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The Professional Expectations and Experiences of Australian Postgraduate Research Students in Engineering Fields

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This paper presents the findings of an investigation into the beliefs and expectations about their professional socialisation of postgraduate research students, at Masters and PhD level, in two Engineering schools in an Australian university. This study is part of a larger research project exploring the views of Engineering postgraduate research candidates, engineering academics, recently employed postgraduate qualified engineers and employers of postgraduate research trained engineers.

BACKROUND

Advanced knowledge and innovative ideas are highly valued in industrial nations because they are seen as ways to maintain industrial and economic competitiveness and to provide social benefit through the flow-on effects of a strong economy. In Australia, the Federal Government has, since 2001, committed 8.3 billion dollars over a ten year period in strategic funding for science and innovation (DEST 2005a), with the aim of fostering new ideas through research and bringing them into practical, commercial usage. Of the twelve research initiatives identified for funding in Backing Australia's Ability – Building Our Future through Science and Innovation (DEST 2005b), nine are highly relevant to Engineering research, and attract 45% of the funds earmarked for research under the national strategy. It is clear from this and other national initiatives that the discipline and practice of Engineering holds an important position in Australia's vision for its future.

Engineering postgraduate research students play a valuable role in both advancing practically grounded theoretical understandings and seeking innovative solutions to practical problems through engineering research. These intellectual activities are closely linked to and benefit business and industry; however, as Brennan et al. (1996) point out, these links are usually viewed from the perspective of ensuring that Engineering and Applied Sciences postgraduates are appropriately trained to meet perceived industry needs. This perspective is evident in the engineering-related submissions to the 1998 Review of Higher Education Financing and Policy, known as the West Review (DEETYA 1998), which acknowledged the vital importance of postgraduate education and training in technical fields such as Engineering. The submissions called for a broad range of employment related skills and personal attributes it deemed desirable in graduates and postgraduates alike, such as problem-solving ability, motivation, and communication skills (B-HERT 1997); funding for infrastructure and technology to allow research to remain regionally competitive (ACED 1997); and closer collaborations between universities and industry in general, with further development of 'industrial' postgraduate programs to meet the needs of industry (Walker 1997). Similar views were expressed in a report for the Science and Engineering Research Council (SERC) in the UK on the relevance and effectiveness of postgraduate research training for the UK manufacturing industry (Whiston 1993). Whiston argued that the skills

developed by postgraduates during candidature needed to remain aligned with organisational change occurring in the manufacturing industry at that time. This current study in part seeks to identify, at a local level, the implications for postgraduate Engineering research students of current alignment of the needs of industry and business organisations with their academically based research education.

Engineers as knowledge workers

Although Lapidus (1997) reported that over 60% of Science and Engineering PhDs in the US seek employment in academia, there is scant literature that specifically describes the professional roles of engineers with postgraduate research qualifications. It is assumed here that they will engage in knowledge-intensive professional work that is characterised by advanced problem-solving, the exercise of discretion and professional judgement, autonomous decision-making and ambiguity (Alvesson 2004). Professional knowledge workers can present challenges to the organisations in which they work, in the form of tensions between loyalty to their profession, loyalty to the firm, loyalty to their personal career aspirations and, in the case of professional service provision, loyalty to clients. According to Alvesson (2004) these tensions arise partly as the result of the perceived incompatibility between the professional identity held by the worker and the financial, processing and marketing goals of the organisation.

Alvesson defines the construct of professional identity as a person's view of her/himself associated with their belonging to a profession; this self view is socially constructed by the individual through social interactions and comparisons. Alvesson distinguishes professional identity from the idea of professional role, which is a set of externally created expectations of a professional person and often determined by a group such as an employee's work organisation. Professional role defines that person's position in relation to others in the group context and Alvesson points out that it is possible to perform a professional role that is at odds with one's professional identity.

Such tensions are not new. As far back as the mid-1950s, research in organisational sociology and psychology recognised a distinction between employees' professional and organisational identities. Gouldner (1957), for example, suggested that professionally trained men [sic] in the workplace tended to be either orientated toward the values and knowledge bases of their professions or toward the goals and procedures of the organisation. Miller and Wager (1971) contended that professional socialisation, which imbues members with the values, attitudes, skills and knowledge of their professional subculture, occurs during masters or doctoral training; organisational socialisation takes place after an employee enters the workplace.

