Industry School Partnerships: Boundary crossing to enable school to work transitions across three targeted industries

Matthew C Flynn, Hitendra Pillay and James J Watters

Faculty of Education, Queensland University of Technology, Brisbane, Australia.

m6.flynn@qut.edu.au
School of Culture & Professional Learning / Faculty of Education / Queensland University of Technology / Victoria Park Road 1 QLD 4059 / Brisbane / Australia.

h.pillay@qut.edu.au
School of Culture & Professional Learning / Faculty of Education / Queensland University of Technology/ Victoria Park Road l QLD 4059 / Brisbane/ Australia.

j.watters@qut.edu.au
School of Curriculum / Faculty of Education / Queensland University of Technology / Victoria Park Road 1 QLD 4059 / Brisbane / Australia.

Bibliographical details

Matthew Flynn is an early career academic in the School of Culture and Professional Learning at the Queensland University of Technology in Australia. His research interests are in the innovative application of vocationalism, systems theory and collaboration. Extensive real-world experience in vocational education in the resources and agricultural industries provides him with a well-grounded approach to his early career research.

Professor Hitendra Pillay teaches in the School of Culture and Professional Learning at the Queensland University of Technology in Australia. His interest in the nature and development of knowledge and systems theory has led to a diverse academic research portfolio including areas such as: distributed/social cognition and learning; adult and community education; industry based training; and technology based learning. He also has extensive expertise in macro and micro aspects of social sector reform in developing countries. He has worked for the World Bank and Asian Development Bank and on associated projects in the Balkans, the Caucasus region, the Central and South East Asian, and the South Pacific region. Drawing on his academic research and social sector development work his current research interest is on synthesising the fragmented research agendas into more holistic and cross disciplinary models of knowledge creation, innovation and global development.

James Watters is an Adjunct Professor in Education at QUT. His areas of research interest include: learning in science and mathematics; inquiry based science; investigations in mathematics; problem based learning; and gifted education. James has provided professional development and published research studies in all these areas. He has a strong commitment to apply research to practice. Jim has also a long standing interest in technology and technology supported learning. He works extensively with education sectors to provide professional development and to explore effective ways of improving student learning.

Industry School Partnerships: Boundary crossing to enable school-to-work transitions across three targeted industries

Industry-school partnerships (ISPs) are increasingly being recognised as a new way of providing vocational education opportunities. However, there is limited research investigating their impact on school-to-work transitions. This paper reports on a government-led ISP, the Gateway to Industry Schools program, established in Queensland, Australia. The Queensland State government facilitated ISPs across three industry sectors: minerals and energy; building and construction; and aviation. This research adopted a qualitative case study methodology and draws upon boundary crossing theory as means to understand the dynamics of each industry sector. The main finding was that as boundary crossing mechanisms are systematically applied by all partners there are mutually benefical outcomes. ISPs who genuinely boundary cross are able to co-produce industry-based curriculums that prepare suitably employable school graduates.

Key words: boundary crossing, partnership, school-to-work transition, education, industry.

Introduction

Internationally, government and industry stakeholders have actively pursued collaborative arrangements with schools. These industry-school partnership (ISP) arrangements operate through policy and funding mechanisms (Cardini, 2006; Davies & Hentschke, 2005) to address the needs of a post-industrial age knowledge economy. A variety of terms are used to describe such partnerships, including the following: joint ventures; public-private partnerships; school-enterprise cooperation; networks; coalitions; collaborations; social partnerships; business-school relationships; school-business partnerships; community-school partnerships; industry-school engagement and industry-school partnerships (Gajda, 2004; Pillay, Watters & Hoff, 2013; Zhao, 2011). Robertson, Mundy, Verger and Menashy (2012) at the broadest level have described these partnerships as "cooperative institutional arrangements between public and private sector actors" (p. 1). These terms reflect the various arrangements from formal contractual agreements through to informal cooperation and supportive activities to achieve mutual goals.

The purpose of this paper is to report on how partnerships have been developed between three major industry sectors and schooling at a systemic level. The study was conducted in the State of Queensland, Australia. For the purpose of this paper, the term Industry-School Partnerships (ISPs) will be employed. The industries involved are minerals and energy, building and construction and aerospace. For clarity, this paper will use MBA ISP when referring collectively to the three industries involved in the ISP.

