Tenth Annual Strategic Leaders Global Summit on Graduate Education

November 15-17, 2016
University of São Paulo
Brazil

What Is a Doctorate?

CGS acknowledges the generous support of our sponsor for the 2016 Strategic Leaders Global Summit:

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2016 Strategic Leaders Global Summit on Graduate Education: Timed Agenda

Tuesday, 15 November, 2016

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Wednesday, 16 November, 2016

Time	Details
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	Marco Antonio Zago, President, University of São Paulo **Suzanne T. Ortega**, President, Council of Graduate Schools **Carlos Gilberto Carlotti, Jr.**, Provost, Graduate Studies, University of São Paulo
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	Hans-Joachim Bungartz, Graduate Dean, Technical University of Munich
	Denise Cuthbert, Dean, School of Graduate Research, Royal Melbourne Institute of Technology University (RMIT)
	Susan Porter, Dean and Vice-Provost, Graduate and Postdoctoral Studies, University of British Columbia
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	Shireen Motala, Senior Director, Postgraduate School, University of Johannesburg
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	David G. Payne, Vice President and Chief Operating Officer, Educational Testing Service (ETS)
	Adham Ramadan, Dean of Graduate Studies, American University in Cairo
	Yaguang Wang, Executive Dean of the Graduate School, Shanghai Jiao Tong University
	Kate Wright, Dean of the Graduate Research School, University of Western Australia
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	Moderator: **Denise Cuthbert**, Dean, School of Graduate Research, Royal Melbourne Institute of Technology University
	Vahan Agopyan, Vice President, University of São Paulo
	Mee-Len Chye, Dean, Graduate School, The University of Hong Kong
	Richard (Dick) Strugnell, Pro Vice Chancellor, Graduate Research, University of Melbourne
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	Moderator: **Shireen Motala**, Senior Director, Postgraduate School, University of Johannesburg
	Jani Brouwer, Director, Doctoral College UC, Pontificia Universidad Catolica de Chile
	Karen Butler-Purry, Associate Provost for Graduate Studies, Texas A&M University
	Barbara Crow, Dean and AVP Graduate, Faculty of Graduate Studies, York University
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Thursday, 17 November, 2016

Time	Details
7:45	Assemble in Lobby of Sheraton São Paulo WTC Hotel
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	Moderator: **Susan Porter**, Dean and Vice-Provost, Graduate and Postdoctoral Studies, University of British Columbia
	Marie Audette, Associate Vice-President, Research and Innovation, Laval University; Past President, Canadian Association of Graduate Schools
	Alastair McEwan, Dean of the Graduate School, University of Queensland
	Christopher Sindt, Vice Provost, Graduate and Professional Studies, Saint Mary's College of California
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11:30–13:00	**Panel 6: How Do Doctoral Assessment & Career Tracking Influence Definitions of Doctoral Education?**
	Moderator: **Hans-Joachim Bungartz**, Graduate Dean, Technical University of Munich
	Philippe-Edwin Bélanger, Director, Graduate and Postdoctoral Studies, Université du Québec
	Luke Georghiou, Vice President, Research and Innovation, University of Manchester
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	Moderators: **Carlos Gilberto Carlotti, Jr.**, Provost, Graduate Studies, University of São Paulo, and **Suzanne T. Ortega**, President, Council of Graduate Schools
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Introduction

Welcome and Introduction

Suzanne T. Ortega
President
Council of Graduate Schools

On behalf of the Council of Graduate Schools (CGS), I am delighted to welcome you to the Tenth Annual Strategic Leaders Global Summit on Graduate Education. We are honored to co-host this year's event with the University of São Paulo (USP), an international CGS member that has participated in the Global Summit since 2011. I would like to express my gratitude to Professor Carlos Gilberto Carlotti and Professor Bernadette Franco for their leadership throughout the planning process, as well as to USP's Vice President, Vahan Agopyan, who first proposed the plan to hold this year's summit in Brazil.

As we begin, I would also like to give special thanks to Educational Testing Service (ETS) for its support of this year's event. ETS is in an excellent position to contribute to our conversation about the changing nature of doctoral education—as an employer of a great number of doctorate-degree holders, and as a global research organization that closely follows trends in graduate education worldwide.

The Strategic Leaders Global Summit: Ten Years and Counting
In 2006, CGS and the European University Association (EUA) held a transatlantic dialogue in Salzburg to discuss reforms in doctoral education. It was this meeting that led to the creation of the Strategic Leaders Global Summit, which expanded to include master's as well as doctoral education.

The first summit took place in Banff, Canada, in 2007, and established principles to guide future global collaboration among graduate deans and other university leaders. Since 2008, CGS has partnered with a diverse range of organizations and universities to organize summits on specific, pressing themes in graduate education: Research Ethics and Scholarly Integrity (2008); International Collaborations (2009); Measuring Quality (2010), co-hosted with the Australian Group of Eight and the Deans and Directors of Graduate Studies in Australia; Career Pathways for Graduate Students (2011), co-hosted with the University of Hong Kong (HKU); "Brain Circulation" and Global Careers, co-hosted with the Technical University of Munich (2012); Graduate Education and the Promises of Technology (2013), co-hosted with Central European University (CEU); Interdisciplinary Learning (2014), co-hosted with Memorial University of Newfoundland; and Big Data in Graduate Education (2015), co-hosted with the National University of Singapore (NUS).

