors remain scarce. Government funds focus on basic or fundamental research, so university researchers are actually discouraged from doing applied research [24].

Universities and businesses are also driven by different incentive systems. University academics are primarily incentivised to create new knowledge and to educate, whereas firms focus on capturing valuable knowledge that can be leveraged for competitive advantage [23].

Time limitation is an important resource barrier that leads to challenges for academics and practitioners to develop effective collaborations [24]. The priority of establishing reputation through publication of high-quality research is critical to academic success and career sustainability [23]. Yet, academics are increasingly expected to align with the fast-paced world of industry [7], [41].

C. WHAT UNIVERSITIES CAN DO TO OVERCOME THE BARRIERS

Literature suggests that universities can play an important role in helping academics and industry practitioners overcome the barriers to collaboration [17], [42], [43]. Awasthy et al. [6] created a holistic framework for overcoming the barriers and enable more effective collaborations. The

framework indicates that it is very important to understand the various kinds of interactions or relationships that are possible between universities and industry, as well as the benefits. It is also important to identify the Stakeholders and conduct a partner evaluation to ensure the selection of partners who have genuine interest and commitment, and adequate resources to support the intended research project. The Stakeholders of university-industry collaboration include researchers and academic units, technology transfer offices (TTOs), university administration, and policy makers. For example, University Business Development Managers link academia and industries to support technology transfer and the commercialisation of academic knowledge. They can assist researchers in administrative issues concerning inventions and the protection of intellectual property, but they can also serve as advisors for researchers to establish successful alliances with firms and appropriately configure alliance management capabilities.

Once the partners have been identified, they should develop and articulate a shared vision [6], [17]. Universities and industry have invariably different motivations for collaborating, for example problem solving, resource-sharing or access to skills development through education. Industry partners must identify what the university can do better or different than them. Universities should also aim at selecting a generalisable problem within the partner organisation, as it will have wider applicability leading to greater impact for the organisation and the partnership. The characteristics of individuals and an organisation influence the level of collaboration and appointing the right people is therefore key to success. Universities should identify the university staff who are open to change, willing to cooperate, and trustworthy. Universities should also enhance the development of entrepreneurial competencies among academics, which may contribute to the application of university research in business practice. Etzkowitz [44] refers to the transformation of an academic institution into an ''entrepreneurial university''. Universities should also improve the relationship management capability of academics [45]. The industry should select capable managers for effective project management. Strong university research leadership indicates the commitment of a university and influences the formation and success of collaborations.

The success of a partnership depends on a basic set of principles where stakeholders identify a win-win situation and ensure a long-term commitment. The expectations of each stakeholder should be spelt out from the beginning [46]. Interpersonal communication is a critical factor in the success of a relationship. Stakeholders should adopt measures to improve communication between them. Universities need to play a more proactive role in the commercialisation of research results [47]. They need to demonstrate the applicability of research for industry in a relevant context and promote their research outcomes. They therefore need to gain a better understanding of the requirements of business and users. Communicating the benefits of the collaboration can

stimulate future collaborations. Universities must use a variety of channels to disseminate results, leading to improved industrial adoption of research and validating the applicability of research results in a client-centric way. The value of a partnership should be seen in terms of other benefits rather than getting hung up on intellectual property (IP). Partners should minimise constraints on information, and universities should not seek to overprotect IP.

Successful collaborations need to be encouraged and supported by policy interventions. Institutions must collaborate to develop a common policy on conflicts of interest for themselves and their faculty to help with resolving institutional conflicts. Partners show commitment by making collaboration a part of their strategy. A good strategy for collaboration will include deliberate and informed planning, identification of key contracts, adopting a legal framework for cooperation, and proper preparation. Mutual trust is an important factor leading to effective knowledge sharing between various stakeholders. A new system of incentives should be created in universities to recognise the efforts of the academics participating in partnerships with industry. It is important to manage collaborations. Universities also need to maintain connection with their graduating students who would work in industry. Connection with those students is an opportunity for university to discuss industry problems and understand ways of working together to solve those relevant problems.

To enhance effective technology transfers and to design purposeful frameworks, evaluation, and incentive systems, policymakers should have an eye not only on the sheer volume of university-industry collaboration, revenues, or third-party funding, but also on the personal relationships between individual academics and industry partners [20], [45], [47].

III. METHODOLOGY

The research follows a qualitative approach with a focus on in-depth understanding of research participants' views and perspectives [48]. This paper describes the 'lived experiences' of academic and industry partners, i.e. the barriers and challenges they encounter in their efforts to knowledge-related academia-industry collaboration. True to the nature of qualitative methods, we did not start with a well-formed hypothesis, but we conducted interviews to identify participants' experience and opinions and developed a set of recommendations based on their experience.

A. RESEARCH PARTICIPANTS

The research participants consist of academics and industry practitioners who actively participate in collaborative activities. We selected 16 participants for the study; nine academics from the STEM academic unit of The University of Enterprise and seven industry partners from various industries. According to recommendations by expert qualitative researchers [48], [49], theoretical saturation can be achieved with ten participants. A profile of the interviewees is included in Table 1.