Pillay, Watters, and Hoff (2013) highlight the benefits that ISPs afford to the education sector. First, they argued that ISPs are posed as a method for the public sector to reduce costs through partnering with the private sector (also see Ball, 2009; Crump & Slee, 2005). This assertion is based on an assumption that the private sector generally possesses activity systems that allow for efficiencies not achievable by rigid public sector bureaucratic institutions (Billet, Clemans, & Seddon, 2005; Engeström, Engeström, and Kärkkäinen, 1995). The second benefit Pillay et al. (2013) identified is that ISPs can help address the supply of educational services to geographically dispersed locations which solves some of the barriers and coordination difficulties for

rural and remote students (Boh, Ren, Kiesler & Bussjaeger, 2007; Kilpatick & Guenther, 2003). In Queensland where the current study is located, there are vast distances between cities and rural communities.

The third and perhaps most difficult and significant for the education sector, is to keep pace with knowledge innovation, new work practices and products with innovative educational solutions. There is evidence in a business context (Fawcett, Jones & Fawcett, 2012) that partnership arrangements allow convergence of partner perspectives, which can result in innovative solutions. These partnerships are based on trust and are drivers of innovation (Billet, Clemans, & Seddon, 2005; Blomqvist, Hurmelinna, & Seppanen, 2005). As ISPs share resources and build trust they will also operationalise innovative educational ideas directly relevant to their respective workforces. Hence, co-produced educational programs create genuine and direct value for both the schools (students as the untimate beneficiaries) and for industry. Notably, an ISP potentially provides access to resources that are beyond the financial capacity of schools. These resources include equipment that is industry standard, which is in contrast to simple options available in school laboratories and workshops as well as personnel who are experts in their respective fields. Finally, through innovative contextualised industry-based curriculum ISP may produce knowledge transfer and workplace readiness of potential employees (Watters & Christensen, 2013).

Existing literature does not clearly articulate the benefits of ISPs afforded to industry. This is likely because the benefits for industry appear obvious, that is, they are a platform for the recruitment of future employees. A secondary benefit to industry is the opportunity to influence school curriculum with the aim of better aligning future employees with the needs of industry. There are also less obvious benefits such the opportunity to demonstrate good community citizenship through sponsorship and support of local schools. Good citizenship is particularly important to industries that typically encounter community resistance to their operations as is the case for the aviation, construction and mining industries reported on in this paper .

Having argued a case for the advantages of establishing ISPs this paper will now discuss literature on boundary crossing for reasons to be outlined in the next section.

Theoretical Framework

Establishing effective ISPs is challenged by the differences in missions of the stakeholders and their inherent norms of practice. Yet, despite the diverse viewpoints of respective partners there is purpose in reconciling differences for mutual benefits. The concept of boundary crossing is means to effectively transverse an apparent impasse between two disparate organistions such as a school and a private company. Simply put, “boundary crossing entails stepping into unfamiliar domains” (Engeström et al. 1995, p. 333). In ISPs this process occurs at two levels. First, boundary crossing is a way of indentifying and negotiating obstacles to the formation of the ISP and improving compatibility for functioning in the new setting (Akkerman & Bakker, 2011a; Star, 1989). Engestrom et al. (1995) identifies various obstacles to boundary crossing such as consensus in sub-groups which may prevent objectivity in determining purpose for ISPs. These obstacles can be resolved as a shared vision for the partnership is established and shared problems are addressed (Billet, Ovens, Clemans & Seddon, 2007; Pillay et al. 2013).

Second, as a primary purpose of ISPs is to facilitate school-to-work transitions, as well as transitioning to further vocational and university education, there are outputs

(such as industry-based education programs) for school students that enable boundary crossing and development of a student's compatibility and readiness for work. The implication is that students must be afforded opportunities to participate in legitimate boundary crossing and authentic vocational education experiences, and thereby increase their personal employability (Billet, 2002; Lave & Wenger, 1991). Engestom et al. (1995) asserts that this can occur as two communities of practice (school and industry) are connected. This implies that respective experts (teachers and industry employees) engage in boundary crossing to enact a hybrid learning space for students where formal, school-based learning and workplace experiences can be closely connected (Zitter & Hoeve, 2012). To facilitate the above the industry partner often provides resources such as access to contemporary tools and knowledge products.