A number of these theme-based summits have given special attention to doctoral education. In 2010, summit participants discussed a variety of international efforts to establish quality measures for the assessment of doctoral programs; in 2011, we heard about strategies that universities are using to prepare PhD holders for a broad range of careers beyond traditional academic pathways; and in 2014, we learned how interdisciplinary learning experiences are strengthening the preparation of doctoral students. This year, we will give these questions even more sustained attention, examining evolving definitions of the PhD and professional doctorates, as well as trends in admissions, mentoring, career preparation, and doctoral dissertations/theses.

Global Trends Reshaping the Doctorate

Recent years have seen a number of national and regional efforts to more clearly define the skills and knowledge associated with various degrees levels, including the doctorate. New degree "frameworks" in Australia, Canada, Europe and elsewhere are strategic efforts to satisfy the growing demand for workers who can lead the responsible creation and management of information in an increasingly knowledge-based economy. While no such doctoral-level framework currently exists in the U.S., CGS, with support from the Lumina Foundation, recently undertook a research effort to explore the potential value of expanding Lumina's Degree Qualifications Profile (DQP) to include transdisciplinary learning outcomes for doctoral education.

Degree frameworks are only the tip of the iceberg when it comes to trends reshaping the nature of doctoral education globally. An incomplete list of other changes would include: 1) growth in the number of "professional" or "clinical" doctorates, which raise questions about differences between these types of degrees and the PhD; 2) a growing demand on the part of students for broader career preparation and professional development; 3) changes in the structure of doctoral education, and in particular, a move toward a more streamlined, institutionalized doctoral training experience in many countries; 4) new efforts to better track the career outcomes of PhD holders, including CGS's project on Understanding PhD Career Pathways for Program Improvement; 5) changes in the way science and scholarship are funded and produced; and 6) changes in academic publication, which have led to the emergence of new formats for the dissertation, as we saw recently in a CGS workshop on The Future of the Dissertation. Undoubtedly, our summit discussions will uncover other forces of change that require thoughtful leadership from the graduate education community.

Looking Ahead

In our final session, we will work together to identify action steps that each of us can take to further the work of this summit when we return home. Such steps might include appointing a committee on one's campus to develop guidelines for learning outcomes assessment in PhD programs, or hosting a 3MT® (3-minute thesis) competition. It might mean joining other universities to launch a new research initiative geared toward solving a particular challenge in doctoral education. These action steps will, I hope, reflect the priorities of our varied national and institutional contexts, as well as some common themes of the meeting. CGS will publish the final document, along with your papers, on the CGS website and share it with our 500 member universities.

I look forward to sharing ideas with this diverse group of graduate education leaders as we examine the present reality of doctoral education and its many possible futures.

1: Current and Evolving Definitions of the Doctorate

Some Thoughts on Cooperative Elements in Doctorates

Hans-Joachim Bungartz
Graduate Dean
Technical University of Munich (Germany)

The need for collaboration

Universities of science and technology have played and are continuously playing important roles for the development of innovation and entrepreneurship as well as for finding solutions to the major societal challenges. The Technical University of Munich (TUM) as an example was founded by King Ludwig II (yes, the one with the castles …) in 1868 to support Bavaria's transition from an agricultural state to an industrial one. In a globalized world, societal challenges hardly ever follow state boundaries, disciplinary research fields, or university practice and regulations. Therefore, international, interdisciplinary, and inter-sectoral collaborations have become vital requirements for today's doctoral training. As societies become more complex, the diversity of doctoral candidates and pathways also needs to be taken into consideration. To keep up with these developments and to prepare their graduates for global careers inside and outside of academia, universities are introducing various models of collaborations in doctoral training. Three basic types of cooperative doctoral training at universities that are of particular relevance for TUM are briefly outlined in this paper: cooperative doctoral research with universities of applied sciences, with industry, and with international partners.

Universities and universities of applied science

Traditionally, the training of doctoral researchers and the conferment of doctoral degrees are among the most distinguished rights and responsibilities of research universities. In a recent official statement, the German Rectors' Conference says that universities of applied sciences (UAS) shall develop the application of science and use applied sciences to adopt a practical approach to teaching, while universities develop the sciences by a combination of research study, teaching and further education[1] – a statement which allows for interpretation. Actually, over the last years, in Germany as well as in other European countries, the popular and typically less research-oriented UAS have gained strength, reputation, and political support and, therefore, strive to develop research capabilities and secure additional funding, also for doctoral training. Hence, there is an ongoing controversial debate on this issue, with positions that reach from "keep everything as it is" up to "let the UAS confer doctoral degrees, too". Since education is up to the states in Germany, several models to deal with that issue have emerged recently. The state of Hesse, for example, decided to end the universities' monopole, however with strong requirements the UAS have to fulfil. In contrast to that, the state of Bavaria chose the option of cooperation, introducing so-called "cooperative doctorates" as well as a joint body of universities and UAS to form "cooperative research training groups" as underlying structure.

The core element of the cooperative Bavarian model is a pair of advisers – one from a university and one from a UAS. While most of everyday research will be done in the latter's

1 German Rectors' Conference (12 May 2015); Managing Cooperative Doctoral Degree Programmes; https://www.hrk.de/resolutions-publications/resolutions/resolution/convention/managing-cooperative-doctoral-degree-programmes/

group and lab, additional scientific advice will also come from the first. This supports outstanding graduates from UAS in going for a doctorate; it reflects the fact that there are research-oriented professors at these institutions, too, and gives them full rights to supervise, review, and examine doctoral candidates and their work, respectively; it avoids the need to duplicate costly structures such as graduate schools; and it strengthens the position of the universities, since the right to confer doctoral degrees remains with them. Already before this institutionalization and even more now, TUM actively uses this option of a cooperative doctorate, with currently 140 respective doctoral projects running.