TABLE 1. Interview participants.

Interviewee	Type	Role	Industry
A1	Academic	Professor	Higher Education
A2	Academic	Associate Professor	Higher Education
A3	Academic	Professor	Higher Education
A4	Academic	Associate Professor	Higher Education
A5	Academic	Professor	Higher Education
A6	Academic	Senior research fellow	Higher Education
A7	Academic	Associate professor	Higher Education
A8	Academic	Associate professor	Higher Education
A9	Academic	Senior lecturer	Higher Education
P1	Practitioner	Manager	Information Technology
P2	Practitioner	Consultant, own company	Information Management
P3	Practitioner	Exploration manager	Mining
P4	Practitioner	Academic engagement manager	Defense
P5	Practitioner	Manager	Defense
P6	Practitioner	Practitioner researcher	Utilities
P7	Practitioner	Consultant	Information Technology

B. DATA COLLECTION

Data were collected via personal interviews to allow in-depth exploration. The individual semi-structured open-ended interviews were conducted face-to-face, each lasting approximately one hour. The interview questions related to collaboration and interpersonal relationships between academic and industry representatives. The interview protocol starts with general questions, allowing the researcher to develop rapport with participants. The questions were directed to the participant's experiences, feelings, beliefs, and convictions about the research questions [50]. Planned (predetermined) and floating prompts (impromptu) were used to obtain further detail. Participants engaged in a discussion about personal experiences regarding collaboration. Each interview was audio-recorded and transcribed verbatim for later analysis.

C. DATA ANALYSIS

The data analysis adhered to the four characteristics of analysis as identified by Giorgi and Giorgi [48], namely description (openly reading, reduction), sorting of meaningful units, search for essences (reflecting on each meaningful unit), and intentionality (based on research questions). Participants' perspectives were sought rather than statistical significance.

The data were analysed manually. The researchers first listened to each audio recording to develop a holistic sense of the data. The authors then individually reviewed each interview transcript to detect similarities or differences between their experience, as articulated by the interviewees. The researchers also used their judgment to interpret the data while consciously avoiding enforcing their preconceived ideas on the data, i.e., not allowing their meanings and interpretations to influence the opinions of the interview participants. True to the nature of qualitative research, the authors did not aim to gather generalisable results. The findings were clustered into meaningful categories.

D. ETHICAL CONSIDERATIONS

Ethics approval was obtained from the University of Enterprise's Ethics Committee. Informed written consent was obtained from participants, ensuring them of confidentiality and secure storage of the research information. Participants understood that involvement in the study was entirely voluntary and that they can withdraw from the research project at any stage without consequence to their career or personal status.

E. ENTERPRISE HUB CASE STUDY

In the final part of the research, we investigated how the recently established Enterprise Hub aims to support the engagement between academic staff and industry partners at the University of Enterprise. This information was gathered from secondary data, including the university web site (www.UniSA.edu.au) and a presentation by the Director of the Enterprise Hub. The Enterprise Hub streamlines the university's partner management model, co-locates university researchers with industry, provides a front door for industry to initiate a conversation, and clarifies the many ways industry practitioners can partner with academics. The Hub makes enquiry management easier, ensuring industry is connected to the right people in the University, driving stronger collaboration.

IV. FINDINGS

In this section of the paper, we report the viewpoints of industry practitioners and STEM academics about the challenges they face and the barriers to collaboration.

A. CHALLENGES FACED BY INDUSTRY PRACTITIONERS

1) ACADEMICS HAVE DIFFERENT EXPECTATIONS AND PRIORITIES THAN INDUSTRY PRACTITIONERS

An Information Technology consultant (P7) said, "industry lags slightly behind academia on innovation and technology, because we're out there trying to provide products and services. Industry knows what works and what doesn't, but what we don't have is that rigour behind definitions, principles, and concepts".

Universities often don't value and prioritise applied research, even in the STEM field.

"If research has a whiff of an applied nature to it, it's the kiss of death". (A1)

"Researchers are more interested in highly academic presentations, which don't help us in a practical sense. The academics get kudos from their publications, but we actually don't get much out of it. So, a couple of projects like that have just sort of withered on the vine." (P3)

"In a research project, the commercial entity is going to want to make money [..] The academic institution is going to want to publish [..]." (P2)

2) ACADEMICS HAVE DIFFERENT TIMESCALES

Industry practitioners and academics have a different "rhythm" (P7) and different timescales (A5, P6).

"For the industry people, the milestone is the most important thing, while some academic researchers never finish a project." (P6)

It takes time to build a relationship between industry and academia, as there is often a natural separation between them (P7). Academics don't always have time to build the relationship (P2, P5).