As a concept, boundary crossing has previously been applied to understand: (a) organisational systems and structures of universities and associated work-integrated learning programs (Kjellen, 2010); (b) teaching out-of-specialisation when teachers are not qualified to teach for example mathematics (Hobbs, 2011); (c) career change professionals entering the teaching workforce (Watters & Diezmann, 2012); (d) combining school and apprenticeship (Akkerman & Bakker, 2012); and (e) human environment systems such as fisheries, floods and pollution problems (Cash et al. 2006).

Morse's (2010) research on how cross-sector partnerships create public benefit through collaboration across jurisdictional boundaries is useful in unpacking the concept of boundary crossing for ISPs. He describes key stakeholder organisations as structural catalysts that enable collaboration and the formation of partnerships. These organisations have the capacity to accelerate change by facilitating connections between potential partners. They enable the convergence of multiple perspectives because of their pre-existing connections across scales. For instance, in the context of the present paper the Queensland Minerals and Energy Academy (QMEA) is a structural catalyst for an ISP between schools and the minerals and energy industry. The QMEA leverage the benefits of their direct connection to the industry peak body and with companies to co-produce outcomes for schools and industry.

In ISPs, schools also need to facilitate boundary crossing with industry. Schools have physical boundaries (fences) to keep students in and others out; there are many legislative boundaries that exist to protect children; and there are government boundaries that gate keep (approval processes), for instance, which curriculum is taught in schools. Industry is also defined by boundaries. They set entry standards for employment; they are bound by legislation such as workplace health and safety; they have certain cultural and behavioural boundaries expressed in codes of conduct; and they standardise operations in policies and procedures. Traversing the foregoing boundaries is partly achieved through stakeholders acting as structural catalysts and by employing various boundary objects. However, further clarification on how boundary crossing works is necessary to understand ISPs.

Akkerman and Bakker (2011) identified through an extensive literature review four boundary crossing mechanisms, which are presented in Figure 1. These researchers suggest further research to investigate, "whether and how these four processes of mutual development of school and work practices take place" (Akkerman & Bakker, 2011 p. 170).

Acknowledging the above, this paper will employ Akkerman and Bakker's (2011) four boundary crossing mechanisms as lens to understand what is occurring in the MBA ISPs in the Gateway to Industry Schools Program in Queensland, Australia (see Figure 1).

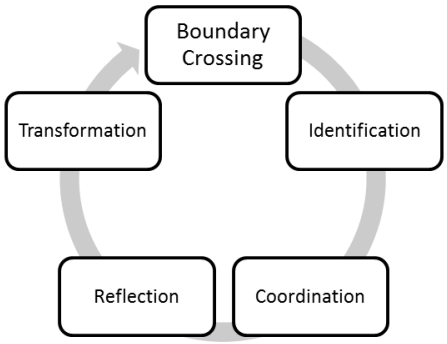

Figure 1. Boundary crossing mechanisms that promote effectiveness in ISPs.

Below is discussion on how Akkerman and Bakker's proposed mechanisms may be conceptualised for the MBA ISP together with other researchers who help to strengthen and synthesise the overall theoretical framework.

Identification. In ISPs, identification is a process of delineating the differences between two partners. Basic questions are asked of partners, such as who are you, what do you do, and what are you willing to bring to the partnership? The factors for each partner to consider in this process are: (a) demand - verifying and understanding the demand for the ISP and it's real source (industry, school or government); (b) compatibility - potential for cultural compatibility of partners; (c) resources - potential resources including direct funding and in-kind support; (d) roles - clarification of the roles and responsibilities of each partner; (e) skills - the skill-sets and training systems necessary for students to cross boundaries; (f) models - models of operation; (g) risks - any potential risks that threaten the sustainability of the ISP.

