ERA Challenges for Australian University ICT Activity

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Introduction
The purpose of this paper is to inform ACS leadership about the threats posed to Australia’s higher education capabilities in ICT research and teaching by the Excellence in Research for Australia (ERA) scheme managed by the Australian Research Council (ARC), how these threats originate largely in ERA’s and universities’ treatment of ICT, and what kind of cooperation could lead to win-win outcomes for all concerned.

ERA background
ERA was conducted during 2010 according to the following broad parameters.

Terms of assessment
A wide range of objects of assessment (see below) were assessed according to across eight discipline clusters (Cluster Five—Mathematical, Information and Computing Sciences being most relevant here). Within each cluster, research was classified and assessed in terms of “disciplines” as per the four-digit and two-digit Fields of Research (FoRs) as identified in the Australian and New Zealand Standard Research Classification (ANZSRC). The “four digit” disciplines represent specialisations of the “two digit” disciplines; in particular the latter subsumed the former and additionally material not considered for assessment under the former was also eligible for assessment under the latter. The two-digit FoR code 08 Information and Computing Sciences was most applicable to ICT, though several others were more or less applicable. The following lists the most relevant:

- 08 Information and Computing Sciences
  - 0801 Artificial Intelligence and Image Processing
  - 0802 Computation Theory and Mathematics
  - 0803 Computer Software
  - 0804 Data Format
  - 0805 Distributed Computing
  - 0806 Information Systems
  - 0807 Library and Information Studies
  - 0899 Other Information and Computing Sciences
- 10 Technology
  - 1005 Communications Technologies
  - 1006 Computer Hardware
Some ICT research may also have been classified under 0906 Electrical and Electronic Engineering.

It must be noted that it was outputs that were classified not researchers; and some outputs from ICT researchers would have been classified under other codes, especially interdisciplinary work where ICT was an enabling technology.

Each university’s submission under the above framework constituted a “unit of evaluation” against which a university’s performance was assessed and published. In order however to be assessed, a unit’s output had to meet a threshold over the six-year period of evaluation – for all of the ICT disciplines listed above, (both two-and four-digit codes) this was 50 articles in journals (not conferences) recognised under a ranking scheme (see below) over the period of assessment (see below).

**Objects of assessment**

- Research Outputs (primarily books/chapters, journal articles, conference papers in selected disciplines including 08 Information and Computing Sciences) for a six-year period: 1 January 2003–31 December 2008
- Research Income (in terms of HERDC categories: Australian Competitive Grants; other public sector research income; other public sector research income; CRC income) for a three-year period: 1 January 2006–31 December 2008
- Applied Measures (research commercialisation income, patents, registered designs, plant breeder’s rights and NHMRC endorsed guidelines) for a three-year period: 1 January 2006–31 December 2008

**Subjects of assessment**

Even though assessments of research outputs were not organised around individual producers of research, a credible affiliation with a university for the period of assessment needed to be demonstrated:

1. on the census date of 31 March 2009, to have been a paid employee or in some other relationship, including as a visiting academic; and
2. if not a paid employee, to have that affiliation substantiated by a publication association.

A researcher’s affiliation on the census date determined the university to which credit for the objects of assessment was allocated; but for non-paid employees, only publications that explicitly cited that university were included in the assessment.

**Criteria of research output assessment**

Research outputs (publications) were included for assessment only if in recognised outlets.
Recognised outlets were ranked according to criteria as follows (adapted from ARC’s ERA 2010 Evaluation Guidelines http://www.arc.gov.au/pdf/ERA2010_eval_guide.pdf):

A* (journals only): Typically an A* journal would be one of the best in its field or subfield in which to publish and would typically cover the entire field/subfield. Virtually all papers they publish will be of a very high quality. These are journals where most of the work is important [it will really shape the field] and where researchers boast about getting accepted. Acceptance rates would typically be low and the editorial board would be dominated by field leaders, including many from top institutions.

A: The majority of papers in a Tier A journal (or conference) will be of very high quality. Publishing in an A journal (or conference) would enhance the author’s standing, showing they have real engagement with the global research community and that they have something to say about problems of some significance. Typical signs of an A journal (or conference) are lowish acceptance rates and (for journals) an editorial board which includes a reasonable fraction of well known researchers from top institutions, or (for conferences) low acceptance rates and a program committee and speaker list which includes a reasonable fraction of well known researchers from top institutions, and a high level of scrutiny by the program committee to look at the significance of the work.