"Everybody's busy. Academics are busy with teaching and learning, while businesspeople are busy selling their services and feeding their teams. Time is always going to be of the essence. Things are always going to have to be done at times on an urgent basis and that requires hard work." (P2)

3) ADVERSE IMPACT ON THEIR CAREER

Practitioners are concerned about potential adverse implications to their career if collaborative projects to not get off the ground. A2 said that "if I back this and the academic [messes it up], I'm going to get fired".

"Academics were always happy to have us on their ARC applications or their internal grant applications, but once they got the money, we actually didn't hear much from them again, which was very disappointing". (P3)

4) LACK OF UNIVERSITY SUPPORT

Industry practitioners feel that the university is not adequately supporting collaboration with practitioners, regarding guidance with finding funding and grant applications (A1), providing cash upfront to mitigate the risk for industry (A2), supporting industry professionals with building relationships with academics (P1) and supporting industry partners to prioritise projects (P3).

"Our new managing director did not feel the university was giving us enough back in return" (P1)

The IT Manager of a large software company (P1) indicated that the university currently does not have good industry account management practices. He stated that industry people want to deal with one contact in university and need access to a consolidated portfolio of offerings and services.

B. CHALLENGES/BARRIERS FACED BY ACADEMICS

1) DIFFERENT PRIORITIES REGARDING CONFIDENTIALITY AND ACADEMIC PUBLISHING

Industry practitioners often do not perceive value in academic publications as they usually publish in industry publications (P4).

"We had to put a very positive spin on the paper to make the company look good". (Ross)

Industry is sensitive to breach of confidentiality.

"Industry doesn't want to publish before the end of the project". (A5)

"Industry seems very protective. It's been two months just trying to make me sign one-way confidential agreements. (A6)

Some companies discourage academics to work with their competitors (A5, A7).

"Industry wants exclusivity, and their motivation is competitive advantage. They believe there should be a restriction in how the university works with another company". (A7)

2) DIFFERENT PRIORITIES REGARDING INTELLECTUAL PROPERTY (IP)

IP disputes often arise because industry wants all the IP (A7, A9).

"The industry partner was taking more credit than they should have and assumed that anything coming out of the project was theirs. In reality, the contracts clearly stated that parties keep their background IP that already existed. (A7)

"We had to really quickly lodge a couple of patents before the CRC-P actually kicked in to make sure that our pre-existing IP was protected" (A6)

3) LIMITED FUNDING AND TIME

Academics must 'publish or perish', and they need research grants to keep moving forward [Karin]. Federal Government budget pressures and changes in funding models pose challenges. Grant applications do not always attract funding and it is especially difficult to get funding from industry. Signing off on financial support can involve several layers of management to get approval. Writing a grant application is a cumbersome process and one must wait a year to find out whether it is successful (A2, A7). Industry practitioners often don't want to wait for grants; they buy an off the shelf solution, instead of doing research to solve their business problems.

Collaboration is also time-consuming, so academics must manage the time they put into a project (A4, A5, A7). Distance and time zones complicate this (A6, A7).

"The internship application for my PhD student took about three months to approve, due to distance and time zones. Every time we have a meeting we've been staying until about 6:30pm here when it's 8:00am there. It's a real barrier". (A7)

4) RESPECT/VALUE PERCEPTION

Industry doesn't always see how engaging with academics can increase the value, sustainability, and competitive position of their company.

My intention was for industry to put some money in so the university can be a resource they could tap into whenever they wanted, but they just didn't see it like that, and I was dumbfounded." (A2)

Academics can potentially be exploited by doing what industry values (P7, A3). An Associate Professor and researcher in the Information Technology field (A9) said that "industry sometimes think that working with university is like charity, like the university must make a donation. They know that academics are hungry for projects and hope they will do it for free". Industry sometimes 'soaks ideas' from academics (A5, A8).

> "I've been involved with some meetings with industry where they'll gather a lot of academics and ask for their feedback on ideas they've got, and then nothing comes out of that meeting". (A5)
> "A mature start-up said we'll pay for you, come and spend the day with us, we'd like to talk to you about problems. I spent the whole afternoon being almost interrogated with questions. It was clear that they just wanted to soak ideas." (A2)
> "Australian companies look at research as a place where you buy outcomes. "You go to these smart people and spend $10,000 and in one month [the problem] will be solved. Quite unrealistic. (A2)

Academics must build a strong reputation. They don't naturally lean that way and they must prioritise various activities.

> "Should I rather spend my time writing press releases or papers? I just don't have time for everything". (A3)

5) LACK OF INCENTIVES AND REWARDS TO COLLABORATE WITH INDUSTRY

University management does not value and reward industry collaboration enough.