Coordination. This is where repeated interactions facilitate the permeation of boundaries between partners. Coordination between schools and industry is critical to effectively operationalising ISPs. The idea is supported by the work of Cash et al. (2006) who identified common characteristics associated with an organisation's boundary crossing processes including those objects that are co-produced through coordination. The factors for each partner to consider in this process are: (a) agreements - formal and informal; (b) linkages - direct and indirect linkages between partners; (c) curriculum - processes for co-producing; (d) coordination model - individual versus team to coordinate ISP; (e) leadership - additional to coordinator role such as school principal; and (f) geography - close proximity between partners. Clearly and transparently articulating the activities and constraints of partners advance the effective coordination of ISPs.

Reflection. This mechanism involves reflection as a means to facilitate partners' "coming to realise and explicate differences between practices and thus to learn something new about their own and other's practises" (Akkerman & Bakker, 2011, p. 145). Reflection may be initiated by either partner and provide opportunities for negotiation for new actions, strengthing of existing arrangements and changing /eliminating existing arrangements. All of these are intended to facilitate border crossing as an on-going process rather than fixed one-off events. For instance, industry

may reflect about what curriculum content best equips students for apprenticeship and work and encourage teachers to consider new curriculum content. While school teachers may have a pedagogical perspective on how the curriculum is taught. Such joint reflective activity can help partners create innovative curriculum and cross the traditional fragemented curriculum development process. Reflection is also inclusive of cultural perspectives such as behavioural standards; industry codes of conduct and school behavioural policies. For instance, a construction site manager may need to emphasise to teachers and students the behavioural standards expected on site. Equally, a school principal may inform industry visitors of school policies prior to their participation in industry-based classes.

Transformation. Finally, transformation occurs progressively as an outcome of the forgoing three boundary crossing mechanisms (see Figure 1). That is, as partners identify the offerings and activities of each other, establish embedded systems to coordinate activities, reflect on the perspectives of each partner, there will likely be genuine transformation or some change in current ISP practices leading to effectiveness within the overall system (Akkerman & Bakker, 2011). This definition of transformation is similar to Engeström and Annalisa (2010) who emphasise the importance of qualitative transformation within an overall activity system. Furthermore, in Caldwell's (2004) paper on the strategic transformation of schools he argues that schools should "reflect the uniqueness of the community in which schooling occurs and the forces of the wider environment that shape the knowledge economy" (p. 96). The acceptance of various ISP supported curriculum by public sector authorities, particularly where the products of the ISP partners are considerd good to be institutionalised and scaled up, is an example of transformation. Together these understanderstandings of transformation provide a conceptual handle for the ISP context.

Context

The study reported here was situated in the State of Queensland in Australia. The Queensland State government, initiated an ISP called, the Gateway to Industry Schools Program to address perceived skill shortages and to promote economic development in key industries (Watters, Hay, Pillay & Dempster, 2013). The MBA ISP reported on in this paper is representative of six such ISPs initiated by the State government. It sould be noted that education in Australia is a state responsibilitiy.

Method

A qualitative case study methodology was adopted which was positioned against a priori theoretical concepts, a deductive approach using four boundary crossing mechanisms (Akkerman and Bakker, 2011 & Layder, 1998) noted in Figure 2. Despite this prior framework the researchers remained continuously responsive to data that were not fitting into the framework so as not to miss emerging themes. Thematic analysis of the data collected included exploration and coding (see Yin, 2009). Explanations and themes were built progressively by aligning priori codes to the boundary crossing theoretical framework and by making meaningful journalistic notes. Key themes were identified as they related to a patterned response or meaning within the data set. Some themes were based on prevalence within the data, while others were interpreted from the underlying ideas and perspectives of participants.

Interviews and documents were used as data sources. In total, 50 interviews were undertaken in two phases and subsequently transcribed. School and industry interviews were conducted in a semi-structured conversational style exploring participants' perspectives on the workings of the MBA ISP. Interview participants included: school principals, deputy principals; subject heads of departments; school teachers; career officers; workplace coordinators; school VET trainers and coordinators; industry project officers, industry community liaison officers; industry apprentice managers and chief executive officers. A broad range of documents were thematically analysed to corroborate the interview data. Some documents were provided by participants at the researcher's request and others were identified by the research team from government websites. Documents were divided into five areas including: industry reports (18); curriculum documents (10); government policy documents (14); government reports (13) and; Gateway school reports (5).