B: Tier B covers journals (or conferences) with a solid, though not outstanding, reputation. Generally, in a Tier B journal, one would expect only a few papers of very high quality. They are often important outlets for the work of PhD students and early career researchers. Typical examples would be regional journals with high acceptance rates, and editorial boards that have few leading researchers from top international institutions, or (for conferences) regional conferences and international conferences with high acceptance rates.

C: Tier C includes quality, peer reviewed, journals (or conferences) that do not meet the criteria of the higher tiers.

As well as the ranking of the outlet, publications were assessed by citation count. It’s been said (as yet unverified) that citations took priority over journal rankings – one may speculate that for more recent publications where citations might as yet be unlikely, outlet rankings served as a proxy.

**Results of assessment**

Results for each unit of evaluation (UoE), i.e. a discipline represented by a two- or a four-digit FoR code at a university, were expressed in a six-point rating scale (also adapted from ARC’s ERA 2010 Evaluation Guidelines):

5 : The UoE profile is characterised by evidence of outstanding performance well above world standard presented by the suite of indicators used for evaluation.

4 : The UoE profile is characterised by evidence of performance above world standard presented by the suite of indicators used for evaluation.

3 : The UoE profile is characterised by evidence of average performance at world standard presented by the suite of indicators used for evaluation.

2 : The UoE profile is characterised by evidence of performance below world standard presented by
the suite of indicators used for evaluation.

1: The UoE profile is characterised by evidence of performance well below world standard presented by the suite of indicators used for evaluation.

n/a: Not assessed due to low volume. The number of research outputs did not meet the volume threshold standard for evaluation in ERA.

Assessments were undertaken for each four- and two-digit disciplinary (FoR code) unit for which the output threshold (50 journals) was achieved.

**ERA Outcomes for ICT**

**ICT research performance**

Table 1 summarises ICT research scores in 2010 ERA.

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Table 1: 2010 ERA results for ICT disciplines

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<th>Also scored one or more 4-digit FoR</th>
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**Benchmark analysis of ICT research performance**

Table 1 reflects the dominance of ICS and sub-disciplines in evaluated (i.e., above-threshold) ICT research, thus ICS will be the focus of our comparison with other disciplines. Table 2 compares ICT ERA outcomes (mostly ICS) with those of some benchmarks in science and engineering with which ICT is likely to be compared by interested parties.
Table 2: 2010 ERA outcomes for ICT disciplines c.f. science and engineering

The message sent by table 2 is that as increasing measures of comparable quality are taken into account, ICT research performs increasingly badly against its likely benchmarks:

- Generally somewhat fewer universities managed to meet ERA performance thresholds in ICT
- The discrepancy becomes ever more-pronounced as achievement in more specialised areas (4-digit FoR codes) is reflected
- The discrepancy is likewise more-pronounced as higher levels of achievement against world benchmarks are reflected. Thus: while ICT research is at least of world standard at approximately 66% of the number of universities at which science/engineering is, when we progress to a level of at least above world standard, the relative percentage for ICT drops to 50%; and when we progress to a level of well above world standard, the relative percentage drops to close to 5%.
- This impression of ICT’s relative poor performance to likely benchmarks is corroborated by the comparison of ICS scores with university averages: ICS research scored at or above average results at approximately only 20% of universities, whereas science/engineering performed at or above average results in approximately 45% of universities. It’s clear that in many cases, poor ICS scores contributed to poorer-than-otherwise university outcomes. Moreover, in the relatively few cases where CIS performed at or above average, that was largely in the context of overall poor performance by the relevant university. There were only three at-or-above-average results for CIS where the university as a whole performed at or above world standard.