> "Research impact is measured and is part of the promotion cycle. But could you get promoted to full professor purely by impact? I would say no". (A1)
> "You get the behaviours that you reward. If you want to enhance collaboration, you should find ways of measuring academics and incentivising them to collaborate with business". (P2)

6) ADVERSE IMPACT ON THEIR CAREER

Academics who collaborate with industry often do less research, which has a detrimental career impact:

> "When you collaborate with industry, you get to talk to much more people, but you do much less research [..]". (A3)
> "Every research hour a level C academic spend working with a company that doesn't produce either research income or papers is detrimental to their academic growth". (A1)

7) LACK OF SUPPORT FROM THE UNIVERSITY

A professor in Computer Science (A1) said that one of the issues for academics to work with industry is that they do not understand the industry drivers and that becomes a frustration on both sides. His colleague (A7) added "The university can do some 'matchmaking'.

Academics do not have time to keep up with changes in policy. A1 said, "I don't read the policies every year. There are people in the university that are tasked with reading and understanding those policies and they need to interpret them on our behalf". Academics also need legal support with licensing and patenting matters (A7) and negotiate contracts on the academics' behalf (A1, A2, A7).

The university offers an Early Career Research' (ECR) development programme (A3, A6), but it can do more to provide training programs.

C. OVERCOMING THE BARRIERS AT THE UNIVERSITY OF ENTERPRISE - THE ENTERPRISE HUB

The Enterprise Hub is operated and supported by a newly formed Enterprise Partnerships Unit. The new Unit helps facilitate the coordination of industry partnerships across the institution, enabling collaborative, dynamic and proactive approaches to innovation and commercialisation, supporting research centres to scale up partnerships. The Unit will also work with the wider University to support industry placement and philanthropy efforts.

As indicated through the empirical research described in this paper, strategic partnerships grow from initial interactions between academics and industry practitioners, such as internships, graduate employment, and research collaboration, to multi-service integrated relationships.

The Enterprise Hub follows a partner-centred approach by improving the experience of businesses wanting to engage with the university in research and providing innovation and partnership options, by providing a clear way in for industry, increasing research income, as well as driving economic growth and sustainable development through supporting growth in the scale of reach of university research translation and commercialisation. The Enterprise Hub removes the barriers that can hinder collaboration:

- Expansion of existing, and development of new, industry-based partnerships and funding opportunities across all University services, as well as improved opportunities for translation of research through industry engagement, commercialisation and spin-offs.
- Increased visibility of Uni-wide partnerships to provide a broader network for Industry engagement and partnership expansion, while at the same time strengthening the university's research reputation.
- Improved transparency of existing partnerships to maximise whole of university partnership value.

- Business development support to improve funding outcomes and partner engagement and help increase research funding.
- Increased students access to internship and placement opportunities.
- Provide clarity around who in the University, staff can redirect enquiries to.
- Further opportunities for collaboration with colleagues from across the University.
- Further training opportunities for researchers.

The Enterprise Hub provides support across the following six categories of services:

1) Business development & growth (business incubation, business innovation, product and process innovation, brand growth, professional services clinics, commercialisation and investment, customised degrees)
2) Collaborative research (Access to IP, cooperative research centres, international research, grant and funding opportunities, research partnerships, consultancy and strategic advice)
3) Engage with the university (invest in research, support tomorrow's leaders, professional partnerships, activate enterprising spaces)
4) Facilities (hire university facilities, access research infrastructure)
5) Professional development & training (custom training solutions, executive education, short courses)
6) Workforce planning (student placements and internships, access graduate talent, engage a research student)

The Enterprise Hub aims to provide a 'seamless outside-in view of the university' and it is the first university in Australia to work across 13 industry sectors, instead of academic units that industry does not understand.

1) SUPPORT FOR ACADEMIC STAFF CONSISTS OF

Business development support (access to specialist business development managers and partner engagement managers, understanding other sectors, identify opportunities in the field and sector, identify potential partners and collaborators, identify future sources of funding);

Commercialisation (patents and licensing, access to investors, management of IP, spin-offs); and Incubation and start-ups (advice and mentorship, access to start-ups, entrepreneurship, collaboration);

An industry partner Customer Relationship Management (CRM) system has been developed that holds thousands of companies and users and new opportunities and is another first in Australian Higher Education sector. The University of Enterprise wants everybody to feel part of the research community, whatever their discipline, sector, background, or interest. International connections are also regarded as important and are included in the CRM.

(https://www.unisa.edu.au/connect/enterprise-hub/)

V. DISCUSSION

When looking at the three categories of barriers, as identified in literature, from a different angle, we identify a few possible additions and enhancements:

The Orientation barriers can be divided into two parts, namely i) personal characteristics of the individual role-players and ii) the orientation due to the professional environment (university or organisation) they operate in.

The Transaction barriers can be divided into i) what they collaborate on and ii) how they collaborate.

Some of the Resource-related barriers are i) within the university's control, and some are ii) outside of their control. As the saying goes you need 'the serenity to accept the things you cannot change, the courage to change the things you can, and the wisdom to know the difference'. Understanding which of the barriers can be overcome and which challenges need to be accepted, will help in managing the expectations of academics and practitioners, and improve the collaboration between the parties.