Findings

To keep this paper within scope the key findings of the MBA ISP were collapsed into four tables. These tables align with Akkerman and Bakker's (2011) four boundary crossing mechanisms: identification; coordination; reflection; and transformation. Additional pertinent discussion and quotations from transcribed interviews are also presented to help strengthen and clarify this section of the paper.

Identification

Table 1. Boundary crossing identification findings.

Aerospace	Building and Construction	Minerals and Energy
• **Demand** - strong demand identified by Boeing, Qantas and Virgin • **Resources** - minimal State government funding • **Skills** - Established a training institute through Aviation Australia • **Model** - partnership between 24 schools (with orientation toward aerospace industry) and industry	• **Demand** - State government indentified need and contracted Hutchinsion Builders (company) to develop and deliver training • **Resources** - some schools identified opportiunties to link to Federal funding through Trade Training Centres and Registered Training Organisations. • **Skills** - identified pathways for 200 apprentices from schools involved • **Model** - Hutchinson Builders identified partner schools (73 schools and formed 6 school clusters	• **Demand** – State government, identified need and approached Queensland Resources Council • **Compatibility** – strong community links and kinship ties to industry • **Resources** - minimal State government funding • **Skills** - Registered Training Organisation involvement • **Model** - partnership between 34 schools and 17 multinational minerals and energy sponsor companies, established Queensland Minerals and Energy Academy (QMEA) • **Risks** - fluctuating industry funding

Table 1 presents findings on the first boundary crossing mechanism, identification. Within Table 1 there were no clear findings under the identification mechanism for *Roles* in any of the ISPs and none for *Compatibility* and *Risks* in the aerospace and building and construction ISPs. We found that each industry had developed a different model to operate their respective ISP. For instance, the aerospace industry together with companies (Boeing, QANTAS, Virgin) persuaded the government of the day to establish a training facility and to take significant action to address skill shortages in aviation. Initially, the government identified schools in close proximity to two major

airports to form a cluster arrangement. In contrast, the building and construction ISP model was initiated by the State government who contracted Hutchinson Builders one of the largest Queensland contruction companies to develop and deliver building and contruction training. Hutchinson Builders worked with Construction Skills Queensland (industry skills body) and schools to provide industry training to students on various large infrastructure projects throughout Queensland. The minerals and energy ISP began with the State government approaching the Queensland Resources Council (Industry peak body) with the aim of replicating the aerospace arrangement. The application of the aerospace model proved unsuitable due to Statewide needs. Therefore a brokerage model was established where an academy (Queensland Minerals and Energy Academy QMEA) was formed to lead and facilitate partnering between industry and schools. Through pre-exisiting networks the QMEA engaged companies (such as Billiton Mitsibishi Alliance, Rio Tinto and Anglo America) to sponsor their program and to work directly with schools. As an example of how the aerospace ISP emerged an excerpt from an interview is provided below:

> So Boeing had some local issues themselves, they were being approached by numerous high schools for support, for work experience, for sponsorship and they said they just weren't able to manage it well, because the demand was just too great at all different levels within their system. So they asked the Department (State government) could they come up with some manageable process whereby they could have some quality, targeted relationships with a small number of schools so that they weren't spreading their resources too thin and that there could be some real outcomes. (Principal Eagle High, 2011)

Coordination

Table 2. Boundary crossing coordination findings.

Aerospace	Building and Construction	Minerals and Energy
• **Agreement** - MOU is a future goal. • **Linkages** - individual schools establish direct networks with industry • **Curriculum** - co-production process • **Coordination model** - sole project coordinator liaison between schools and industry • **Leadership** - school principal leadership • **Geography** - close school geographic proximity to industry (Brisbane airport and surrounding schools)	• **Agreement** - no formal MOU in place despite this being a requirement of Gateway membership • **Linkages** - pre-existing personal links between project manager and industry contacts and some teachers, indirect links between schools and community organisations • **Curriculum** - co-production process • **Coordination model** - dedicated school coordinator between school and industry • **Geography** - school clusters within geographic proximity to work placement sites	• **Agreements** - multiple formal MOUs and informal arrangements • **Linkages** – QMEA project officers with pre-existing industry contacts, project officers are primary link between schools and industry, **i**ndirect links between schools and community organisations (sporting clubs) • **Curriculum** - co-production process • **Coordination model** - QMEA includes basic organisational structure, dedicated school coordinators between school and industry • **Leadership** - school principal leadership • **Geography** - close school geographic proximity to industry (Mining communities)