Bases for Poor ERA Outcomes for ICT
A number of factors may have combined to give these disappointing results

a) The relative fine granularity of FoR codes pertaining to ICS would generally have diminished the relative performance of ICS compared to other broad disciplines. For example, the entire field of Engineering was also covered by a single two-digit code, whereas substantial sub-disciplines (e.g. Chemical, Civil, Electrical Engineering) had only four-digit codes. Further, this fine granularity for ICS would militated against the achievement of thresholds especially at four-digit level, though failure to register at four-digit level did not necessarily preclude a good result, e.g. RMIT achieved a two-digit score of 3 without having met any four-digit thresholds.

b) ICS research (and ICT research overall) is particularly at risk of being submerged into other disciplines, especially in view of its role as a fundamental enabling technology for contemporary scholarship, and not just in the engineering and physical sciences (i.e. such research would have been published in outlets classified according the application domain). Moreover as noted, some ICT fields were classified under “Engineering” or “Technology” (communications or hardware).

c) The citation coverage service used by the 2010 ERA (Scopus) does not cover ICT well, not does it cover conferences.
d) The exclusion of conferences from threshold counts is inconsistent with including conferences in the overall ICS research outputs.

e) Research performance was measured against international benchmarks of university quality and quantity output, and was not pro-rated for small units (viz. the absolute threshold of 50 ranked journal articles).

f) The significant decline in Australian university ICT academic staff numbers since 2000 must therefore have impacted significantly on the evaluation, as successive rounds of redundancies have seen the departure of numerous productive research personnel, recalling that individuals needed to have a demonstrable association with a university by the 31 March 2009 census date for their research output for the 2003-2008 period to be attributed to that university. Some university ICT organisational units lost of the order of 50% of their academic staff - at that scale of retrenchment, it’s difficult not to lose a number of research-capable staff, and anecdotal evidence supports the contention that a significant number of high-achievers took the opportunity to take effective early retirement.

g) The significant national investment in university-derived ICT research represented by NICTA goes unrecognised because NICTA-funded staff are employed directly by the NICTA organisation rather than by universities funded from NICTA. This contradicts the normal pattern of Australian research funding.

While the past downsizing is beyond the control of the ARC, the above catalogue (items a-e) suggests that the current ERA system includes pitfalls that need to be taken into account when attempting to modify organisational and individual behaviours to optimise future ERA outcomes.

**Impact of Poor ERA Outcomes for ICT**
These poor outcomes place university ICT at risk in various ways.

**Funding threats**
ERA connects to the sustainable Research Excellence in Universities (SRE) initiative which aims to compensate for the gap in funding for the indirect costs of university research (costs include hitherto uncosted items such as proportions of academic staff salaries, and more realistic costing of technical and administrative research infrastructure - for more information see [http://www.innovation.gov.au/Research/ResearchBlockGrants/Pages/SustainableResearchExcellence.aspx](http://www.innovation.gov.au/Research/ResearchBlockGrants/Pages/SustainableResearchExcellence.aspx)). Access to SRE funding is contingent upon participation in 2010 ERA and its successor(s); further some of the funding available under the scheme (1/3 of a total of approx $121M for 2011) appears to be tied to ERA performance. SRE extends the existing RIBG (Research Infrastructure Block Grants) and its not inconceivable that RIBG may be rolled into SRE in future.

$40M distributed across 41 universities on the basis of ERA outcomes is relatively insignificant and probably exceeds the university-side cost of administering the exercise. However, now that the principle of “excellence”-based distribution of public funds has been established, influential forces will be at work to increase its impact in future. It can be assumed that whatever revenue is earned
by universities as a result of ERA will largely return to the research-successful disciplines that “earned” same.

**Reputational threats**
While direct ERA-based public funding remains relatively insignificant, the early impact of ERA on other sources of funding and other enablers of university effectiveness could be significant.

- In the absence of a national teaching assessment, ERA is likely to serve as a proxy for overall rankings and thus become critical to Australian universities’ profiles as destinations for international fee-paying students at all levels. For example, [http://www.australian-universities.com/rankings/](http://www.australian-universities.com/rankings/) lists a number of rankings of Australian universities, with ERA-derived rankings already listed first (and by virtue of the level of detail supplied, apparently most authoritative as well). Some Australian universities report [http://www.students.idp.com/study/australian_universities.aspx](http://www.students.idp.com/study/australian_universities.aspx) international student numbers approaching if not exceeding 50%, the budget impact of same being heightened by the excess of international student fees charged by many universities over government subsidies for domestic students.

