

U and I

Insights form a University-Industry Design Collaboration

van Rijn, Roxanne A.C.; van Esch, Pip M.R. ; Price, Rebecca Anne; Oonk, Maite M.E.M.; Netten, Matthijs P.

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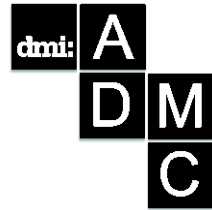
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U and I: Insights from a University-Industry Design Collaboration

Roxanne A.C. VAN RIJN^a, Pip M.R. VAN ESCH^a, Rebecca A. PRICE^a,
Maite M.E.M. OONK^a and Matthijs P. NETTEN^a

^a Delft University of Technology

Companies now look to leading universities to anchor an increasingly broad set of design innovation activities and to design graduates as vital catalysts for the introduction and stimulation of new ways of creating and capturing value. However, much is to be uncovered about the experience of working within design orientated university-industry collaborations – in particular the benefits and challenges in this space. Therefore, the aim of this paper is to contribute stakeholder insights toward the formation of a ‘new space’ between industry and education. The paper reveals respective experiences of students, industry partners, university administrators and academics working within a strategic collaboration between a Dutch University’s Faculty of Industrial Design Engineering and a collection of organizations from the aviation industry. A qualitative research design is applied which includes archival work, interviews and a focus group discussion with key stakeholders undertaken. Findings reveal how the described university-industry design orientated collaboration grew from small beginnings to its current state. Importantly, the findings convey the benefits and challenges of university-industry collaborations for key stakeholders. This paper contributes new knowledge and practical recommendations for students, industry partners, administrators and academics.

Keywords: design, education, innovation, students, industry

* Corresponding author: **Roxanne van Rijn** | e-mail: R.A.C.vanRijn@tudelft.nl

Introduction

At the turn of the century, Findeli (2001) identified the dawn of the *dot.com* era had brought a fundamental change in the practice of design and the subsequent graduate capabilities required for designers to be adequately prepared for the world they were to face. No longer were designers *making* physical products, rather designers were *acting* and *thinking* in new ways to create value – often dematerialised (Oxman, 1999). A significant upheaval of design curriculum followed.

Similarly, the 1970s and 1980s hailed the rise of human-computer interaction design – a radical departure from the Modernist heritage of design practice and education instituted most notably at the Bauhaus during the 1920s (Findeli, 2001). More recently, Wormald and Rodber (2008) identified that industrial product design education was inadequately preparing designers to contribute positively in increasingly complex environments for new product development. Luache, Bohemia, Connor and Badke-Schaub repeat the sentiment (2008). Reflecting on current events, there is indeed a need for a new set of graduate and post-graduate design capabilities required to lead in an innovation era (Wrigley 2016).

Understanding what such capabilities entail has brought academia and industry together, with research through design methodologies offering a way forward (Stappers & Giaccardi, 2017). Indeed, companies now look to leading universities to anchor an increasingly broad set of design innovation activities and to design graduates as vital catalysts for the introduction and stimulation of new ways of creating and capturing value. Such is the extent of this intersection that Sanders calls for the formation of a ‘new space’ between practice and education (2017, p.14) – an intersection operationalized through research activities that benefit industry partners, students and academics. However, much is to be uncovered about the experience of working within design orientated university-industry collaborations – in particular the benefits and challenges of this space.

Therefore, the aim of this paper is to contribute stakeholder insights toward the formation of a ‘new space’ between industry and education. The paper reveals respective experiences of students, industry partners, university administrators and academics working within a strategic collaboration between a Dutch University’s Faculty of Industrial Design Engineering and a collection of organizations from the aviation industry. This inquiry is guided by the following research question:

[RQ1]: What are the experiences of students, industry partners, university administrators and academics during a university-industry design collaboration?

The research question is intentionally open to support an explorative approach – citing the work of Lau (2012) who similarly studied design student experiences when using virtual reality tools. Identifying experiences that are challenging and beneficial provide two research objectives that further guide this research inquiry.