Findings on how each ISP project was coordinated is detailed in Table 2. There were no findings under the area of *Leadership* for the building and construction ISP. The aerospace and building and construction ISPs were similar in that they both were coordinated by sole project coordinators or managers. A weakness of this approach is that the focus of the ISP is overly susceptible to the perspective of one individual. Whereas the minerals and energy ISP was coordinated via a more typical organisational structure. The QMEA in partnership with the State government and the minerals and energy peak body (Queensland Resources Council) established a team consisting of a chief executive officer, business manager and project officers. This brokerage type model was found to be a strategic catalyst for action throughout the ISP. However, this approach also has it's challenges in that it is costly and challenging to execute efficiently across a geographically dispersed State such as Queensland.

Critical to the coordination of each ISP was the close proximity of schools to industry projects. However, the building and construction ISP partnership with schools was constrained when it came to coordinating workplacements as they were relying on large government led infrastructure projects. Assigning students to new project sites away from their schools was a challenge, and although economically viable, this model left the previously engaged schools without a sustainable project. Furthermore, although coordination of the building and construction ISP was initated by the State government, it was in reality based on relationships between individuals rather than institutional arrangements. This is perhaps the reverse of what occured with the QMEA

model where it was initially coordinated by an individual but as the demand grew the QMEA was formed to help manage the ISP.

Also critical to the effective coordination of each ISP were pre-exisiting and indirect links between industry and school and various community members and organisations. In mosts cases there were pre-existing links with community members who were able to support schools to achieve objectives with companies. For instance, one school principal in the minerals and energy ISP was able to negotiate directly with mining mangers at the local football club (see Table 2) where the principal was a coach. The coordination of ISPs is also enacted through agreements or memorandums of understanding (MOU) or contracts that state mutually beneficial objectives. MOUs may also contain, clearly documented roles and responsibilities, and activities and timeframes for each partner serving as a foundation for effectively coordinating and operationalising an ISP. However, interviews conducted with participants found that partners did not always employ MOUs. The aerospace and building and construction ISP had not formalised arrangements, although aerospace identified an MOU as a future goal. The minerals and energy ISP had executued numerous MOUs over time between schools and companies. Although, MOUs were not seen as critical by some industry partners, school partners (principals) viewed and valued MOUs as means to ensure commitment and sustainability of ISP programs. This was found to be particularly important for the effective coordination and assignment of human and financial resources to various ISP initiatives. An industry apprentice manger expressed his view on MOUs with the following statement:

> A few years ago we looked at an MOU, and I know (another school) did an MOU with the school. Look, I'm not a formal person. If Susan rings up and says hey, can you come and talk to the kids next Wednesday, we'll be there, and if I fall over and break a leg, someone will be there. I just think we need to support the schools as much as we physically can and whatever support that we can give, we'll be there. Whether that's formalised or not, I don't care, the outcome's not really ever going to change. I just think that we need to be a strong partnership with the school, which we are, and I don't know if it would even change if we did a formalised partnership (Industry apprentice manager 2013).

Reflection

Table 3. Boundary crossing reflection findings.

Aerospace	Building and Construction	Minerals and Energy
• Address skill shortages and develop partnerships • Program focus dependent on project coordinator experience e.g. industry vs. school • As industry priorities change the nature of the partnership changes (e.g. curriculum content changes) • Level of regulation in airports restricts student site visits • Industry lack understanding of what schools do	• School leavers over qualified for apprenticeship • Industry will not pay higher rate for qualified school levers • School release for industry-based subjects impacts on school timetable and non-industry subjects • Training programs need to be mobile to enable delivery where infrastructure projects are located	• Over qualified school leavers for apprenticeship • Industry will not pay higher rate for qualified school levers • School release for industry-based subjects impacts on school timetable and non-industry subjects • Purpose - address skill shortages and develop partnerships • Economic fluctuation impacts on school industry partnership sustainability • High teacher turnover rate • Shortage of teachers with industry-based knowledge