These earlier studies, and many recent ones, are written from the viewpoint of an organisation, where employee job satisfaction significantly influences employee organisational commitment and the decision to remain with the organisation (Wanous 1980; Wanous et al. 1992). Given the cost to an organisation of early employee turnover, most businesses are keen to ensure that new recruits will be satisfied with their roles in the company by using strategies such as Realistic Job Previews (RJP) to ensure that a new employee's anticipated role expectations align with their subsequent experience (Meglino et al. 1988; Vandenberg and Scarpello 1990).

The concepts of professional and organisational identity, role expectation and job satisfaction have relevance for the present study. The expectations of postgraduate engineers need to be understood, as does the reality of the jobs they will fill. Employers need to know how to present potential employment situations in ways that will best align employee expectations with ultimate experiences. The university postgraduate engineering environment might better prepare students by providing them with opportunities to develop clearer, realistic expectations of their anticipated roles following graduation and to ensure, where possible, that they are prepared for those roles. Of course, students might already be adequately prepared by their postgraduate experiences for their future professional roles; if so, this too would be useful to determine.

Engineers as academic researchers

Like most postgraduate research students in Australia, many Engineering research candidates will work in academic settings, and there is copious international literature that focuses on

postgraduate students' socialisation into their discipline academic cultures (Delamont et al. 2000; Lovitts 2001; Conrad 2003; Weidman and Stein 2003). In the Australian system of research education, this enculturation is best described by Lave and Wenger's concept of situated learning (Lave and Wenger 1991), in that students are expected to function as novice researchers in their disciplines from the commencement of candidature, in a learning environment of other academic researchers, technicians and postgraduate students. The social learning process by which a person becomes a participant in a community of practice subsumes the learning of knowledge and procedural skills. In this way, as students become fully participant researchers, their knowledge and subject skill levels increase. In this context, the transition from postgraduate research student to discipline researcher is relatively seamless over time.

This view appears to concur with Barnacle (2004), whose findings suggested that research learning is a social activity for Australian postgraduate students. In her study, participants reported that their learning takes place through various types of social interaction, and that most postgraduates' social activity centred around research. Her study included engineering students, although no attempt was made to identify the social climate of specific discipline environments.

Weidman et al. (2001) also considered socialisation for professional practitioners at the lowest postgraduate level (eg medical practitioner, graduate engineer), reflecting the American higher education system where many professional entry level programs are offered only at postgraduate level. Thus, these programs have a significant component of explicit professional practice, but this cannot be considered advanced professional practice. Furthermore, Weidman et al. (2001) viewed the outcome of professional socialisation of postgraduates as the acquisition of generic skills and attributes such as teamwork, group maturity and collaboration, but did not explore how students see themselves using these skills in future professional roles.

A different perspective on students' socialisation into academic research cultures is the suggestion that they are vulnerable to coercive processes. Egan (1989) suggests candidates are disempowered by requirements to 'readjust' their professional self-image to conform to the values and beliefs of their disciplinary culture. Lovitts (2001) uses the term 'greedy institution' to describe an environment where, for example, students are expected to comply with demands on their time and energy out of loyalty and commitment to the discipline and university department, at the expense of their sense of self-worth.

All studies mentioned here have focussed on professional socialisation of postgraduate students for roles within industry or academia, but none have focussed specifically on the professional socialisation of engineering candidates for academic and scholarly roles. Given the strong links between industry and engineering research education, this focus has merit. Thus, the aim of the present study is to explore, from their perspective, engineering candidates' socialisation for their professional roles.

THE STUDY

Fifteen postgraduate research students in the Schools of Mechanical Engineering and Chemical Engineering at the University of Adelaide participated in one of two focus group discussions (5 and 10 participants respectively) centred on their beliefs and understandings about the ways candidature prepares them for their anticipated professional roles. The students were at various stages of candidature, ranging from 6 months to 5 years. A key assumption underlying this study is that, as reflected in the background section to this paper, Engineering disciplines place high value on the practical and industrial relevance of their research activities and research education. Five key questions prompted the open discussion: 1) Why did you choose to undertake postgraduate research? 2) What do you plan to do after completion of your postgraduate candidature? 3) What kind of professional experience have you had so far? 4) What have you learned from candidature that you believe is of value to prospective employers? 5) What, if anything, has interfered with your professional socialisation during candidature?

The discussions were audio recorded and transcribed, with the understanding that participants' confidentiality would be maintained. Each participant has been assigned a code indicating their focus group and an arbitrary number, e.g. A5. Participants' comments were analysed to identify the concepts and categories that emerged from the transcribed data (Strauss and Corbin 1990; Creswell 2003).