This paper contributes to the body of knowledge by providing insights into the cultural, motivational, and organisational aspects of collaboration as a driver of digital transformation. Specifically, we enhance the current knowledge in three ways: Firstly, we provide additional insights into the classification of the barriers; Secondly, we indicate how the Enterprise Hub is used to support academics and practitioners in their collaboration efforts; Thirdly, we also provide a set of fundamental principles for effective engagement and collaboration between academics and industry practitioners.

The barriers to collaboration, (categorised as Orientation, Transactional and Resource-related barriers) are summarised in Appendix A and the support required to overcome the barriers is listed in Appendix B.

The findings of the research indicate that universities can support academics and industry practitioners in many ways. An Enterprise Hub can play an important role in these efforts. Amongst others, universities can support the parties by managing industry partners on behalf of the academics and connect them with projects, providing a single point of contact for the industry partner, providing support for academics to interpret and explain the university policy and strategy, providing legal support, sourcing businesspeople to provide guest lectures and providing entrepreneurship training and training to understand partners and potential customers, as well as workshops on legal matters and agreements.

As with all relationships, the academic and industry partners need a set of fundamental principles that they adhere to. The managing director of a consulting firm (P2) commented that age, gender, nationality, do not matter if [the academic and practitioner] fundamentally have the same set of principles. He warned, "if you don't have the same set of principles and one organisation wants profoundly different things out of the relationship and is hell-bent on making that happen, you've got the makings for division and ultimate failure".

From the literature and empirical research, we derive a set of principles that will enhance and support the academic-practitioner relationship:

1) PRINCIPLE1: UNIVERSITIES SHOULD VALUE AND ENCOURAGE APPLIED RESEARCH

It is not basic research only, but also applied research that is interesting and useful for both academics and practitioners. Applied research creates opportunities for enhanced academia-industry collaboration and partnerships, resulting in tangible business benefits.

2) PRINCIPLE 2: UNIVERSITIES SHOULD CREATE AWARENESS OF, AND SUPPORT, RESEARCH COMMERCIALISATION AS AN ENABLING FACTOR OF SUCCESSFUL COLLABORATION AND REVENUE

Universities' positive attitude towards commercialisation of research outputs motivate academics to work with industry partners to develop workable solutions and products. Commercialisation can result in increased number of patents and licenses, enhanced international reputation, and additional revenue streams for the academic institution.

3) PRINCIPLE 3: UNIVERSITY ACADEMICS SHOULD BE ENCOURAGED TO CONSTANTLY SEARCH FOR OPPORTUNITIES TO COLLABORATE WITH INDUSTRY PARTNERS AND REWARD THEM FOR SUCH COLLABORATION

It is important to strengthen academics' awareness of the benefits of collaborating with industry and to support and reward them to collaborate with external partners. Universities should provide career incentives for researchers who demonstrate effective engagement with industry by regarding corporate engagement as one of the researchers' performance objectives. Industry practitioners should be encouraged to collaborate with universities on research work-integrated learning (WIL), including internship programs and graduate employment opportunities.

4) PRINCIPLE 4: UNIVERSITIES SHOULD ENHANCE THE INDUSTRY ENGAGEMENT SKILLS OF ACADEMIC STAFF

University-industry collaboration can be strengthened through management programs to train academics and enhance the transformation of academic institutions into 'entrepreneurial universities'. Universities should train their academic staff to communicate effectively with industry partners and provide the skills to manage collaboration in various forms. Senior researchers with extended experience with industry collaboration, as well as external industry experts can share their experience during the training. Universities can enhance the development of industry engagement competencies among academics, which may contribute to the application of university research in business practice.

5) PRINCIPLE 5

The university should support the industry partner by providing a seamless entry into the university, to connect with academics and gain access to expertise and equipment. Previous research identified incompatible rules and regulations, bureaucratic structures, as well as limited capabilities of universities' industry liaison offices as limitations to the collaboration [19]. Our study confirmed that industry partners often feel that support from the university is insufficient.

VI. CONCLUSION
A. LIMITATIONS OF THE STUDY

As with any empirical study, there are limitations to our findings. Only nine academics from the University of the Enterprise and seven industry practitioners participated in this study. The small number of participants in the study might limit the generalisability of the findings. However, the high similarity between responses from participants suggests there is no reason to believe that the results cannot be generalised to the larger population. This needs to be empirically investigated.

B. FUTURE RESEARCH

Future research should investigate the collaboration between academics in other higher education institutions and their industry partners. The different roles within a university can be investigated to determine how university-industry collaboration can be optimised with the correct support in place. Future research can also focus on the commercialisation aspect of Academic Capitalism, as well as the impact of gender on the propensity to collaborate and commercialise academic research output.