Collaboration with industry

Probably more than in other regions of the world, in Europe the vast majority of doctoral candidates, especially at technical universities (TU) such as TUM, will not pursue an academic career, but rather go to industry or other non-academic sectors. Nowadays, TU are developing innovative approaches to doctoral training that combine acquiring sound research competences with interdisciplinary and transferable skills training to enable doctoral candidates to become independent thinkers, responsible researchers, and leaders in their future profession – inside or outside academia. Besides career perspectives for the graduates, close collaboration with industry and external actors are also fruitful to bridge the gap between fundamental research and applications, to foster technology transfer, and to address the grand societal challenges. Therefore, doctoral projects in collaboration with industry have a long tradition in Germany – with models ranging from a mere industry funding up to doctoral projects in companies. While such a collaboration does have a lot of chances, issues such as independence of research, sovereignty of the university over topics and processes, no restrictions concerning publications, or quality assurance have to be addressed. If a proper balance is found, the potential reciprocal benefits are enormous.

International collaboration

"Internationality" is probably one of the most discussed but least controversial issues in doctoral training, since no country and no university can master the challenges of a globalized world on its own. TUM's internationalization strategy focuses on attracting the best talents to our university as well as on preparing our students and researchers for their future global careers in the best possible way. For the TUM Graduate School (TUM-GS), this means five main dimensions of international collaboration: (1) short- and medium-term PhD stays abroad, (2) joint summer/winter schools; (3) individual joint PhD degrees; (4) university-wide joint PhD supervision programs ; (5) funding of joint research projects.

Every PhD candidate can access central funds to go abroad for conference visits or research stays at a partner lab. On top of this, we support faculty to organize joint summer/winter schools for the doctoral candidates to explore possible research collaboration. In close cooperation with the TUM International Center, we prepare university-wide exchange agreements to foster doctoral mobility. Concerning the hot topic "joint degrees", our strategy is to focus on an "extended joint supervision" model: joint supervision, a significant time spent at the partner university, but just one degree conferred by the home university only. This approach has been very successful for us since 2011 with Nanyang Technological University (NTU) in Singapore.

At the strategic level, TUM has joined both the EuroTech and the GlobalTech University Alliances to share best practices and to foster research cooperation, networking, and researcher mobility, e.g. through multi-national funding schemes such as the EU programs.

Needless to say that internationalization as it is promoted by universities is not something that fits into every doctoral research agenda or personal life situation; but also needless to say that those who choose that option as part of their doctoral life benefit a lot.

Graduate Schools should strengthen the academic environment, enabling doctoral candidates to focus on the very core of their work: research. Research needs freedom, time, discussions, and it must allow for side routes and failure. Universities should develop a culture where individual performance, teamwork, interdisciplinarity, and international exchange complement each other in a synergistic way.

The Drive for Impact, Innovation, Accountability (and Possibly Sustainability): The "outward-facing PhD" in Australian higher education

Denise Cuthbert
Dean, School of Graduate Research
RMIT University Melbourne (Australia)

Introduction and overview
In the Australian HE sector, the most striking development in the modality – if not the definition – of the PhD in the last decade has been its progressively external orientation. This is accompanied by a growing if uneven conceptualisation of the PhD as more than merely the nursery of the academy, but as a key driver of innovation and economic growth. Outward-facing modality takes at least two forms, with signs of a third form which combines the first two emerging.

This development has a range of drivers which in turn arise from several fields: these include, the increased sophistication of the internationalisation agenda of HE from its mobility and coursework recruitment origins towards research; the hegemony of global rankings with their emphasis on research drivers; knowledge economy imperatives (ubiquitous among governments and funding agencies); and well-worn but growing accountability imperatives calling for returns on investment in doctoral education for the economy at large and diverse career trajectories for graduates. A further driver is increased competition for talent, whereby the partnered PhD offers a model for sharing the market as distinct from growing market share. An attempt is made to classify these drivers below.

Modes of external facing PhDs
The first mode of externality comprises several variations on the industry-engaged PhD in which industry engagement may occur along a continuum which includes doctoral candidates being fully or partly funded by an industry partner and spending significant periods of time embedded in the industry setting; candidates working on an industry problem within the university with some supervision by an industry partner, and candidates accessing discrete industry experience through internships either during or in the final stages of candidature. This development is currently receiving further impetus through Australian government initiatives related to that national innovation agenda (NISA, 2015) and arising from two recent reviews into research training in Australia and the funding of research and research training through research block grants (ACOLA, 2015; Commonwealth of Australia, 2015a, 2015b).

The second form of this outward-facing PhD modality sees increasing numbers of Australian universities engaging in collaboration with other HE institutions in the delivery of the PhD. Predominantly this collaboration is international, although there are instances of joint doctoral delivery between Australian universities. This has been a somewhat messy field of endeavour in term of definitions with a plethora of terms and definitions at play – joint and double-badged, split site, sandwich, and co-tutelle.