- In view of the emphasis placed on research achievement in academics’ career development and prospects, the poor research rating of Australian university ICT will act a strong disincentive for ICT academics to consider Australian universities: top international researchers will be less likely to consider Australia; and top Australian researchers will be tempted increasingly to pursue their careers overseas. The threat to Australian ICT research capacity is obvious, but the threat also applies to the quality of ICT education: while the research-teaching nexus may in some cases be exaggerated, it’s undoubtable that a significant number of advanced-level Australian ICT courses benefit from being taught by active researchers in the relevant fields; and while there may be some truth to the stereotype of the brilliant but inarticulate researcher, it’s often the case that excellent academics excel in both dimensions of endeavour – teaching as well as research. Any threat to the attraction and retention of excellent ICT researchers in Australian universities is a real threat to Australian ICT education.

- In similar vein, any detraction from the appeal of Australian universities to prospective research students (research masters and PhD) will further detract from the appeal of Australian universities to research academics and will in itself substantially impact upon Australian universities’ research capacity. In view that the global market for PhD students is becoming one in which top students are awarded fee waivers or equivalent scholarships, these threats are probably more significant in the long run than any impact on fee income from this class of student.

**Internal threats**
The financial and reputational pressures upon universities (see above) to improve their ERA scores could conceivably have beneficial impact upon ICT, as universities seek to remedy deficiencies made apparent by ERA.

On the other hand, one may not unreasonably fear that universities may be tempted consider other options to improve their ERA scores, not necessarily to ICT’s advantage. For example, a reasonable
strategy that might be adopted would be for a university to invest in areas that have demonstrated their potential to perform by relatively good ERA results, but which have room for improvement. Under such a scenario, below-average performances in the ICS disciplines might very well not meet universities’ criteria for development investment. Indeed, the temptation to remove resources from “losers” in order to maximise the further prospects of “winners” might see a catastrophic decline in ICT’s position in a number of universities.

Moreover, for universities at which ICT was unrated (over 40%!), a choice decision now confronts them. Any effort to put ICT “on the map” runs a considerable risk in that it will be difficult for universities to determine with confidence that the result will actually be creditable. An unrated performance is the result of not meeting the ranked journal output threshold, and might be transformable into a rated one by transforming academics’ behaviours to pursue ranked journals in future. That is however no guarantee that the resulting ERA assessment would be one that the university desires. At the very least, any future below-average ERA result for ICT is one that is likely to attract a university’s disapproval.

Finally, it must be emphasised that it is not just Australia’s ICT research capacity which is under threat in this way. As well as the broad risk to the quality of Australian ICT academic staff, the very existence of ICT as an academic endeavour at some universities may be under question.

A vicious cycle threatens
To summarise, Australian university ICT is threatened by a vicious cycle of poor ERA evaluations leading to reduced resourcing and reputation leading to reduced performance leading to poorer ERA evaluations etc.

What to Do?
Even though the 2012 ERA exercise has effectively already begun (reference period for publications was six years until 31.12.10; census date for staff is 31.3.11), various stakeholders could now usefully engage in (initiate or maintain) activities that could lead to improved outcomes in 2012 and subsequent ERA exercises

What can ICT researchers and research groups do?
For ERA 2012, there is little that individual researchers can do. For example, the survey period for publication data has now closed (31.12.10).

For subsequent ERA-style exercises, a number of lines of development suggest themselves for attention; some more useful than others.

- Focus: it may be tempting for universities especially with relatively small numbers of ICT researchers to improve outcomes, especially at the four-digit FoR level, by concentrating on a very few, maybe even one, research areas. As well as potentially improved ERA scores, this is a means by which the issue of critical mass may be addressed. However there are means by which small numbers of effective researchers can manage to establish effective connections (with PhD students, with collaborators at other institutions, through NICTA). Further, lack of recognition at ERA four-digit level does not appear to exclude a good result at two-digits (e.g. the “world standard” evaluation achieved by RMIT for two-digit CIS without any four-digit result). Thus,
imposition of a tighter research focus does not in itself seem to be a priority (as opposed to any which may emerge as a result of differentiation – see below).

- Select: it’s evident from consultation with ICT academics that selection of publication outlets needs in future to be much more attuned to ERA requirements (i.e. ranked journals and conferences), noting the journal-only threshold. It should however be noted that it’s at present not clear how much weight was attached to varying kinds of performance, i.e. higher vs lower ranked outlets, ranking vs citations, conferences vs journal (other than meeting the threshold). For example, it’s at present impossible to counsel a colleague about the trade-off between pursuing A* vs. A ranked journals, in terms of chance of acceptance vs. ERA kudos. However, coarser trade-offs can be the subject of effective judgment, e.g. a C-ranked publication only detracts from a researcher’s standing. Other kinds of performance should not be neglected, e.g. competitive grants and industry contracts. Senior staff would do well also to pursue esteem measures such as prestigious fellowships and memberships of boards. The celebrated unsociability of ICT experts will need to be overcome.