The selection of the aviation industry as a context for this inquiry places emphasis on the relevance and significance of the industry to society. The context is considered ideal as it provides a complex intersection of diverse populations and cultures, technology, risk and reward, reliability, regulations, sustainability and commercial competitiveness. A qualitative research design is applied with archival research, semi-structured interviews and a focus group discussion completed with key stakeholders. Beyond unearthing the respective experiences of stakeholder within a university-industry design collaboration, this paper contributes new knowledge and practical recommendations for industry, academics and students that can be applied to; a) build a long term strategic university-industry design collaboration, and; b) sustain such a collaboration to benefit all parties.

University-Industry based Design Collaborations

The accelerated rate of technology change, shorter product life cycles and globalization effects pose economic challenges to private and public sectors alike (Wright, Clarysse, Lockett, & Knockaert, 2008). Martin (2007) identifies that solving wicked problems necessitates integrative thinking – an inherent strength of design. It is this way of thinking and the possibilities associated that has drawn much interest from the business community (Muratovski, 2015).

Organizations from various industries are looking to design as a source of innovation - with universities as research and education institutions benefiting from an increase in new knowledge and multifaceted interactions (Frølund, Murray & Riedel, 2018). This interest is timely. Universities have faced pressure to continually deliver research outcomes, educate and stimulate innovation, while managing capacity and demand constraints of a growing population (Barnes, Pashby, & Gibbons, 2002). A resource strain on public-sector funding and necessity of innovation in the private sector has

contributed to the increasing attractiveness of university-industry collaboration (Ankrah & Al-Tabbaa, 2015).

Collaboration between universities and industry can be categorized in multiple ways. Ankrah and Al-Tabbaa (2015) identified six distinctive categories of university-industry collaboration, with increasing level of engagement: 1) personal informal relationship; 2) personal formal relationship; 3) third party; 4) formal targeted agreement; 5) formal non-targeted agreement, and; 6) focused structures.

Frølund and colleagues (2018) distinct two categories. First, an 'ad hoc approach', or collaborations that are established by individuals through their personal network and are often small and agile. Second, a 'strategic partnership', which is not only based on personal connections, but on a strategic level, choosing university partners based on their expertise in certain fields.

In successful university-industry collaboration, all parties benefit (Gibbons & Johnston, 1974; Cohen, Nelson, & Walsh, 2002; Ankrah & Al-Tabbaa, 2015). Known success factors of prosperous university-industry collaboration are the presence of informal networks, (Meyer-Krahmer & Schmoch, 1998), geographic location and proximity of collaboration partners (Arundel & Geuna, 2004), environmental factors, ensuring equality, project management (Barnes et al. 2002) and the preparedness of both parties and their alignment of strategic goals (Frølund et al. 2018). Other aspects to consider, like barrier-minimizing factors are the level of trust between partners and prior experience of collaborative research (Bruneel, D'Este, & Salter, 2010).

According to Ankrah & Tabbaa (2015) the risks of university -industry collaboration can be condensed into the following categories for both industry and university stakeholders: 1) deviation from mission or objective; 2) quality control; 3) conflicts of interest, and; 4) financial risks. These risks hold potentially severe consequences for both university and industry partners. For universities, these risks are particularly the case when more comprehensive partnerships are not established.

Therefore 'strategic partnerships' (as opposed to 'ad-hoc approaches'), are considerably more desirable. Even though the latter typically leads to a large number of collaborations, a lack of synergy can restrict efforts to produce meaningful research or education outcomes (Frølund et al. 2018). In short, the company or industry partner benefits from existing yet contextually new knowledge, while the university is unable to produce genuine novel knowledge stemming from quality research.

In research on collaboration between universities and industries, one voice that remains limited is that of the student. The benefits for students are noted, for example employment opportunities, exposure to practical problems (Ankrah & Al-Tabbaa, 2015), early publication opportunities and mentoring (Bozeman, Fay, & Slade, 2012). But there are no sources to draw from when determining what students themselves find important during design orientated university-industry collaborations.