APPENDIXES
A. BARRIERS TO COLLABORATION BETWEEN ACADEMICS AND INDUSTRY PRACTITIONERS - EXPANDED

Orientation barriers

i) Differences in personal characteristics and capabilities

Different priorities

Different capabilities

Different attitudes toward the other party

Different orientation towards time, deadlines, and productivity

Different attitude towards learning and teaching

Different communication and work styles

ii) Differences due to the environment in which they operate

Different KPIs and expectations (e.g. IP requirements, commercial gain, and confidentiality)

Different timescales, e.g. time to get a grant accepted

Different view of valuable collaboration (e.g. basic vs applied research, commercialisation, etc.)

Differences in their tolerance for bureaucracy and red tape

Differences in requirements for career enhancement

Transactional barriers

i) Barriers to what they collaborate on

Research projects

Co-publishing

New product development

Co-teaching

Innovation

Commercialisation – e.g. patents

ii) Barriers to *how* they collaborate

The parties have a unique and sometimes incompatible approach to problem solving

Relationships are not always based on mutual respect and trust

Involving the other party in activities and opportunities is not encouraged enough

Communication can get blocked

Sharing facilities and equipment is not encouraged

Resource barriers

i) Barriers the university can overcome

Limited support matchmaking, contracting, relationship management

Limited time to search for partners and introduce individuals

Lack of training in entrepreneurship, project management, contracts, patents

Limited support for grant applications

Cash not injected into a project

Limited funding from industry

Not enough awareness of the value of academic research amongst practitioners

ii) Barriers the university cannot overcome

Strict and limited government funding budgets

Delays in approving grant applications

Disruptive external changes (technology, changes to government, financial pressures, natural disasters, and pandemics, etc.)

B. SUPPORT REQUIRED TO OVERCOME THE BARRIERS

Support required by Practitioners

Provide guidance with finding funding and grant applications

The university can also provide cash upfront to mitigate the risk for industry.

Support with building relationships

Prioritising projects

Manage industry partners

Support required by Academics

Online communication and social media visibility.

Manage industry partners on behalf of the academics and connect them with projects.

Provide a single point of contact for the industry partner and academics.

Interpret and explain the university policy and strategy

Employ businesspeople as guest lecturers

Incentivise academics to collaborate

Provide legal support

Training (various topics)

REFERENCES

[1] M. Wiggberg, J. Gulliksen, Å. Cajander, and A. Pears, "Defining digital excellence: Requisite skills and policy implications for digital transformation," *IEEE Access*, vol. 10, pp. 52481–52507, 2022, doi: 10.1109/ACCESS.2022.3171924.

[2] N. A. Gómez-Cruz, J. Montes, and D. Anzola, "Interactions between innovation and digital transformation: A co-word analysis," *IEEE Access*, vol. 10, pp. 111607–111622, 2022, doi: 10.1109/ACCESS.2022.3215552.

[3] S. Ankrah and O. Al-Tabbaa, "Universities–industry collaboration: A systematic review," *Scandin. J. Manage.*, vol. 31, no. 3, pp. 387–408, Sep. 2015, doi: 10.1016/j.scaman.2015.02.003.

[4] M. Hemmert, L. Bstieler, and H. Okamuro, "Bridging the cultural divide: Trust formation in university–industry research collaborations in the U.S., Japan, and South Korea," *Technovation*, vol. 34, no. 10, pp. 605–616, 2014.

[5] C. Rocha, C. Quandt, F. Deschamps, S. Philbin, and G. Cruzara, "Collaborations for digital transformation: Case studies of industry 4.0 in Brazil," *IEEE Trans. Eng. Manag.*, early access, Mar. 17, 2021, doi: 10.1109/TEM.2021.3061396.

[6] R. Awasthy, S. Flint, R. Sankarnarayana, and R. L. Jones, "A framework to improve university–industry collaboration," *J. Ind. Collaboration*, vol. 2, no. 1, pp. 49–62, 2020, doi: 10.1108/JIUC-09-2019-0016.

[7] K. Miller, M. McAdam, and R. McAdam, "The changing university business model: A stakeholder perspective," *R&D Manage.*, vol. 44, no. 3, pp. 265–287, Jun. 2014, doi: 10.1111/radm.12064.

[8] E. Evans, R. Burritt, and J. Guthrie, *Bridging the Gap Between Academic Accounting Research and Professional Practice*, 1st ed. Sydney, NSW, Australia: Institute of Chartered Accountants in Australia, 2011.

[9] Department of Industry and Science (Australia). (2013). *Australian Innovation System Report 2013*. [Online]. Available: https://apo.org.au/node/36450

[10] B. Hall, A. Link, and J. Scott, "Barriers inhibiting industry from partnering with universities: Evidence from the advanced technology program," *J. Technol. Transf.*, vol. 26, pp. 87–98, Jan. 2001.

[11] M. O'Dwyer, R. Filieri, and L. O'Malley, "Establishing successful university–industry collaborations: Barriers and enablers deconstructed," *J. Technol. Transf.*, Mar. 2022.

[12] L. M. Camarinha-Matos, R. Fornasiero, J. Ramezani, and F. Ferrada, "Collaborative Networks: A pillar of digital transformation," *Appl. Sci.*, vol. 9, p. 5431, 2019, doi: 10.3390/app9245431.