In the present study, the five key questions formed the categories for analysis. Concepts were constructed by text classification, coded and grouped by meaning, with the unit of analysis being word, word sense or phrase, or sentence (Insch et al. 1997). These units are routinely referred to as comments or statements throughout this paper. Due to the relatively informal and unstructured nature of focus group discussions, comments addressing one question occasionally had relevance for another question. In such cases, they were counted both times. For example, the comment

- 'As for teaching or lecturing/ I may or may not become involved with that also/ because I've always enjoyed being able to teach people./ You know seeing that little light bulb come on.'

was made in response to question 2, but the third phrase, 'because I've always enjoyed being able to teach people' implies the speaker has had teaching experience. The fourth phrase strengthens the implication. Phrases 3 and 4 are equally relevant to question 3.

Results

The responses to question 1, 'Why did you choose to undertake postgraduate research?', were analysed and the resulting concepts and number of comments relating to each concept are shown in table 1.

Table 1: Reasons for pursuing postgraduate research

Concept	No. of comments
Belief that PhD would open up opportunities	10
Graduate work seen as boring/seeking challenging work	6
Offered scholarship/seen as temporary job	4
Enjoys research	4
Wishes to pursue a field of interest	3
Seeks status and recognition of ability	1
Total comments	28

Most candidates viewed the PhD as a means of opening up career opportunities. For some, this meant a way to move more quickly up the career ladder, but for many this response reflected their desire for interesting, challenging work. This was closely linked to item 2; the participants voiced a strong belief that work as a graduate engineer would fail to deliver the intellectual and creative stimulation they wanted from their work. The desires to avoid boredom and engage in novel, innovative and challenging undertakings were recurrent themes in these discussions.

- 'I found most of the jobs I was being offered I was over qualified for and therefore I was rather bored.' (B4)
- 'For me it was a bit of a disappointment with actually being in the industry to begin with. Didn't meet sort of my expectations and realisations. I think some of it can be boring…' (B1)
- '[My friends had] gone out to do graduate work…I didn't like the sound of anything they were doing. They find it boring.' (B3)

Four students identified being offered a scholarship as a catalyst for undertaking research studies, and two viewed higher degree candidature as a temporary, interesting job. Four students were motivated primarily by a love of research; however, only three identified a wish to pursue a specific field of interest as their reason for undertaking further study. One student openly admitted that he wanted the status of being called 'Doctor', but a large number also laughingly expressed empathy with his view.

The responses to question 2 'What do you plan to do after completion of your postgraduate candidature?' are shown in table 2.

Table 2: Plans for post-completion work

Concept	No. of comments
Industry employment	8
Research (in research organisation or university)	8
Self-employment (consulting)	6
Teaching	6
Pursue challenging work (including internationally)	4
Something completely different	2
Not in a university	2
Do not know	2
Not teaching	1
Total comments	39

Most respondents identified more than one potential path. None mentioned availability of a definite job prospect, and all seemed quite unsure about their post-candidature future. One participant claimed that he had been studying for so long that he does not believe he would be attractive to an industry-based employer, except as an entry level graduate engineer; this would be unacceptable to him.

- 'I would be interested in working in an industry….I wouldn't see how I could actually move in to that given my age and how I've been here for so long. And my lack of industrial experience, unless I move in as a, as a graduate student…Which I wouldn't do. Not after six years of post-graduate.' (A3)

Six students said they would consider teaching and lecturing because they enjoy the teaching experiences offered during candidature. However, there appeared to be unanimous, strong disinterest in full academic employment because they perceived it to be a treadmill that was highly bureaucratised, with little opportunity for research and career advancement. Several students specifically identified the Australian Research Council grant application process, a major source of academic research funding, as their major disincentive for pursuing an academic career.

- 'But I also see the lecturers at our university, and …they're expected to do research on the side, they're expected to be involved in research but the reality is they have absolutely no time for that.
- I think for one or two years that would be really interesting but I'd get to a stage where I felt I'd no longer be furthering myself …they spend a lot of time writing grants, being rejected from grants, writing more grants, and finally hopefully getting a tiny bit of money but nowhere near what they want to be able to do the research they want.' (A4)

The responses for question 3, 'What kind of professional experience have you had so far?' are summarised in table 3.