What can universities do?

Universities have options other than to wind-down apparent poor ERA performers.

For the longer-term, a number of lines of development suggest themselves for attention in parallel with those that can be undertaken by individuals and research groups.

- Differentiate: in the light of possible significant levels of actual research capability among staff, it does not seem wise to maintain an even distribution of teaching load in some cases at relatively high-levels compared to some of the other more successful ERA disciplines.

- Invest:

  i. Differentiated workloads for staff on the basis of research capability represents a significant HR investment, and would well be matched by other kinds of investment in ICT research capability. In particular, the prevalence in the global market for PhD students of fee waivers and stipends indicates that any perception of (high-quality) PhD students as a significant source of revenue will have diminishing validity. Rather, PhD students should be thought of as relatively high ROI research personnel, in a sense as amplifiers of their supervisors’ capabilities. Needless to say, the more capable the supervisor, the more effective the amplification. Other more expensive HR investments could be considered (such as hiring research “stars”), but this writer is of the opinion that quality PhD students are the royal road to research productivity. Fee waivers and living stipends for top-quality PhD students should be greatly encouraged as a general rule across all disciplines.

  ii. For ICT specifically however, it’s well past time for (some) universities to stop treating ICT as a cash cow to be sent to the slaughterhouse once it’s stopped giving cream. During the ICT boom of the 1990s, universities as a while did very well from the overheads charged on ICT student income (government subsidies and mostly international fees), but during the following decade of downturn ICT organisational units
were drastically pruned proportionate to the drop in revenue. This makes for an interesting contrast with the treatment of some other disciplines the research capability of which was preserved by internal subsidies from universities until their enrolments problems corrected themselves.

**What can the ICT community do?**

ACS has the opportunity to work productively with other Australian ICT leadership groups (ACDICT, CORE) leadership groups both to improve ICT’s apparent position for 2012 and substantially for subsequent exercises.

For 2012, ACS should as a matter of urgency (see [http://www.arc.gov.au/era/era_2012/review_of_era10_ranked_outlet_lists.htm](http://www.arc.gov.au/era/era_2012/review_of_era10_ranked_outlet_lists.htm) for 21 March and 4 April deadlines for publication-related feedback):

A. lobby the ARC (if the opportunity arises, in collaboration with ACDICT and CORE) to remove the artefacts in the ERA process that militate against a fair reflection of the strength of Australian university ICT research, specifically:

i. in view that conferences are ranked by ERA and included in ICS discipline assessments, modify the “50 journal” assessment threshold to include conferences

ii. if citation analysis is to remain the major factor in assessing research output (publication) quality, adopt a citation service other than Scopus which does not have poor coverage of ICT

iii. journals and conferences that report on application of ICT research in other disciplines should be given multiple FoR-codes so that appropriate ICT research can be recorded under the ICS umbrella

iv. attribute outputs by NICTA-funded staff working at a university to the research productivity of that institution.

Beyond 2012, ACS would do well to

B. lobby the ARC (if the opportunity arises, in collaboration with ACDICT and CORE) to introduce greater transparency into ERA processes, especially the relative weightings attached by its panels to the various objects of evaluation

C. apply pressure to universities not to adopt hasty and punitive responses to the flawed assessment of ICT in ERA 2010 (and depending upon the outcome of A. above, possibly ERA 2012 as well)

D. maintain its support for the research sector of the Australian ICT scene.

(Regarding D., this it not to say that the current choice of research projects or patterns of research interest by Australian ICT academics should be give any kind of blanket endorsement by ACS – indeed, the question of what if any national ICT research themes are appropriate is a pressing
related question – but rather what’s needed in the context of the current ERA result for ICT is continued clear commitment by ACS to the broad endeavour.)

Conclusions
Some process such as ERA is inevitable at this stage in the development of Australian higher education policy; it may well not be the case that ERA will be a standing, let alone a permanent feature of the Australian higher education policy landscape. Coming as it does however when Australian university ICT is struggling to recover from a severe period of retrenchment, it’s essential that the misunderstandings of ICT research that it creates and perpetuates do not go unchallenged.

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