Across this paper's dataset there was considerable evidence of Akkerman and Bakker's (2011) third mechanism, reflection. Participants expressed perspectives on a broad range of challenges encountered by their respective ISPs. Most reflections were openly communicated among partners which enabled challenges to be shared, better understood and in some cases solved. The findings for this mechanism are presented in Table 3. Coming through strongly in the data was the interdependent nature of ISPs. For instance, the focus of the aerospace ISP changed as the industry priorities changed. Initially the focus was on pilot and cabin staff training and maintenance engineers particularly related to Boeing contracts in servicing F111 military aircraft. However, as F111 were phased out of service, and the global financial crisis impacted the aviation industry partnerships changed. New industries filled the gap particularly driven by the minerals and energy sector where there was a steep increase in the need for a fly-in-fly-out mining workforce. In the minerals and energy ISP there was a similar picture emerging where the objectives of the ISP was impacted by the economic fluctuations in the mining sector. In some instances this resulted in the withdrawal of direct funding from sponsor companies to the provisioning of more in-kind support.

An interesting reflection expressed by the building and construction ISP was the over-qualifying of school leavers. This view was also a factor in the minerals and energy ISP where school leavers held equivalent or higher qualifications than existing industry employees. To further complicate the issue employee pay scales are sometimes aligned to qualifications. A consistent finding across ISPs was the negative impact on school timetables and non-industry subjects when students were released to industry for work activities. Additionally, there were challenges associated with the lack of industry-based knowledge held by teachers. This posed as a problem when teachers were expected to contextualise the curriculum with industry examples. The issue was addressed in part by industry provisioning professional development and various resources for teachers.

Transformation

Table 4. Boundary crossing transformation findings.

Aerospace	Building and Construction	Minerals and Energy
• Institutionalised ISP curriculum - accredited by State government • European Aviation Safety Agency (EASA) approval as training organisation • VET approved • Negotiatiated contextualised aviation related qualifications from aircraft maintenance engineering to cabin crew training. • Eagle State High School transititioned from a general high school to an aviation focussed school	• Institutionalised ISP curriculum - accredited by State Government school education authority • VET approved • Standard industry-based safety training • Negotiated contextualised Maths, English and Science • Certificate I (year 10) • Certificate II (year 11-12)	• Institutionalised ISP curriculum - accredited by State government school education authority and • VET approved • Standard industry-based safety training • Resources Industry Orientation Certificate I and II) • Negotiated contextualised Science, Maths subject (called QSMART) • Engineering camps for professional pathway

The Gateway to Industry Schools program in Queensland aspired to transform the way that schools and industry collaborate to produce outcomes for the State. Findings in the MBA ISP are evidence of the reality and challenges of such transformation. Although each ISP had taken a somewhat different approach, they had successfully adapted and embedded industry-based learning opportunities into their curricula. This process involved filtering the industry-based curriculum through: (a) school approval processes; (b) VET standards and audit requirements; and (c) industry body approvals. There were specific examples of State approved school subjects (such as aerospace and other STEM subjects) as well as examples of contextualising existing subjects (earth science with mining geology knowledge). Moreover, the curriculum content was often co-taught by industry trainers and school teachers under the auspice of registered training organisations who could issue qualifications. An example assessment item from an aerospace studies school subject is provided below:

Your Job: To demonstrate the skills required for an Operations Analyst role, your job is to:

1. Select an aerospace-related flying business of your choice (e.g. aerobatics display, agricultural services, commercial passenger transport, flight training, etc.).
2. Make an informed selection of a suitable aircraft to perform the business role. Explain why the performance characteristics of the aircraft make it the best choice.
3. Select two suitable aerodromes from which operations could be used.
4. Research, analyse and explain the meteorology of the proposed sites.
5. Compare and contrast the two aerodrome locations to evaluate the most suitable option.
6. Apply this information to draw conclusions that recommend and justify the most suitable site for Leo Air Biz.

Figure 2. Assessment Item in Aerospace Studies.

Discussion and conclusion

Boundary crossing theory has provided a revealing framework from which to explore ISPs. Our purpose was to explore how partnerships were developed between three major industry sectors and schooling at a systemic level. Drawing on boundary crossing theory leads us to suggest four necessary propositions for ISPs to advance their objectives and overcome boundaries between partners.

> ISP partners need to *identify and understand* the types of boundaries and common interfaces that exist between schools and specific industries.