More recently, several Australian institutions – most notably Macquarie University in Sydney – have settled and streamlined these models in operation. In the case of Macquarie, the model

and its variants are encompassed under the rubric of the co-tutelle PhD. In my own university, the messy definitional space has been streamlined under the rubric of Collaborative Research Training Agreements (CRTAs), with the dominant models being co-tutelle (where the partnership is with another PhD awarding institution) and the partnered PhD (where the partnership is with a non-PhD awarding institution, such as the German and Austrian Fachhochschulen which have research capacities but are legislatively constrained from offering doctorates). The third emergent form of this outward orientation is the combination of industry engagement with internationalisation. That is, the quest to leverage international industrial research training opportunities from collaborative research training programs. And, vice versa: the quest to embed research training opportunities in international industry partnerships. Apart from noting this development as a space to watch, I will not spend time on it in this brief paper.

Understanding the drivers of the outward-facing PhD

I am less concerned in this paper with looking closely at the forms taken by what I am calling the outward facing PhD in Australian HE, but rather to understand some of the drivers of this development. As briefly indicated above, the drivers emerge from several fields and may be usefully classified as relating to impact, innovation and accountability.

Impact: Aspirations for high impact research drive both international PhD partnerships and industry PhDs in slightly different ways. For the former, it is largely the now received knowledge of the impact of international co-authorship on citation rates (and in turn their impact on rankings) which is a key incentive to build doctoral delivery through international collaboration agreements into research partnerships. Producing graduates with international outlook and global research experience is also a consideration.

The desire for high impact research is also a driver of industry-engaged doctoral education, with PhDs being designed to yield deliverables beyond the standard scholarly outputs – patents, improved industrial/business process and techniques, impact on policy, governance and professional practice. This driver has been boosted in HE sectors with research quality audit exercises, such as the UK and Australia, which seek to include measures of research impact within their scopes.

Innovation: The aspirations for innovation arising from PhD research is now a central desideratum in the policy platforms of many national governments. By aligning the research of PhD candidates more closely with the needs of end-users, and equipping PhD candidates with a range of industry-related skills and literacies, both the governments and agencies funding PhDs and the universities delivering them hope to unleash innovation alchemy.

Accountability: Closely related to the first two drivers and also with a long history in the relationship between universities and their funding masters is the issue of accountability. This includes accountability for the return on investment in doctoral education by the state and by individual scholars which is to be measured in non-academic terms – innovation, economic and/or social benefit, career trajectories of graduates, and the relevance or utility of the PhD to the world beyond the university. The accountability driver appears biased towards non-scholarly outcomes of the PhD for which external modalities are both a measure and a proxy.

Other considerations and concluding remarks

This attempted taxonomy of drivers of the external facing PhD does not capture all drivers; rather it tends to speak to those drivers imposed on universities by the policy landscape in

which they operate.

There may be a further driver for both the industry-engaged and internationally collaborative PhD and this is sustainability. By sustainability, I primarily refer to the capacity of universities to secure streams of talented candidates for their PhD programs on which both the research and education eco-systems of our universities rely. The outward facing PhD allows us to "share the market" internationally, each talented student in a joint program can drive the research agenda of more than one university, with all the benefits which that brings. Industry-engaged PhDs allow universities to tap a another source of candidates – high performing professionals who bring to the university industry savvy and industry problems to be put through the PhD process.

Sustainability in other regards, also, recommends this approach to doctoral education. The outward facing PhD has the capacity to garner talent and support from a variety of sources, places collaboration to the point of co-production at the heart of the endeavour, and possibly also offers a further anti-dote to brain-drain beyond brain-circulation – brain sharing. This final potential offers a more sustainable way for universities in the global North to interact with those in the South.

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The Protean PhD

Susan Porter
Dean and Vice-Provost, Graduate & Postdoctoral Studies
University of British Columbia (Canada)

> *[The research university] should prepare for the service of society a class of students who will be wise, thoughtful, and progressive guides in whatever department of work or thought they may be engaged. Universities easily fall into ruts. Almost every epoch requires a fresh start.*

Daniel Coit Gilman, who spoke these words at his inaugural address as the first President of Johns Hopkins University in 1876, played a pivotal role in the revolutionization of higher education in the U.S. through his adoption and adaptation of the concept of the German graduate school to the American context. Gilman realized the necessity of scholarly inquiry (rather than reliance on received wisdom) for the advancement of society, and appreciated the critical importance of the Humboldtian ideals of academic freedom and the interdependence of scientific investigation and teaching. But he warned of the dangers of narrow technical specialization and the risk of developing graduates who had no understanding or connection to the society for which they were to be 'wise, thoughtful, and progressive guides'.

Gilman was the first to regularize PhD requirements in North America, and much of what he devised stands to this day. This includes the completion and examination of a thesis, under the auspices of a faculty adviser, on a subject that is sufficiently broad to 'require prolonged and arduous study' (although 'prolonged' in 1876 was 'the greater part of an academic year'). He believed that educational endeavours need to be relevant to the particulars of the society in which they are situated, and thereby rejected some aspects of the German model. He has been described as the originator of the 'protean PhD', that is, one that resembles Proteus, the Greek sea-god who is able to change into many different forms, is adaptable and versatile.

The PhD has indeed been an evolving entity. The basic intent of the degree – to generate new knowledge and to develop individuals who use the power of scholarly inquiry to advance society – has arguably been constant, but the forms and specific purposes have varied by era, by discipline, and (for better or worse) by the culture and political climates of the societies the academy serves.