Research Design and Methodology

This research design contains three phases. The first step for the research team was to collate the key activities and key partners that formed the design collaboration between university and industry to date. This required archival research to locate and collate activities completed and to trace key partnerships. The university data-base for post graduate research and faculty newsletters provided an avenue to search for related content. Figure 1 provides insight into nature of the collaborations with a collage of activities and insight into design projects. Table 1 provides an overview of the volume of work completed during 2011 to 2018 to date. The table comprises of the year, key activities and key partners involved in projects.



Figure 1. Collage of activities (images courtesy of authors, TU Delft and Christine de Lille)

Table 1 Key activities and key partners, 2011-2018

Year	Key Activities	Key Partners
2011	1 Graduation project completed	1 Airline
2012	2 Graduation projects completed	1 Airport 1 Airline
2013	12 Graduation projects completed 1 Course - training employees 1 Industry award received	5 Airlines 1 Airline seat manufacturer 1 Airport 3 Aircraft part manufacturers 1 Luggage related company 1 OEM
2014	12 Graduation projects completed 1 Course - training employees 1 Industry award received 3 Events attended	7 Airlines 1 Airline seat designer 1 Airport 4 Aircraft part manufacturers 1 Supplier
2015	24 Graduation projects 1 Course - training employees 2 Industry awards received 1 Publication 1 Research program completed 1 Course – education run 1 Doctorate (PhD) completed 1 Event industry attended 2 Post Docs acquired	11 Airlines 1 Airline ground handling 3 Airports 1 Airport supplier 2 Aircraft manufacturer 5 Aircraft part manufacturer 1 Aircraft seat manufacturer 1 Luggage system 1 Independent
2016	14 Graduation projects 3 Awards received 3 Courses - education 2 Publications 3 Industry events attended 2 Workshops run 1 Infrastructure 1 Course - training employees 1 Research contract attained 1 Post Doc acquired	12 Airlines 2 Airports 1 Aircraft manufacturer 1 Aerospace manufacturer 1 Aircraft seat manufacturer 1 Aircraft interior design 1 Airline alliance
2017	13 Graduation projects completed 2 Awards received 2 Research contracts attained 6 Industry events attended 3 PhDs started n/a Collate archive of work 2 Courses - education 3 Courses - training employees n/a Acquire B737 testing infrastructure	15 Airlines 1 Airline alliance 4 Airports 1 Furniture manufacturer 2 Suppliers 1 Aircraft seat manufacturer
2018	1 Course - training employees 2 Events attended 1 PhD started 3 Graduation projects completed so far	4 Airlines 1 Aircraft part manufacturer

Semi-Structured Interviews with Key Stakeholders

The second phase of the research consisted of semi-structured interviews with key stakeholders involved in the collaboration. These key stakeholders were working at the design faculty or at one of the companies involved in collaborating with the faculty, details of which can be found in Table 2. One doctorate candidate working within an industry partner (airline) was also interviewed. Ten semi-structured interviews were conducted, after which a thematic analysis was completed. Foci included how the collaboration started, key learning moments and value gained. Identifiers were removed from transcripts and participants were coded to maintain anonymity.

Table 2. Key stakeholder participant details

Stakeholder Position	Employer	Involvement in University-Industry Collaboration
Collaboration Manager	Design Faculty	Supporting collaborations with aviation partners including long-term collaboration with airline and airport interior suppliers
Assistant Professor & Lead Researcher in airline collaboration	Design Faculty	Content lead in long-term collaboration with airline. Coaches and mentors students in courses, internships and graduations.
Doctorate Student (PhD)	Design Faculty	Involved in training airline employees, coaches student during courses and graduation. Researcher in prototyping organizations.
Head Education & Student Affairs of Design Faculty	Design Faculty	As member of teaching board responsible for quality of education.
Senior Vice President Pricing & Revenue Management	Airline	Involved in many big research projects connected to passengers and the baggage domain
Business Development Manager	Airline	Many different projects, including CRISP Research project. Mentors students in internships, courses and graduations from a company perspective
Director Operations Decision Support	Airline	Mentors students in internships, courses and graduations from a company perspective
Director Product Strategy	Airline	Mentors students in internships, courses and graduations from a company perspective in different projects
Chief Executive Office	Air Traffic Control	Coordinating projects, not involved on content level
Vice President of Passenger Services	Airline	Coordinating projects connected to passenger operations

