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Doctoral employability as read in non-academic job adverts asking for advanced research skills: a machine learning study

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Conference research domain: Employability, enterprise and graduate careers (EE)

Background/rationale:

- What sort of work skills do non-academic employers indicate they want in job advertisements asking for a high degree of research-related skills?
- How does this analysis compare with the 'skills gap' identified in the literature on employability (incl. govt reports)

2. What does this analysis tell us about what is required in industry vs academia?
Are there different skills valued/sought by industry vs academia at the meta level?
What additional graduate capabilities does industry require, in addition to those listed in common curriculum development instruments, such as the Vitae Researcher Development Framework

Implications / provocation:
How are these skills reflected (or not) in debates about research education?
With the shift towards 'industry ready' PhDs – do we really comprehend what this means?

150 words (121 words)**:**

Early employment in academia can be tenuous and industry is increasingly seen as a desirable career destination by PhD graduates, with over half of Australian and UK PhD graduates not commencing an academic appointment on completion of their doctoral studies. If we take the position that the PhD is being used by graduates to prepare for workplaces outside academia, what graduate skills, characteristics, and attributes are most desirable to develop? While a growing number of government reports and studies list what industry employers outline as desirable graduate attributes, these are largely anecdotal accounts. This paper builds on a natural language machine learning analysis of job advertisements to ask: what do non-academic employers really want when they hire for advanced research skills?

1000 version (866 words, excluding references)**:**

What is it we are trying to accomplish with doctoral education and for whom? Debates about the nature and purpose of the PhD have been ongoing for an extraordinarily long time. Nearly a century ago, Edgar Dale raised concerns about the fitness for purpose of the PhD in relation to producing able teachers (Dale, 1930). Producing classroom-ready graduates is a problem that is still being debated today, but for those tasked with overseeing the quality and direction of PhD curriculum the large, and growing, proportion of graduates working outside academia is of even more concern. How to prepare PhD graduates for a wide range of possible career outcomes is a challenge for both educators and policy makers and has been the subject of increasing attention throughout the last decade (see for example League of European Research Universities, 2010; The Allen Consulting Group, 2010; Deloitte, 2012; McGagh et al., 2016).

Governments around the world forecast a need for large increases in the number of researchers required to achieve innovation and growth targets and to remain competitive. Encouragingly this is infused with a goal to improve the mobility of researchers. Mobility not just geographically, but between sectors, with researchers moving seamlessly from university to industry and back again (see for example Deloitte, 2012). But, there is increasing pressure from government – and parts of industry – to change the doctorate to promote a more 'work ready' research workforce. This call is echoed in other nations. This push gathers persuasive force when put in relation to the fact that doctoral candidates and graduates themselves identify gaps in their training or report that their doctorate was not closely aligned to their subsequent work (Edwards et al., 2009; Edwards et al., 2011). Rapid changes in technology are another factor in the argument for change, with research on job advertisements showing a clear and pressing need for more graduates with high level skills in the production and manipulation of data (Burning Glass, 2017).

Approaching the issue of doctoral training as one of professional development, rather than employability per se, the Vitae (2010) Researcher Development Framework (RDF) is a representation of researcher skills. The four domains (knowledge and intellectual abilities, personal effectiveness, research governance and organisation, and engagement, influence and impact), twelve sub-domains, and descriptors encourage a consideration of varied skill sets and their relevance for an individual and their career. The Vitae RDF, as a curriculum development instrument, has gained dominance in the UK and abroad. This instrument has proved to be extremely useful in doctoral training, but is this instrument sufficient for the training considerations of candidates headed for non-academic destinations that still require advanced research-related skills? The work we have undertaken to date (Pitt and Mewburn, 2016) suggests sets of attributes and skills that universities, as key stakeholders in doctoral education, regard as important for doctoral graduates seeking employment within academia. But there is, as yet, no instrument for non-academic jobs. What lists do exist are often defined through industry working groups or employer self-reports in relation to the broader consideration of employability, not necessarily doctoral education per se. Does this leave us with a gap in skills training that we aren't considering?