In recent years, the issues that have caught the academy's imagination and led many to engage in 'fresh starts' of thinking about the doctorate include changing forms of scholarly work and communication, globalization, evolving national economic drivers, shifting public and academic viewpoints on the role of the university in society, and the challenges and opportunities relating to an increasingly smaller academic job market relative to the number of graduates. Most of these are not new to our age. A flurry of projects in the 1970's and 1980's, for example, were established to respond to the 'crisis' in doctoral education, brought on in part by a perception that the academy, and graduate education, had lost its way with regards to the institution's original intent to be relevant to and in service to society. There was also a constricted academic job market, forcing graduates to look elsewhere for careers, and enrolment numbers and purposes of the doctorate were questioned. Many of

the recommendations of the time did not take root, although the seminal work by Ernest Boyer and others in articulating a more generous notion of scholarship did slowly come to be accepted in some of the academic world. For graduate education in particular, Boyer echoed Daniel Gilman in his warning that 'the real danger is that graduate students will become specialists without perspective, that they will have technical competence but lack larger insights', and urged a creative redefining of what it means to be a scholar.

Boyer's warning continues to resonate with many today, in light of a renewed interest in the university's role in the public sphere, and the increasing diversity of actual and potential doctoral career pathways. In response to the latter, there has been much world-wide interest and exploration of the preparedness of PhD graduates for work in non-academic contexts over the last two decades. Very broadly, employers have been found to appreciate doctoral holders' abilities in critical thinking, but express common concerns including a lack of ability of graduates to work productively in teams, to communicate in various settings, and to appreciate the values and imperatives of different contexts. The narrowness of doctoral research and training and its disconnect from real-world problems has often been critiqued.

One response to these issues has been to itemize the 'transferable skills' graduates lack, and to introduce programming during graduate education to help ensure they are gained. We have argued that although such courses and workshops can be useful, they have significant limitations. These limitations relate to the dissociation of the activities from students' primary intellectual development (generally oriented to the professorial vocation), and their minimal contribution to students' broader identities and development as 'scholar-professionals'.

To address this problem, a more integrative approach that we and others are exploring is a broadened conception of the core work of the student, the dissertation. We affirm Boyer's notion of the legitimacy of alternative forms of scholarship (that of teaching and learning, application, and integration, in addition to the traditional discovery form), and their importance for the vitality of the academy and its relevance to society. We also know that many students (and faculty) desire to connect their scholarship to a larger context and sense of purpose. Accordingly, we have launched the Public Scholars Initiative (PSI), an experimental, cross-campus, program that encourages and supports PhD students (financially and academically) interested in explicitly linking their doctoral work to an arena of public benefit, and integrating more career-relevant scholarship into their dissertation. We prioritize those students with collaborative partners in the public and private sectors (including higher education teaching) who are undertaking research of mutual interest to the university and partner. Students are encouraged to include mentors on their committees able to support and evaluate the work, and to incorporate into their dissertation relevant scholarly artifacts (e.g., policy papers, films, exhibition material, websites, etc.) with a scholarly exegesis of the material if appropriate. Initial feedback on the program from students, faculty, and community partners has been overwhelmingly positive, and two students have successfully defended their dissertation thus far.

Projects supported by the PSI include an English student's collaborative work to create and assess a computer program to enhance writing skills; a Psychology student's collaboration with the U.S. White House and two private companies to explore ways to improve job satisfaction and employee engagement; and a Botany student's work with our provincial government to devise a new, much needed, protocol for monitoring at-risk plant species in the province. All of these projects are integrated with the students' primary research focus,

and will be incorporated into their dissertations. The types of scholarship PSI students are undertaking are generally highly interdisciplinary, and span all of Boyer's domains. Some of these forms are normative in some disciplines, but for some disciplines they are completely foreign, and the concept has not always been welcomed by faculty. One of the greatest barriers to a broader acceptance and interest relates to the apprenticeship paradigm in the sciences, where students' entire focus is traditionally on their supervisors' (discovery) projects. By demonstrating the feasibility and benefits of students gaining some exposure to broader, more applied or publicly engaged approaches, and by highlighting the extraordinary accomplishments of our PSI scholars, we hope to encourage an opening of the conversation about the purposes and potential forms of the PhD.

Alongside this initiative, we are working to clarify the evaluation criteria of alternative forms of scholarship, and are embarking on a broader, national project (sponsored by the Canadian Association for Graduate Studies) to explore the current thinking on the dissertation and to make recommendations on its scope, content, assessment, and purpose.

Daniel Gilman had a grand vision for the mission of the research university that included 'a reaching out for a better state of society'. His 'protean PhD' reached out for a better state of 19th century America. May we heed his exhortation to think afresh about the right forms of the degree for the current day.

Changing Times in Doctoral Education

Mark J. T. Smith
Dean, Graduate School
Purdue University (United States)

The convergence of globalization, the emergence of the knowledge society and the accelerating growth in technology are driving many of the discussions about the future evolution of higher education [1]. As society advances, higher education must naturally keep pace, not just in content, but in pedagogy, providing flexibility, providing appropriate credentialing, and offering a breadth of degree offerings to meet workforce needs. Advanced degree education in particular must recognize that the systems and enterprises that fuel our economy are more sophisticated now than ever before, typically requiring employees to be collaborative and proficient in research/development that is often interdisciplinary in nature.