Focus Group Discussion with Students

The third phase of the research design comprised of a focus group discussion with past and present students (Krueger & Casey, 2014). The aim of the focus group was to explore the challenges, benefits and experiences of students undertaking projects, internships or graduating with one of the long-term partners in the industry to find their experiences and challenges of completing projects within organizations. The aim of performing this focus group was to allow students who had graduated from industry based projects to reflect upon their experiences. Foci included questions regarding experiences of doing projects in context of an organization. The participants of the focus group, all of them design students from the design faculty, were selected because they worked on projects at an aviation related company during their post-graduate education program. An overview of participant details can be viewed in Table 3. Participants were coded to maintain anonymity.

Table 3. Overview of students present in focus group discussion and projects involved

Master of students	Graduation Project conducted at	Collaboration description
MSc student Design for Interaction	Airline	Currently graduating on how to enlarge employee engagement during turnaround processes
MSc student Strategic Product Design	Airline	Involved in education course internally in company on how to improve turnaround of airplane. Involved in second education course internally within company on improving life of apron employees. Worked during internship on digitizing apron operations. Currently graduating on how to improve collaboration within operation decision support
Graduated in Design for Interaction	Airline	Graduated on how to improve briefing process for cabin crew
Graduated in Strategic Product Design	Airline	Involved in education course internally in company on how to improve passenger punctuality using Bluetooth beacons. Graduated on how to implement strategy to ensure employee engagement

Qualitative Data Analysis

A qualitative data analysis was performed using a thematic method. Thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within data. (Braun & Clarke, 2006, p. 6). The method is epistemologically flexible, and this case, adheres to the constructivist paradigm in which this research design is positioned. A theme as Braun and Clarke state, “captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set” (2006, p10). In this case, themes were accounts of experience, challenges and benefits during the university-industry design collaboration. Two researchers coded data, applying a qualitative thematic approach. Inter-coder reliability was positive across all major themes.

Findings

Findings reveal how the described university-industry design orientated collaboration grew from small beginnings to its current state. Importantly, the findings convey the benefits and challenges of university-industry collaborations for key stakeholders.

Sustained Collaboration: Beyond One Project, One Context and One Partner

The first immediate finding based on archival research was that the long-term collaboration achieved between industry and a design faculty required a consistent stream of completed projects. At first, only a few graduation projects were undertaken (2011 and 2012 for example). These graduation projects were completed with one or two industry partners, typically airports and airlines. Further, these projects were with one or two partners from industry only.

Dissemination of project outcomes to industry presentations led to a much broader range of industry partners approaching the design faculty to collaborate. In 2015 there was a witnessed increase in the number of industry partners that approached the design faculty. This demand is formalized through research contracts that provide the design faculty with the necessary funding to grow - three Post Docs and one Collaboration Manager were hired during 2015 and 2016 allowing the collaboration to grow considerably. In 2017 and 2018, four PhDs began their candidacy as the next wave of growth.

A key task for the university staff was to sense what the strategic ambitions of an industry partner were and then be proactive in setting up projects to align to these ambitions to research ambitions. One educator describes a loop of activities in which both organizations' learn about each other as an outcome of a design collaboration that begins with student projects;

If a [Master's] student finds his or her own graduation assignment at a company, I will maybe come there once or twice, but I can mean less to such a company than if there is a long-term collaboration. Otherwise the chair and the mentor can learn something from the company that they can use in their education to illustrate. And the company can learn about the knowledge development at the university. Then you increase the efficiency of your collaboration.

Efforts by the design faculty to sense through this learning-loop what industry partners required during collaboration and align these to learning goals was appreciated by industry partners, "I was very impressed by how the faculty was trying to understand what the company is actually interested in".

While early projects were attained through opportunistic planning, where an idea between an industry partner and academic spurred action – later projects were planned. For example, an educator mentioned "I think in long-term collaborations you can get better graduation [Masters] assignments, because you can let them continue upon each other". Looking back, one industry partner notes;

If we would start over, we would start small again in the operation, close to the employee. It results in a bottom-up push. The unique selling point has been that we said, 'we are going to think of solutions in a fast-pace and we involve the employees and their work environment'.