Table 3: Previous professional experience

Concept	No. of comments
No prior experience	8
Teaching in a tertiary institution	5
Industry	4
Consultancies while in university	3
Research organisation	1
Non-engineering professional level work	1
Total comments	22

More than half the participants had no previous experience working as engineers, and had commenced their postgraduate training directly from undergraduate study. Only four had worked

as graduate engineers in industry, one had worked for a large research organisation and one continued to work in non-engineering professional employment. Of the four who had previous engineering workplace experience, three had worked in several jobs and found the type of work they were offered to be unsatisfying. This was also the case for the one person who worked for a research organisation. These participants shared some of their 'war stories' of life in various Engineering workplaces.

Three students had been engaged in engineering consultancy work during candidature and had found it enjoyable. At various times in the discussions, five participants mentioned teaching experiences during candidature and these are noted here. It is likely however, that others, although not mentioned, also had this experience since casual tutoring and demonstrating positions are commonly offered to postgraduate students.

For some students, the interesting work they hoped to find did not necessarily have to include research, but others were motivated by a love of the research process and the desire to find solutions to problems, even though for most their only prior experiences of research were the small projects they undertook in their undergraduate training.

The responses to question 4, 'What have you learned from candidature that you believe is of value to prospective employers?' are shown in table 4.

Table 4: Beliefs about value of postgraduate experience to employers

Concept	No. of comments
Communication and professional skills	26
Technical knowledge/advanced problem solving ability	13
Large scale project management	8
Time management	7
Ability to work independently	7
Self-confidence/self-appraisal	7
Preparation skills	3
Learned how to teach/supervise	3
Persistence	2
Experience of creative/intellectual freedom	1
Total comments	77

Participants made 26 individual references to communication skills and communication-related professional experience gained during candidature. These included ability to write for various purposes and audiences, including non-technically trained audiences, speaking in both formal and informal settings, negotiation skills, group management skills and dealing with difficult people. Students also mentioned that they learned how to run efficient meetings and valued the experience of attending international conferences.

Several students pointed out that they had learned an enormous amount of technical and theoretical knowledge, including a deep understanding of the theoretical concepts relevant to their area of research, from working on their projects. Several noted that this was far more than what they had grasped in their undergraduate education, and here it is important to note that these students were some of the best achieving undergraduate students. They also believed they had developed advanced technical problem solving ability.

The ability to manage a large scale project was specifically mentioned by eight participants as the most professionally valuable outcome of their postgraduate research studies. This, however, incorporates many of the other benefits itemised individually. It requires the ability to conceptualise a problem; critically assess the approaches used previously on the same or related problems and develop a novel solution; break the project down into a series of manageable tasks, each requiring a diverse skill set; flexibility in approaching tasks and unforeseen difficulties; negotiation with a wide range of professional and technical staff; ability to build equipment and tools required and

manage all of this within typically tight budget, time and resource constraints. Embedded in this are good preparation skills to plan technical work, timelines and costs. Also, the ability to work independently is strongly fostered in the Australian postgraduate research process, and seven candidates felt that this ability had been extensively developed during candidature. The long term nature of the project means that it requires vision, great persistence and flexibility.

'the ability to be able to work in a research project, for most of us …our thesis topic, our research towards our PhD is the biggest single task that we've ever undertaken. However much our supervisors have been there for us, however much they've supported us, we're the ones that have done the research, we've done our experiments, played around with our equations, written it up and submitted it. Some employers will appreciate that. Others won't..' (A4)

Overall, students felt positive about the character building nature of candidature. They developed confidence in their ability to achieve, and one student identified the skill of self-appraisal as an invaluable benefit derived from research education. By this he meant the ability to reflect critically on one's own work without loosing self-esteem.

The responses to question 5, 'What, if anything, has interfered with you professional socialisation during candidature?' are summarised in table 5.

Table 5: Beliefs about impediments to professional socialisation

Concept	No. of comments
Supervisor/supervision	12
The PhD	8
Irrelevant compulsory activities	7
Opportunity for poor time management	6
Lack of resources	3
Lack of adequate remuneration	3
Conducting confidential research	1
Working (consulting) for a poorly run organisation	1
Total comments	41

Supervisors and supervision appear to be seen by candidates as placing obstacles in their way toward completion; however, close inspection of the comments indicates that supervisors often bear the blame for situations beyond their control. Areas where supervisors are seen as obstructive are in their demands for publications and conducting additional, irrelevant research. Several students believed that their supervisors were doing this because it was an important means of attracting funding to the department, and felt that supervisors used PhD students as their personal workers. Three students mentioned lack of necessary physical resources or lab space as a major impediment to progress, and implied their supervisors were to blame. Two candidates mentioned that their supervisors did not have adequate technical knowledge of the candidate's research field.