Keeping pace with change is not a new conversation in the higher education community. Observations and changes in doctoral education have been considered in many circles for several decades [2], [3]. In fact, a study was launched in 1995 by the National Academies Committee on Science, Engineering and Public Policy, resulting in the published report, titled *Reshaping the Graduate Education of Scientists and Engineers* [4]. In their deliberations, the committee members considered typical career paths for scientists and engineers, how those paths have changed, how graduate students can prepare for alternative careers outside of research, and whether universities are producing too many PhDs. Interestingly, we are continuing to wrestle with these same questions today, more than twenty years later.

In this short article, a number of trends and observations are highlighted that, in the opinion of the author, should not be overlooked as revisions to doctoral and PhD programs are considered. Many of the observations expressed in this article reflect a science, technology, engineering, mathematics (STEM) perspective, but most are relevant to many non-STEM fields as well.

Trends and Observations

The time constant of relevant skills is decreasing. There was a time not too long ago when graduates could rely on the skills and knowledge learned in college to serve them in the workforce indefinitely. Now, in many disciplines, what you learn in college may be obsolete in several years. For this reason, many professional organizations and societies require their members to take continuing education and professional development courses on an annual basis [5]. As the volume of knowledge and system complexities increase, the time to obsolescence decreases. This suggests that those holding advanced degrees should be trained to be self-learners, equipped with the ability to transition from one area of expertise to another, and doctoral education should include adaptive learning skills.

Supply and demand are not in balance. In many disciplines including STEM fields and the humanities, the job of choice for PhD graduates is often a tenure-track faculty position. Many graduates, however, are not able to find faculty positions because there are not enough openings. Consequently, some take employment as a post doc and others find employment in industry, in government, or working in the non-profit sector [6]. Thus, it is important that

universities prepare doctoral graduates to be successful in a variety of different job positions. While this is common in some fields (e.g. many engineering fields), it is not currently practiced uniformly throughout the academy.

Collaborative research is on the rise. The complex nature of today's industry projects and grand challenge problems often requires engineers and scientists to work in teams. This trend is not restricted to STEM fields. Evidence of increasing collaboration can be seen locally on campuses by the increasing number of grant proposals that include multiple principle investigators. Co-authorship of publications, another indicator of this trend, has been increasing significantly and can be expected to continue [7]. Thus, doctoral degree programs should appropriately consider equipping their graduates with skills and experiences to prepare them to be effective collaborators. In some fields, dissertations are allowed to include collaborative research, with proper attribution given to the various contributors. But this flexibility is not present uniformly in the academy.

Interest in professional and specialized doctorates is increasing. While definitions may vary somewhat, particularly on the international stage, the PhD is largely regarded as a research degree where recipients of that degree are expected to make original contributions to the field that are recognized as significant by peers. Professional doctorates, on the other hand, tend to be more focused on mastery of knowledge or skills. The growth in doctoral degrees has been observed on a global scale [8], [9], but this growth can also be observed by examining the number of new advanced degree requests approved by U.S. regional accreditation agencies. To probe further, we examined requests approved over the last five years by the Higher Learning Commission (HLC), one of the six regional accreditors for higher education institutions in the United States. In 2010, HLC approved seven doctoral programs. Five years later in 2015, HLC approved 31.

In additional to the numbers, the variety of doctorates appear to be expanding. PhDs account for most of the doctoral degrees in the U.S. [9], with the Doctor of Education degree (Ed.D.) taking the number two position. The HLC data show significant growth in Ed.D.s, many of which are accompanied by disciplinary qualifiers. Examples include Ed.D. in Interdisciplinary Leadership, Ed.D. in Transformative Learning in the Global Community, and Ed.D. in Health Professions Education. We are also seeing on the HLC approval list many other specialized doctorates that are not Ed.D.s, such as the Doctor of Information Technology, Doctor of Educational Technology, and Doctor of Science in Cyber Security, presumably reflecting a perceived demand for these degrees by the institutions seeking approval.

Another trend worthy of mention is the increasing expectation that PhD research be made available broadly (open access). The National Institutes of Health (NIH) Public Access Policy, for example, now requires that all investigators funded by NIH submit their final peer-reviewed papers in electronic form to the National Library of Medicine's PubMed Central, to be made publicly available no later than 12 months after the date of journal publication [10]. The National Science Foundation (NSF) has a similar policy [11].

Related to this trend is the increased expectation that research results should be communicated to the public. The National Science Foundation (NSF), for example, now requires investigators to submit a Project Outcomes Report—a 200-800 word summary describing the project results in layman's language to help the public better understand the work that

has been supported, its intellectual merit, and its broader impacts [12]. This would suggest that the ability to communicate to the public the specialized contributions made in a dissertation should be part of the PhD program. We are seeing signs that this is already occurring, a case in point being the Three Minute Thesis competition, with is rapidly gaining popularity throughout the world.

While these patterns may not be observed uniformly in all disciplines, they are worth considering in the general discussions about future doctoral programs.

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Gatekeeping or Innovation: The Professional Doctorate in South Africa

Shireen Motala
Senior Director, Postgraduate School
University of Johannesburg (South Africa)

In South Africa there has been an increased interest in the professional doctorate after the revised Higher Education Sub framework clearly articulated this qualification in 2013. In this framework there is the professional doctorate (designated as D followed by the discipline e.g. DBA, DCom or DEd) and the doctoral degree (designated as a PhD, DPhil or Dlitt). However, it is important to first understand the context in which this articulation is formatted. The concept of a professional doctorate has been around for some time in South Africa. However, it has never been clearly differentiated until the 2013 articulation.