From Student Experience to Young Design Practitioner

It was found that the university-industry collaboration brought the two domains closer together to create a learning context in which students could thrive. Working within industry meant that students were required to interface with various stakeholders that did not share the same design background. The following was observed by an academic;

I think it is very hard, and you can find this in literature as well, to educate designers that are context sensitive, sensitive to the company, that realize what happens when you unleash designs within an organization. We can't teach students that, unless universities and industry collaborate.

Further, students were required to achieve quality outcomes while being located within a company. One educator reflects;

I think in education there should be a mix [of fictive and real case studies], because with a fictive case you can control the learning goals you want to realize. [...] But [a fictive case] will never be as interesting or as motivating as a real case.

For students that were able to perform, and start the journey towards a young professional, the long-term nature of the university-industry design collaboration meant that both educators and industry partners could be aware and proactive in identifying and acquiring talent. Post-graduate collaboration with industry effectively acted as a job recruitment that mitigated the job prospect uncertainty of shifting from student to young professional. As one industry partner noted;

If we create a talent program, consisting of graduation internships, focused on real business challenges, followed by a job for 2 years (provided the student did an outstanding job), and then – just like traineeship – an indefinite term contract when successful, the partnership would really be successful .

Overall the university-industry collaboration is experienced positively by industry partners and helps to prepare students for their forthcoming professional careers.

Authentic Learning: Pursuit of the Real World Context

A clear finding from the interviews in particular was that educators and university administrators sought to create a sense of authentic learning for students, as opposed to hypothetical or fictive case scenarios. The design faculty's mandate to interface with industry is explicated, as recalled by an educator during one interview;

In the university's vision on education until 2024 there is a part that the university should collaborate with industry partners to solve societal challenges of the future.

One educator described the gain of working with industry that could not be simulated in the classroom. In this particular case, the collaboration provided full access to operations for students and researchers to test, learn, fail and succeed, "For me it was something that I couldn't find elsewhere. [AIRLINE] is a company where we get full access to the entire operation". Of what is achieved with that access, the educator continues to state;

What I find important from a faculty's perspective, is that students get as much authentic learning tasks as possible. This is also stated in our education requirements. This includes that students are confronted with realistic tasks that they could also encounter while working in practice. And how to better do that then take real assignments from the industry and confront students with real clients?

Monitoring the quality of partnership remains a key activity during university-industry engagement. One educator notes the support structures that are required to achieve this, "Monitoring of quality is a task for the examination committee. [...] We mainly look at the learning goals and if we come upon them in the results that students show". A student describes the authentic learning experience:

We had one course [in our Masters] to calculate the Net Present Value and at the end of every project you have to make a roadmap with cost estimates, but that's it. Other than that you never look at the reality of the business, whether it's possible.

While working within industry partner's organizations, students were made immediately aware of viability constraints on their projects.

Openness of Industry to Design University Collaboration

As the company is often the one to invest money into the collaboration, the benefits for the company are vital. Collaborating with universities can create long-term benefit for companies. Initial examples of these benefits

are that projects run by students are perceived as less threatening within the company;

I think collaborating between university and industry is important, since, as a university, you are unbiased, a non-threatening group. This means that you can do a lot more experimental stuff and you can try more things that are out-of-the-box and outside of their comfort zone [in industry].

Students were perceived by industry as unbiased, without clear interests or a connection to internal politics and therefore a fresh influence within the organization, as mentioned by this industry partner;

We needed fresh input, free thinking, regardless of budget availability, based upon latest insights and knowledge, leading to independent points of view, not constrained by corporate structures.

This was especially the case when employees were involved in design projects that involved co-creation methods. However, caution should be taken to ensure students are not viewed as low-cost solutions. As one educator notes, this cannot detract business from eventual design consultancies that the design students may later be employed by. As an educator notes of the added challenge of unintended competition with design consultancies or agencies;

We have to be careful, we shouldn't compete with design agencies. One of the agencies out of the professional field committee already told us that they didn't receive any projects since the university started the collaboration. We made agreements that we are not allowed to compete with them.