All postgraduate research students in the University are required to undertake a series of workshops and tasks, called the Structured Program, deemed necessary for their development as researchers. The tasks include writing a research proposal within six months of candidature commencement and presenting a seminar on work in progress. At the end of twelve months, they must complete a review of candidature to assess their progress to date. Engineering students are also required to write up minutes of their supervision meetings, which are expected to occur on a fortnightly basis as a minimum. Many students regard the time taken to meet these requirements as impediments to progress toward degree completion. However, when immediately reflecting on their own comments, most agreed that in fact, having to produce documents and give seminars forced them to consolidate their knowledge. It seems that, for some, there is a sense of frustration that builds when they feel their momentum is halted arbitrarily. Two participants described dealing with the interference of the Structured Program and paperwork as a lesson to be learned:

- ‘…it’s probably taught us a more valuable lesson about how life just isn’t fair and if you’re going to, whether it be academia or industry, no matter how much you enjoy work, there’s going to be a lot of crap that you just don’t like. So, I mean that’s valuable experience in itself quite frankly.’ (A5).

Several participants, including those who found it an impediment, acknowledged that the compulsory nature of the Structured Program tasks were helpful in progressing candidature.

- ‘I mean my first departmental presentation really got me going because I was about nine or ten months in from when I started and I really had to take the time out and didn’t really have anything. So when I saw that my name was down on paper in a month’s time to give a presentation, what have I got? …I sat down with my supervisor, we spent you know, a couple of days sitting there really thinking about “where is the project really going? …It gave me all the structure. And then the upgrade report…that really outlined…a lot of my PhD thesis.’ (A3)

Perhaps the most interesting finding of this study is that eight participants believed that the PhD itself interfered with their opportunities for professional work. Their pessimism related to the time they spent out of the workforce and their perception that employers did not value PhDs. Some also felt that employers preferred Masters degrees.

- ‘I went to a job interview about two months ago…they let me know that the PhD was of no value to them whatsoever. They said, “We hire your learning capacity and previous experience”. I said, “…perhaps I’m not, you know, suited to actually working here”.’ (B1)

- ‘I ring at least two to three HR people a day and they ask, “So, the ad says two to three years experience.” I’m also doing a PhD, I’m nearly finished, but you know.’ (B6)

Some participants felt that inadequate remuneration for PhD students and employees with postgraduate research qualifications indicated that their education was not valued, and made them more anxious to complete on time.

- ‘If I finish my PhD in three years as opposed to five years I’ll probably be $100,000 better off.’ (B10)

Summary

The outcome of these focus group discussions appears to indicate the candidates were unsure about their ultimate future employment, sought intellectually challenging work, favoured research and teaching, and eschewed the bureaucratic demands of academia. They believed that the outcomes of postgraduate learning of most value to employers were advanced technical and problem-solving ability, large scale project management expertise, a broad range of professional and people management skills, and personal characteristics of independence, initiative, persistence and self-discipline. Most of them recognised some value in requirements to give seminars and write papers, but felt that other compulsory tasks such as attending the seminars of other students and research group meetings interfered with their progress. They believed obstacles to their professional preparation were those demands which they perceived drew their attention away from the immediate demands of their research and slowed down progress toward completion of their degree. Candidates interested in working in industry felt that employers did not value PhD experience, and several participants expressed the view that the PhD itself might be an impediment to getting a job.

DISCUSSION

It was surprising that so few students had a clear vision of the professional roles they intended to assume in the workplace on completion of their degrees. Only one student stated with certainly that he intended to work in a research organisation, and that it was for this reason that he commenced PhD study. Several students identified roles they did not intend to pursue – in particular,

management or teaching. It had been expected at the start of this study that more participants would know the career path and professional role they intended to follow. It was also anticipated that some students would have forged promising links, or even negotiated a position with a potential employer. While this might have been the case, no evidence of it was found in the data.

Two underlying themes emerged from this study: the students undertaking higher degrees were driven to engage in autonomous, intellectually challenging work, and the students had strong, confident professional identities based on an awareness of their own intellectual and financial worth. Although they were unclear about their future professional roles, the participants in these discussions appeared to have developed strong professional identities as advanced knowledge workers, according to Alvesson's criteria. Participants' aversion to boring, unstimulating work possibly contributed to their intolerance for demands and processes that appeared to them to be irrelevant and interfered with their immersion in their research projects.