This includes identifying the obvious generic differences and those that are peculiar to an industry or individual company. Such knowledge helps to clarify and manage expectations and to identify areas of genuine interface where partnerships can develop. Most critical is the identification of the specific motivation for each partner's involvement as well as the factors that could dramatically change or end the partnership. For instance, economic fluctuation or a policy change.

> Effective ISP coordination models across partner boundaries is dependent on the geographical scope of activity.

For ISPs that operate in geographically dispersed locations, ISPs may be best served by a small broker type organisation that can act as a structural catalyst across jurisdictional boundaries. This model is able to converge the perspectives of partners and draw upon school and industry linkages throughout the ISP system. The staffing and travel costs of this model may prove prohibitive for ISPs with limited budgets. ISPs that operate in more localised settings will benefit from a sole coordinator or project manager that can work directly and efficiently with stakeholders. It should be noted that this model is susceptible to the personal bias of the sole coordinator. To ensure sustainability of ISPs, ongoing consideration needs to be given to both models in the area of succession planning.

> ISPs who practice reflection and address challenges transparently can expect to develop innovative and sustainable programs.

Our research found that there are many challenges that potentially impact on an ISP realising it's objectives. However, when problems are communicated openly among partners there is typically a willingness from all partners to arrive at innovative solutions that are acceptable to all. Equally, where partners do not practice reflection and become self-serving in their endeavours the ISP will reach a threshold that may be unsustainable.

> ISPs who seek to integrate programs into existing external systems will transform and realise school-to-work transitions that meet the needs of all partners and ultimately the end beneficiary – the school student.

In this study each ISP employed different models of operation, however there were some key common elements. This led to the mapping of a five-step transformation process presented in Figure 3.

1. ISPs transformed practices through the application of boundary crossing mechanisms.
2. ISP transformed practices through the co-production of curriculum.
3. ISPs transformed by embeddeding co-produced curriculum in external pre-existing systems.
4. The approved curriculums were co-taught/trained by school teachers and industry trainers and mentors. This occurred on school and industry premises

employing innovative knowledge and technology not available is standard school programs.

5. Though arduous, this process ensures that school students are work-ready because the gaps in standard school curriculums have been adequately addressed by co-produced industry based curriculums. Students who participate in these programs are making school-to-work transitions or in some cases further education or training.

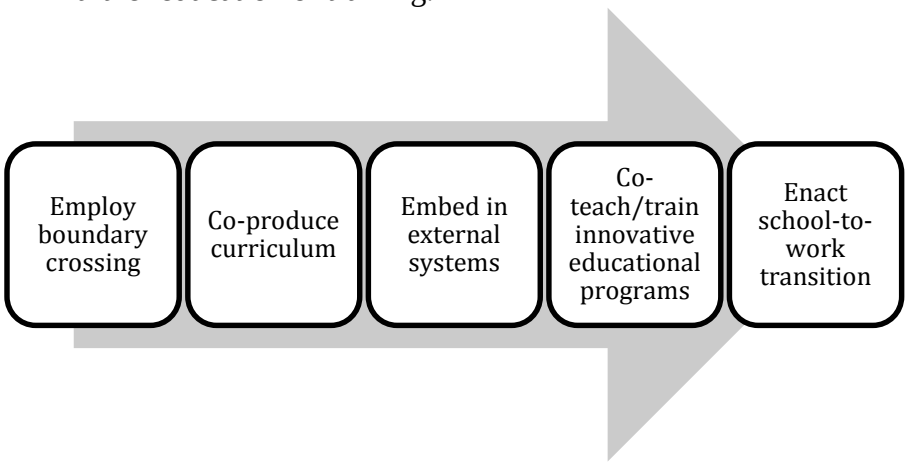

Figure 3. Five-step industry-based curriculum transformation process

Boundary crossing requires disparate organisations to identify, coordinate and activate common spaces. These don't happened spontaneously but require clear guiding principles which we have proposed for ISPs. We have also acknowledged the work of previous researchers who contributed to theory on boundary crossing and conclude that we found it a particularly useful lens for better understanding the dynamics of ISPs. A more detailed understanding of the specific boundaries of schools could be explored in future research together with practical strategies to connect schools and industry.

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