Further, students may be given innovation challenges that far exceed their capability set. The learning process of the students is the main obligation for the university and should also be understood as an imperative by the industry partner. For example, as an industry partner describes;

Big transformation projects cannot be done with students. One must be careful in exposing these kind of projects to students, especially when it comes to socially complex matters/questions.

While the university-industry collaboration began as an ad-hoc pursuit of opportunities for research, education and innovation – the quote above reveals how the growth of this collaboration created unexpected challenges. What the educator also reveals is that dialogue was the preferred option to negotiate such challenges.

Design Students as Change Catalysts

Many benefits of having students working on projects were noted. The positive reception of design students from industry was vocalized, “A very good student has the same level [of skills] as a McKinsey consultant”, and, “The students bring lots of dynamics and drive. I really like working together with young people, full of drive and passion”. Further, design students were identified by industry as being suited to innovation;

[Design] students can think broadly, can identify the core issue quickly and translate this into solutions. Research is very much applied and realistic. [...] [Design] students approach issues based upon cross-silo thinking, from an integral perspective. [Design] students consciously or sometimes unconsciously break through all silos within our company. They navigate easily in the corporate context, with all its interests and stakes.

One industry partner at an executive level describes the value of a design student within their company;

We want our employees to be competent, reach out, for which we need to create this environment as leaders, be critical when needed. [...]. An advantage I see that comes with design-thinking is that I have no other choice than to change.

Finally, students were identified as asking the right questions by industry partners;

Students bring in a certain atmosphere, they ask us critical questions on more than just the topic they are working on, they help to sharpen our minds, they create output around the subject, and they help us to truly implement ideas.

The Voice of the Student

The voice of the student is a vital and often overlooked perspective in university-industry research. Students mentioned learning how to apply their theoretical knowledge within a corporate environment as a shock, “It’s like the Ice-Bucket challenge, a healthy dose of a reality check” and building upon this comment, “I regret that I didn’t get the reality check sooner in my curriculum”.

Students raised that they suddenly became aware of the open-minded nature of the university environment when placed in industry, “Here at the university you have so many awesome innovative ideas, but at [AIRLINE] you get a reality check. Here at the university we are way ahead of society in our thinking”. Another student notes;

I have the feeling that people who did their whole education at the university and that never worked at a company, that they are very naïve. That they have a very naïve vision about what working in an industry looks like.

While working in a company, students learned to look more at viability and to substantiate their plans financially. This also connected to the realization that their ideas and designs, if implemented, would have real impact on other people’s lives and/or jobs, making it feel a lot more serious.

However, caution should be exercised in this regard as well. One student notes that while a dose of realism is necessary, after working with [AIRLINE] for one year, it somewhat hindered their ability to come up with creative solutions in projects, because they developed a critical attitude in the realization of new ideas during design phases where such an attitude is not conducive to a solution.

Another important aspect they mentioned was that because they could orient themselves and get to know what kind of work they enjoyed doing, and see what different jobs entailed, they had a much more defined idea of what they would like to do after graduation. For example, one student notes, “I’m currently orienting on my career after graduation. It’s nice to be inside a company and look around.” Pride was also mentioned as a provider of purpose. Students felt, “part of the family” and were very positive about the effect of this on their education.

Discussion and Recommendations

The findings showed that both industry partners as well as the university experience benefits in this collaboration. Bruneel et al. (2010) note that student projects bring industry and academia closer together and create trust between the partners. Growth beyond one project, one context, and one partner is an indication of this. However, university resources must also grow should a desire to meet industry demand be present. A resource burn must be avoided, as the quality (or synergy) of collaboration is essential success (Frølund et al. 2018).

Since the implementation of design thinking is a transformational process, a strategic collaboration can help to legitimize the need for change in an organization, which is essential for creating organizational change. Collaborating with a design faculty can bring industry partners a fresh perspective, innovative ideas, a lot of energy from students and can initiate a change in a company's way of working. However, students alone cannot nor should not be relied upon to carry an organization's transformation efforts. The learning experience is the imperative, and organizations that do partner with universities must be conscious and act to ensure such a positive learning environment is maintained.