[13] L. M. Camarinha-Matos, R. Fornasiero, J. Ramezani, and F. Ferrada, "Collaborative networks: A pillar of digital transformation," *Appl. Sci.*, vol. 9, no. 24, p. 5431, Dec. 2019, doi: 10.3390/app9245431.

[14] C. Burchardt and B. Maisch, "Digitalization needs a cultural change—Examples of applying agility and open innovation to drive the digital transformation," *Proc. CIRP*, vol. 84, pp. 112–117, Jan. 2019, doi: 10.1016/j.procir.2019.05.009.

[15] V. Yadykin, S. Barykin, V. Badenko, N. Bolshakov, E. de la Poza, and A. Fedotov, "Global challenges of digital transformation of markets: Collaboration and digital assets," *Sustainability*, vol. 13, no. 19, p. 10619, Sep. 2021, doi: 10.3390/su131910619.

[16] N. Evans, A. Miklosik, R. Bosua, and A. M. A. Qureshi, "Digital business transformation: An experience-based holistic framework," *IEEE Access*, vol. 10, pp. 121930–121939, 2022, doi: 10.1109/ACCESS.2022.3221984.

[17] A. Alexander, D. P. Martin, C. Manolchev, and K. Miller, "University–industry collaboration: Using meta-rules to overcome barriers to knowledge transfer," *J. Technol. Transf.*, vol. 45, no. 2, pp. 371–392, Apr. 2020.

[18] H. Chesbrough, "Open Innovation: Where we've been and where we're goin'," *Res.-Technol. Manage.*, vol. 55, 2006, doi: 10.5437/08956308X5504085.

[19] T. Kleiner-Schaefer and K. J. Schaefer, "Barriers to university–industry collaboration in an emerging market: Firm-level evidence from Turkey," *J. Technol. Transf.*, vol. 47, no. 3, pp. 872–905, Jun. 2022, doi: 10.1007/s10961-022-09919-z.

[20] V. Tartari and S. Breschi, "Set them free: Scientists' evaluations of the benefits and costs of university-industry research collaboration," *Ind. Corporate Change*, vol. 21, no. 5, pp. 1117–1147, Oct. 2012.

[21] M. Steinmo and E. Rasmussen, "The interplay of cognitive and relational social capital dimensions in university-industry collaboration: Overcoming the experience barrier," *Res. Policy*, vol. 47, no. 10, pp. 1964–1974, Dec. 2018.

[22] V. Garousi, D. Pfahl, J. M. Fernandes, M. Felderer, M. V. Mäntylä, D. Shepherd, A. Arcuri, A. Coskunçay, and B. Tekinerdogan, "Characterizing industry-academia collaborations in software engineering: Evidence from 101 projects," *Empirical Softw. Eng.*, vol. 24, pp. 2540–2602, Apr. 2019, doi: 10.1007/s10664-019-09711-y.

[23] J. Bruneel, P. D'Este, and A. Salter, "Investigating the factors that diminish the barriers to university–industry collaboration," *Res. Policy*, vol. 39, no. 7, pp. 858–868, Sep. 2010, doi: 10.1016/j.respol.2010.03.006.

[24] M. F. Ramli and A. A. Senin, "Success factors to reduce orientation and resources-related barriers in university-industry R&D collaboration particularly during development research stages," *Proc.-Social Behav. Sci.*, vol. 172, pp. 375–382, Jan. 2015.

[25] J. M. Bartunek and S. L. Rynes, "Academics and practitioners are alike and unlike: The paradoxes of academic–practitioner relationships," *J. Manage.*, vol. 40, no. 5, pp. 1181–1201, Jul. 2014.

[26] P. Jarzabkowski, M. Giulietti, B. Oliveira, and N. Amoo, "'We don't need no education'—Or do we? Management education and alumni adoption of strategy tools," *J. Manage. Inquiry*, vol. 22, no. 1, pp. 4–24, Jan. 2013.

[27] P. Ping Li, "The rigour–relevance balance for engaged scholarship: New frame and new agenda for trust research and beyond," *J. Trust Res.*, vol. 1, no. 1, pp. 1–21, Apr. 2011.

[28] D. L. Shapiro, B. L. Kirkman, and H. G. Courtney, "Perceived causes and solutions of the translation problem in management research," *Acad. Manage. J.*, vol. 50, no. 2, pp. 249–266, Apr. 2007.

[29] A. Van De Ven and P. Johnson, "Knowledge for theory and practice," *Acad. Manag. Rev.*, vol. 31, no. 4, pp. 802–821, 2006.

[30] M. J. Kane, D. Z. Hambrick, and A. R. A. Conway, "Working memory capacity and fluid intelligence are strongly related constructs: comment on Ackerman, Beier, and Boyle (2005)," *Psychol. Bull.*, vol. 131, no. 1, pp. 66–71, Jan. 2005, doi: 10.1037/0033-2909.131.1.66.