The DTech offered in South Africa until very recently was differentiated primarily by the institution that offered it. DTechs were offered by Universities of Technology and in comprehensive universities in some disciplines. The DTech was also a research based degree although the research problem was mostly derived from a practice based problem. Unfortunately, the DTech had a reputation as a 'lesser' degree and this degree is currently being phased out and alternative doctoral degrees such as the PhD are being offered. The use of a Doctorate as a designator has been used to imply a doctorate that is more applied in nature than a PhD or a DPhil but this is not true of all cases. The DEd, DCom and DBA/ DBL are also well established but these degrees very seldom differed from any other research based degree. The DEng, in the case of the University of Pretoria, is a well-established doctorate that is awarded on the basis of publications as opposed to a traditional thesis but is still a research based qualification. In many ways the history of a professional doctorate in South Africa has been complex and little understood, and as such the context in which universities are looking at professional doctorates is already murky.

Global shifts in discourses on higher education with focus on the knowledge economy and "education for development" have also informed our postgraduate strategy in SA. It is widely accepted that a strong human capital foundation is the bedrock for robust economic growth and social development. As a response, SA has very challenging postgraduate and in particular for Doctoral targets (5500 pa by 2035 as opposed to the current scenario of around 2051), but there are many concerns about how realistic these expectations are.

Massification in postgraduate qualifications has significant capacity implications, particularly in terms of supervision. The state has steered funding according to a differentiation model, however access and articulation across different pathways in postgraduate studies have proved complex in implementation. This lack of technical knowledge has prevented the absorption of labour into a more diversified growth path. Tertiary enrolments have doubled since 1994, however there are a low number of SET graduates (4-6% SET). There is an active debate on doctorateness, and the ability of universities to be responsive to new labour market needs and demands, with the call for improved industry linkages getting louder. The question is being asked is if an increase in doctorates by PhD in research the only way – or even the most appropriate way? The CHE in particular is very active in this regard. The need of the knowledge economy drives the pedagogic imperative to provide doctorates that are

enabled to actively participate in the economy in other ways than a typically research doctoral graduate.

At the same time South African universities are undergoing public scrutiny, assessment and reduced funding, which challenges their very core purpose. The importance of research and research training remain very much at the forefront of the higher education agenda and in postgraduate studies issues to do with quality supervision, timely completions, high quality publications, and increasing knowledge management and production are issues that continue to challenge administrators, academics, policy makers and postgraduate students. These transitions and transformations are evolving and impacting upon higher education governance, postgraduate research, research development and dissemination, research leadership and the academic lifestyle. The recent growth in the number of doctoral enrolments and graduation has strained the capacity of universities as clearly shown at the University of Johannesburg and it this is a key driver in the current process to consider alternatives in the forms of supervision models as well as in the nature of doctoral degrees being offered. A Professional doctorate is an attractive option as it significantly reduces the demand on supervisory capacity and, as students can be situated in their professional environments, it also reduces the demand on the universities physical infrastructure.

The funding model for higher degrees is also an area of concern as the South African model privileges the research aspects of a qualification and a professional master's degree attracts significantly lower subsidies than a full research master's degree. Of course, the supervisory load of a professional doctorate could be significantly lower than a traditional doctorate and the output of such degrees could be higher as a result of the cohort model. Yet this argument is seen as another problematic aspect as it is seen as an example of how an increasingly materialistic higher education is "lowering standards". The fact is that most academics in South Africa are products of traditional doctoral programmes and as gatekeepers to this level of achievement they have a very strong role in the establishment or not of professional doctoral programs.

Another aspect that influence the potential development of professional doctorates is the demographics of the academic body in South Africa. Most academics with doctorates that are based on pure academic research and function in a predominantly academic environment. As such they see the role of a doctorate as a process that, among others, serves to enculturate the student into a community of practice. And the community of practice, as understood in South Africa is fundamentally a research community despite the fact that many doctoral graduates enter the NGO sectoral and industry (Assaf, 2010). In an environment where creation and advancement of knowledge through research has been seen as the ideal and rewarded it is difficult for academics to see a professional doctorate as equal to its traditional form. A doctorate is not seen to be something that has practical aims and objectives according to the traditional values of the South African academic community and there are concerns about adopting the values of the knowledge economy (Herman, 2012).

In addition to the concern about equality or equivalence as described by McSherry et al. (2014), the major concern from the academic community is about quality. Quality in a traditional research degree can be 'inspected in' through the assessment of the final research thesis or articles. However, in the case of the professional doctorate the quality assurance has to be built into the process and how this can be done is not always clear to the academics involved with the design of professional doctorates.

But there is another perspective as well- that is the perspective from the professional community. The professional bachelor's degree is a four year degree compared to the normal 3 year degree and articulates at SAQA NQF level 8 as opposed to the NQF level 7 of the three year degree. A student with a professional bachelor's degree can register as a professional (e.g. BEng) and can articulate directly into a master's degree but a normal bachelor's degree has to be followed with the South African Honours degree that is a one year degree that has both coursework and a research component. The traditional fields for professional qualifications would be Law, Engineering, Architecture, Accountancy and Health, but the fields that are considered to be professional have expanded over the years to include Psychology, Social Work, Education, Human Resource Management, Journalism and others. The duration of study required for professional registration also varies with some requiring PG qualification at Master's level (e.g. for clinical psychologists) and this is would be determined by the professional board governing the field.