Findings show this learning environment allows for failures, provides access to operations and stakeholders and encourages students to push new ideas and perspectives. As such, the industry must also consider that outcomes will be more unpredictable than those of traditional design agencies, accompanied by the possibility of an undesirable outcome considering the imperative of the central learning process of students.

Wrigley states that a student can be the catalyst for a cultural shift within an organization (Wrigley, 2016). This study also emphasizes the role of the student as a catalyst, a person who incites change to happen but does not burden the task of implementing that change. Further, findings show that while one student can be the catalyst, the further journey of the organization or industry partner is supported by a continuing series of students operating at a post-graduate level of education – provided there is coherent project briefing.

Each project must consolidate and build upon knowledge created during the previous projects. The educator and industry partner become critical stakeholders that 'design the design brief' for students. Each student becomes a catalyst that adds energy to the continued transformation of an organization. These observed central activities contributed towards what Frølund et al. (2018) describe as university-industry synergy – strategic

partnerships that benefits all parties. Ankrah & Al-Tabbaa, (2015) also note that all parties, including the student, must benefit within university-industry collaboration. Universities should therefore obstruct against students becoming an inexpensive source of labor for industries, and thereby competing with design agencies. Any form of competition as a university should be prevented, rather there should be looked for opportunities to connect with design consultancies and agencies to strengthen collaboration efforts.

The benefits for students are noted, for example employment opportunities, exposure to practical problems (Ankrah & Al-Tabbaa, 2015), early publication opportunities and mentoring (Bozeman et al. 2012). In this study, findings show that students are sought after resources within the industry and that early talent identification by industry partners can assist both student an organization to grow together. Students were described as 'truly innovative' and 'impactful' within the companies.

The student perspective confirms the importance of working in the industry as a first step within a career pathway. Students raised exposure to practical problems and the realities of professional practice as being a positive experience. Of interest was that while industry partners were actively creating a learning environment for students (access to information, ability to fail), students themselves experienced the pressure of industry differently.

The authors contend that this is due to a self-expectation amongst students to rise to the expectations of the industry workplace around them, even if those pressures are not directly applied to them. Further research is required to confirm this. Consequently, students' individual characters will likely influence whether they respond positively to such a pressure. In such a scenario, the educator benefits from an engaged and proactive student; the industry partner benefits from fresh perspective and disruptiveness associated with innovation, and; the student benefits from an enriched education and subsequent preparation for professional career.

Recommendations

Based on the findings of this paper, the following recommendations are provided to parties wishing to establish university-industry collaboration. Recommendations are provided to students, industry partners and universities. A framework structuring these recommendations is provided in Figure 2.

For design faculties, academics and administrators:

- Start collaborations with low-key projects such as internships and student projects to stimulate a bottom-up change and build an understanding of the potential value of design through action rather than rhetoric;
- Resources should not be the limiting factor. It is therefore important to invest in educators and administrators to manage accounts and to have a responsibility towards a set of activities that are associated with each industry collaboration;
- Attend industry events such as conferences to disseminate collaboration outcomes;
- Ensure that university-industry collaboration that involves student participation has an agreed imperative – that students are to learn first and foremost, and that development of a positive learning environment is key to this, and;
- Consider the position of a university in relation to practitioners. Prevent any form of competition and rather look for opportunities connect with design consultancies and agencies to strengthen collaboration efforts.

For organizations seeking to partner with university design faculties:

- Reach out and connect with a university through shared interests in innovation and research;
- Start with projects that are close to employees and the company's operations to build trust and demonstrate the value of design;
- Share the outcomes of successful student projects to employees to create momentum and an environment for change and innovation;
- Allow access to operations to ensure design students can fully explore and frame relevant problems to solve, and;
- Embrace the imperative that students have a primary goal to learn and not deliver guaranteed results for business.

For students wishing to benefit from university-industry collaboration during their education:

- Being exposed to an organization, its employees and stakeholders can help to gain a more realistic perspective of the impact of design in an industry;
- Search for and take on projects that personally appeal, to discover if a chosen career is interesting;
- Visit industry and academic events as a way to connect with potential student projects or job prospects;
- Understand your position as student in an industry context. There is room to be disruptive, ask bold questions and side-step politics, yet;
- Rise to the occasion of working in industry, meet and surpass company expectations.