[31] G. Szulanski, "The process of knowledge transfer: A diachronic analysis of stickiness," *Org. Behav. Hum. Decis. Processes*, vol. 82, no. 1, pp. 9–27, May 2000, doi: 10.1006/obhd.2000.2884.

[32] R. P. O'Shea, H. Chugh, and T. J. Allen, "Determinants and consequences of university spinoff activity: A conceptual framework," *J. Technol. Transf.*, vol. 33, no. 6, pp. 653–666, Dec. 2008.

[33] P. D'Este and M. Perkmann, "Why do academics engage with industry? The entrepreneurial university and individual motivations," *J. Technol. Transf.*, vol. 36, no. 3, pp. 316–339, Jun. 2011.

[34] C. Chen, Y. Jim Wu, and W. Wu, "A sustainable collaborative research dialogue between practitioners and academics," *Manage. Decis.*, vol. 51, no. 3, pp. 566–593, Mar. 2013.

[35] D. J. Teece, "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy," *Res. Policy*, vol. 15, no. 6, pp. 285–305, 1986, doi: 10.1016/0048-7333(86)90027-2.

[36] D. C. Mowery and A. A. Ziedonis, "Academic patent quality and quantity before and after the Bayh–Dole act in the United States," *Res. Policy*, vol. 31, no. 3, pp. 399–418, Mar. 2002, doi: 10.1016/s0048-7333(01)00116-0.

[37] S. Shane and D. Somaya, "The effects of patent litigation on university licensing efforts," *J. Econ. Behav. Org.*, vol. 63, no. 4, pp. 739–755, Aug. 2007, doi: 10.1016/j.jebo.2006.05.012.

[38] D. Partha and P. A. David, "Toward a new economics of science," *Res. Policy*, vol. 23, no. 5, pp. 487–521, Sep. 1994.

[39] V. Galán-Muros and C. Plewa, "What drives and inhibits university-business cooperation in Europe? A comprehensive assessment," *R&D Manag.*, vol. 46, no. 2, pp. 369–382, 2016.

[40] P. D'Este, P. Tang, S. Mahdi, A. Neely, and M. Sánchez-Barrioluengo, "The pursuit of academic excellence and business engagement: Is it irreconcilable?" *Scientometrics*, vol. 95, no. 2, pp. 481–502, May 2013.

[41] M. Perkmann et al., "Academic engagement and commercialisation: A review of the literature on university–industry relations," *Res. Policy*, vol. 42, no. 2, pp. 423–442, 2010, doi: 10.1016/j.respol.2012.09.007.

[42] A. Leischnig and A. Geigenmüller, "Examining alliance management capabilities in university-industry collaboration," *J. Technol. Transf.*, vol. 45, no. 1, pp. 9–30, Feb. 2020.

[43] R. Walden, "Progressing a university-industry collaboration (UIC) model for open and sustainable innovation," Cumulus Hong Kong, Open Des. E-Very-Thing, Hong Kong Design Inst., Hong Kong, Tech. Rep., 2016.

[44] H. Etzkowitz, "Anatomy of the entrepreneurial university," *Social Sci. Inf.*, vol. 52, no. 3, pp. 486–511, Sep. 2013.

[45] M. Perkmann, V. Tartari, M. McKelvey, E. Autio, A. Broström, P. D'este, R. Fini, A. Geuna, R. Grimaldi, A. Hughes, S. Krabel, M. Kitson, P. Llerena, F. Lissoni, A. Salter, and M. Sobrero, "Academic engagement and commercialisation: A review of the literature on university–industry relations," *Res. Polietj*, vol. 42, no. 2, pp. 423–442, 2013.

[46] S. Cartwright and D. Borger. (2014). *Industry Research Collaboration. Inquiry Into Innovation and Creativity: Workforce for the New Economy.* [Online]. Available: https://www.aph.gov.au/DocumentStore.ashx?id=1bbc71fa-f3a0-471a-b853-4135069750cc&subId=460174

[47] A. Leischnig and A. Geigenmüller, "Examining alliance management capabilities in university-industry collaboration," *J. Technol. Transf.*, vol. 45, no. 1, pp. 9–30, Feb. 2020.

[48] A. P. Giorgi and B. M. Giorgi, "The descriptive phenomenological psychological method," in *Qualitative Research in Psychology: Expanding Perspectives in Methodology and Design*, P. M. Camic, J. E. Rhodes, and L. Yardley, Eds. Washington, DC, USA: American Psychological Association, 2003, pp. 243–273.

[49] T. Groenewald, "A phenomenological research design illustrated," *Int. J. Qual. Methods*, vol. 3, no. 1, pp. 42–55, 2004, doi: 10.1177/160940690400300104.

[50] J. C. Welman and S. J. Kruger, *Research Methodology for the Business and Administrative Sciences*, 2nd ed. Cape Town, South Africa: Oxford Univ. Press, 2001.

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