Most universities undertaking development of their undergraduate and masters course offerings seek employer and government perspectives in relation to the skill sets they value/require. This kind of industry consultation is rare in doctoral education. In what small scale studies that do exist, the researcher skills gaps noted by employers centre on soft skills and issues of skill/knowledge translation outside the academic setting. For example, a study by The Allen Consulting Group (2010) found that almost 72% of sampled Australian employers hired researchers (not just PhD-qualified) to 'advance the body of knowledge' and 'access specialist knowledge and/or skills'. However, these consultation processes are based largely on retrospective self-report from targeted employer groups. Curriculum development work in the PhD space suffers from a lack of data, making it extremely difficult to forecast exactly what industry requires now, let alone making predictions about coming years. One way to overcome the limitations of retrospective, self-reported employer opinion is to look at job advertisement texts which articulate what employers are actively looking for in employees.

This paper builds on the results of a previous pilot study by Pitt and Mewburn (2013; 2016) that examined academic job ad texts to analyse what academic employers were looking for in early career academics. This analysis was useful in revealing the applicability of tools like the Vitae RDF to curriculum development work aimed at aligning the PhD with contemporary expectations of academic workplaces. With the help of a machine learning natural language processing algorithm that can 'read' job advertisements and sort them according to research skills intensity, we produced a preliminary mapping of the extent of demand for PhD graduates in the Australian workforce (Mewburn et al. 2016; Mewburn et al, 2017). This paper reports on a deeper examination of the high research intensity jobs located in the process of training the machine and comparing the results to the existing Vitae Researcher Development Framework. This analysis is offered as an extension and supplement to our existing models of research training to accommodate a wider diversity of employment outcomes.

References:

Burning Glass. (2017). *The quant crush: how the demand for data science skills is disrupting the job market*. Available from http://burning-glass.com/the-quant-crunch-landing-page/

Dale, E. (1930). The training of Ph.D.'s. *The Journal of Higher Education*, *1*(4), 198– 202.

Deloitte. (2012). *Researchers' report 2012*. Prepared for the DG Research and Innovation, European Commission. Available from https://cdn2.euraxess.org/sites/default/files/policy_library/121003_the_researchers_report_2012_final_report.pdf

Edwards, D., Radloff, A., & Coates, H. (2009). *Supply, demand and characteristics of the higher degree by research population in Australia*. Report for the Department of Innovation, Industry, Science and Research. Available from http://research.acer.edu.au/higher_education/10/

Edwards, D., Bexley, E., & Richardson, S. (2011). *Regenerating the academic workforce: The careers, intentions and motivations of higher degree research students in Australia*. Findings of the National Research Student Survey (NRSS). Available from http://research.acer.edu.au/higher_education/23

League of European Research Universities. (2010). *Doctoral degrees beyond 2010: Training talented researchers for society*. Leuven, Belgium. Available from http://www.leru.org/files/publications/LERU_Doctoral_degrees_beyond_2010.pdf

McGagh, J., Marsh, H., Western, M., Thomas, P., Hastings, A., Mihailova, M., & Wenham, M. (2016). *Review of Australia's Research Training System*. Report for the Australian Council of Learned Academies. Available from www.acola.org.au.

Mewburn, I., Grant, W., Suominen, H., & Kizimchuk S. (2016). What do non academic employers want? A critical examination of 'PhD shaped' job advertisements for doctoral employability presented at the *Society for Research into Higher Education* conference, 7-9 December. Available from https://www.srhe.ac.uk/conference2016/abstracts/0097.pdf

Mewburn, I., Suominen, H., Grant, W. *Tracking Trends in Australian Industry,* report prepared for Department of Industry. (2017, not yet publicly released).

Pitt, R., & Mewburn, I. (2013). Doctoral employability as read in job adverts. Presented at the *Society for Research into Higher Education* conference, 11-13 December. Available from http://www.srhe.ac.uk/conference2013/abstracts/0121.pdf

Pitt, R., & Mewburn, I. (2016). Academic superheroes? A critical analysis of job descriptions. *Journal of Higher Education Policy and Management*, *38*, 88-101. Available from http://dx.doi.org/10.1080/1360080X.2015.1126896

The Allen Consulting Group. (2010). *Employer demand for researchers in Australia*. Report to the Department of Innovation, Industry, Science and Research. Canberra. Available from http://pandora.nla.gov.au/pan/121182/20100707-1404/www.innovation.gov.au/Section/Research/Documents/EmployerDemandforResearchersinAustraliareport.pdf

Vitae. (2010). *Introducing the Researcher Development Framework*. Careers Research and Advisory Centre (CRAC) Limited. Available from www.vitae.ac.uk/rdf