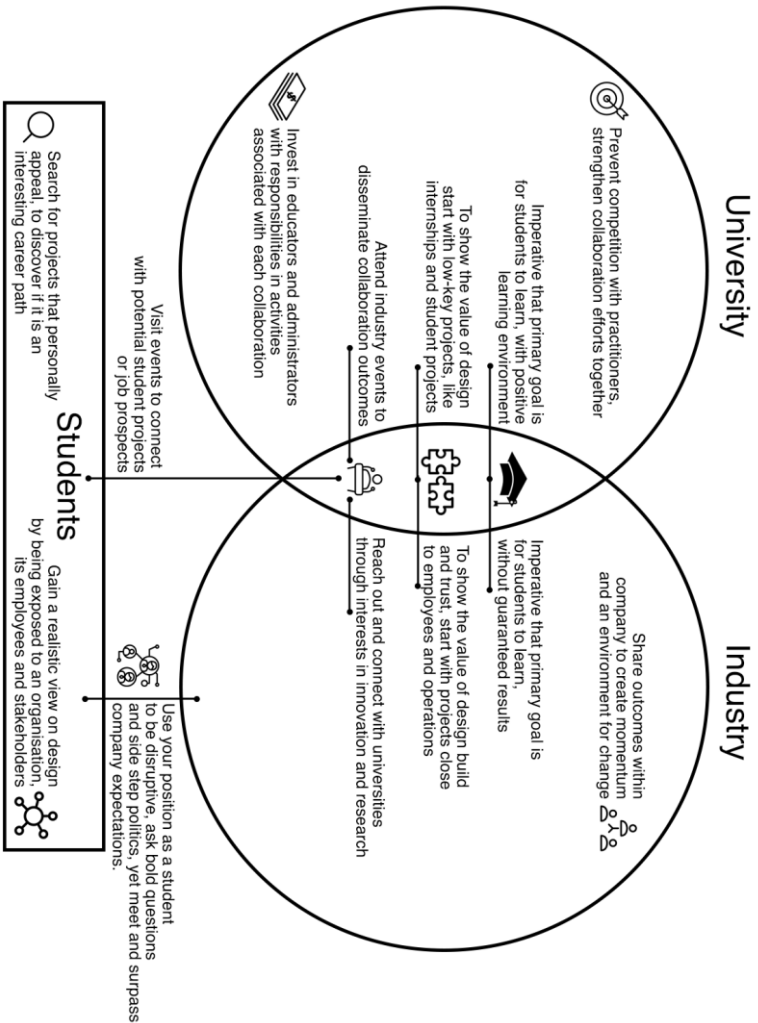


Figure 2. Framework of Recommendations

Conclusion

Design practice is shifting in response to problems encountered. So must design education respond in order to adequately prepare design graduates for the demands of industry. However, adjusting complete curriculums is an arduous journey. There is little doubt that the design practice will shift again to allow new challenges to be addressed. Adaptability to new problems is one of the underlying strengths of the discipline. Thus, new ways of aligning education and practice must be conceptualized. Sanders (2017) in particular calls for a 'new space', the meeting of education and practice mediated by research activities.

This paper presents the stakeholder experiences of a seven year long university-industry design collaboration between a Faculty of Industrial Design Engineering and organizations from the aviation industry. In particular the benefits and challenges of university-industry design collaboration are presented. The article contributes insight into the experiences of stakeholders within this 'new space' between practice and education. Findings reveal there is great benefit in university-industry collaboration as long as quality is maintained during engagement, students' learning experience is emphasized, innovation challenges are undertaken that meet the capabilities of all parties, current design agencies and consultancies are also factored into the design of partnership and that new insights are funneled into efforts to update design curriculum.

To conclude, design graduates are the future of the discipline. Ensuring they are adequately prepared for practice must be a critical and ongoing task in response to developments in industry. University-industry design collaborations provide proximity between the two domains that can be harnessed to support this task.

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