Furthermore, their responses appear to reflect Alvesson's contention that knowledge workers with a sense of professional identity are particularly vulnerable to disaffirming messages about their value as expressed through lowered perceived status, pay and interesting work. Several participants expressed frustration and disappointment that their achievements and what they have to offer do not seem to be valued highly in the workplace. Many believed there is little financial reward awaiting them on completion and that the years spent studying have set them back financially. Several were disheartened by employer comments that a PhD was not an important requirement for employment. Little more than anecdotal evidence was offered to support their contentions, but their concerns about lost income over the period of candidature might be related to the high salaries currently offered to newly graduated engineers in Australia.

These discussions further yielded evidence of highly individualistic identities as researchers. Many expressed their intentions to move on when their future work ceased to be stimulating and challenging. Using Gouldner's model, they appeared to be 'cosmopolitans' rather than 'locals'. Very few candidates expressed interest in pursuing careers in management, even though several believed that this was the most likely pathway to professional advancement in industry. Notwithstanding their financial concerns, they appeared to favour somewhat insecure but intellectually rewarding work conditions, despite these being unlikely to provide the status and recognition they seek.

Several candidates appeared to have legitimate complaints about lack of resources or excessive demands by supervisors for publications. These issues have been raised previously in the literature on postgraduate student experience. However, the students who participated in these discussions showed no evidence of being victims of 'greedy institutions' (Lovitts 2001). On the contrary, they appeared to maintain a strong sense of their own worth as engineers and discipline researchers, and were openly critical of what they perceived as irrelevant demands on their time and energy. This criticism was chiefly directed at their supervisors, although unpacking of comments revealed that bureaucratic demands, compulsory attendance at seminar and workshops and lack of physical resources are often outside the area of supervisor responsibility. Furthermore, participants often recast critical statements so that the perceived impediment, such as writing a paper, was later viewed in a positive light. This adds some weight to the earlier suggestion that students were vulnerable to feelings of frustration when their attention was drawn away from their immediate focus on their projects.

Further evidence of the students' ambivalence toward the perceived burdensome demands placed on them is that there were 26 references to the contribution of communication and professional skills to their professional development: six of these referred to speaking and writing improvement and 14 to general communicative competence and interpersonal skills. For all these students, these developments would have been the outcome of the formal speaking and writing requirements of candidature. Barnett (1994) argued that universities and disciplines develop 'academic skills' and that business and industry seek 'operational skills' in their employees; hence, a concept such as communication skills likely carries quite different meaning in each context, so that while these

abilities contribute to candidates' strong professional identities, they may not be what is required in their professional roles.

A second strong theme that emerged from the discussions was a sense of confidence students possessed about their own abilities and worth as researchers, both within their disciplines and as prospective employees. Many expressed confidence that they had eventually developed the preparation and time management skills necessary to succeed in completion of a large scale project. They noted their deep technical and theoretical understanding and their ability to independently manage large projects, and identified improvement to their written, spoken and interpersonal communication as particularly valuable attributes for the workplace. Several clearly articulated their desire to complete their degree without 'interference' so that they could move into the workplace and use their valuable knowledge and skill. Additionally, Zorn et al. (2006) demonstrated that focus groups can be sites of empowerment for participants that serve to strengthen self-efficacy for both communication and consideration of controversial issues, and it is possible that this phenomenon was evident in the present study.

Judging from the items mentioned that were seen to have contributed to students professional preparation, it appears that the participants believed they gained much that was professionally useful during candidature. It remains to be seen if employers of postgraduate research-trained engineers agree with this assessment of postgraduate attributes, skills and knowledge. This aspect will be addressed in another phase of the larger research project.

CONCLUSION

This study was limited to a small group of postgraduate Engineering research students in one Australian university. Nevertheless, it reveals evidence of strong professional identity but unclear role identification in these students. The second finding is surprising, considering the strong practical and industrial focus of the Engineering discipline culture.

Despite the apparent value placed on advanced engineering research and development in Australia, as noted in the introduction to this paper, many candidates doubted that employers valued the advanced research and technological training they received in research candidature. Future studies, as part of our larger project, will investigate engineering academics and employers' expectations and perceptions of postgraduate research trained engineers. These studies may go some way in determining whether these students' beliefs are well founded, and the degree to which postgraduate research education prepares students for their professional roles in industry and academia.

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