The idea of a professional master's is therefore also established through the Master's degree needed for professional registration, the MBA/MBL and the Master's degree in Engineering management. However, these Master's degrees have never been defined a professional degrees and it is only after the re-articulation of the Higher Education Sub-framework of the NQF in 2013 that a clear professional Master's degree has been defined. Some of the MBAs have been articulated as professional degrees and others are being considered but this is still in progress. One of the main concerns is that a professional Master's degree attracts less subsidy than the coursework Master's degrees that these degrees were previously framed as. And a coursework Master's degree attracts significantly less subsidy than a research Master's degree.

The development of programmes and qualifications at UJ, as at any other SA university, have to be in line with the HEQSF and the requirements of professional bodies (some statutory and some market related). This is already a concern around some of the professional bachelor's degrees. Unfortunately, in many new fields that are aspiring to 'professional' status, one finds a number of competing boards or councils and this gives an indication that the profession is not yet mature or settled. So professionalization of fields in the economy is an ongoing process. Even in established fields such as the construction industry, there are conflicting understandings between national and international bodies. Many of these bodies does not recognise a Master's degree as an entry into the profession and has therefore not articulated any requirements. In the case of professional doctorates this will be an even more significant challenge to articulate the 'professional' aspect of the degree in disciplines that have conflicting requirements.

However, within this context the opportunity to develop and offer professional doctorates that are clearly differentiated has clear benefits, both form the institutional perspective and the perspective of industry and the knowledge community within South Africa. At the University of Johannesburg, the Postgraduate School is looking forward to being an active participant in the national and institutional debate and in contributing to the development and delivery of professional doctorates.

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The Doctorate as the Engine for the Research University or National Workforce?

Andrew T. S. Wee and Brenda S.A. Yeoh
Vice-Provost, Graduate Education
National University of Singapore

Introduction

A **doctorate** (Latin docere, "to teach") or **doctoral degree** (licentia docendi) is "an academic degree awarded by universities that, in most countries, qualifies the holder to teach at the university level in the degree's field, or to work in a specific profession".[1] In the higher education landscape today, leading universities aspire to be a "doctoral/research university", a category that the Carnegie Classification of Institutions of Higher Education uses to indicate universities in the United States that engage in extensive research activity, as measured by research expenditures, number of research doctorates awarded, number of research-focused faculty, and other factors.[2] Whether explicitly stated or not, an important mission of the doctoral/research university is to generate world-class research and produce doctoral students by research. What is sometimes neglected today is the second definition of the doctorate, involving training for a specific profession. This paper describes the tension between the doctorate as the engine of the research university, and the doctorate as training for specific professions to meet national workforce requirements. We use the case study of Singapore, a small country with a population of 5.6 million and two research universities, to discuss this globally relevant issue.

Singapore Case Study

Singapore has steadily increased public funding in research and innovation since the first five-year National Technology Plan (S$2 billion) was announced in 1991. Over the next twenty five years, this investment has expanded to the current S$19 billion *Research, Innovation and Enterprise 2020 Plan* (RIE2020), amounting to one per cent of the nation's Gross Domestic Product (GDP) (Table 1).

Plan	National Technology Plan 1995	National Science & Technology Plan 2000	Science & Technology 2005 Plan	Science & Technology 2010 Plan	Research, Innovation and Enterprise 2015 Plan	Research, Innovation and Enterprise 2020 Plan
Budget	$2 billion	$4 billion	$6 billion	$13.5 billion	$16 billion	$19 billion

Table 1. Singapore's public investment in research and innovation over six 5-year plans.[3]

This strong public investment in research has led to the growth in the number of Researchers in R&D (per million people) in Singapore from 4,245 in 2000 to 6,307 in 2010.[4] The quality of research from Singapore has also improved, and is ranked well above the world average

1 https://en.wikipedia.org/wiki/Doctorate
2 http://carnegieclassifications.iu.edu/
3 RIE 2020 Plan, National Research Foundation, Singapore: http://www.nrf.gov.sg/rie2020
4 United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics: http://data.worldbank.org/indicator/SP.POP.SCIE.RD.P6

with an average Field-Weighted Citation Impact of 1.76[5] for the period 2011-2015 (Figure 1). Figure 1 also shows that the top three publication fields are in Engineering, Medicine and Computer Science, reflecting the strong emphasis on science and technology R&D in Singapore.

Recently, as Singapore matures as a nation and confronts increasingly complex challenges arising from sharpened social disparities, rapid ageing, increasingly differentiated social expectations and pathways, changing social norms and sense of identity in the context of heightened global interconnectedness, the state has turned attention to strengthening Social Science research with a view to contributing "fresh perspectives and new approaches to public policy".[6] A Social Science Research Council was formed in 2015 with funding amounting to S$350 million over five years to develop talent and capabilities in this sphere. It is also expected that social science research "can also strengthen our economy and create new niches for growth and professional development".[7]

The number of PhDs graduating from universities in Singapore has continued to increase over the years, reaching 7,522 in 2011 to 7,850 in 2015. These PhD students form the main manpower resource that has driven the meteoric rise of Singapore's largest two research universities, namely the National University of Singapore (NUS) and Nanyang Technological University (NTU). The question that Singapore policy makers are now asking is whether this rise in supply of PhD graduates matches its workforce manpower demands.

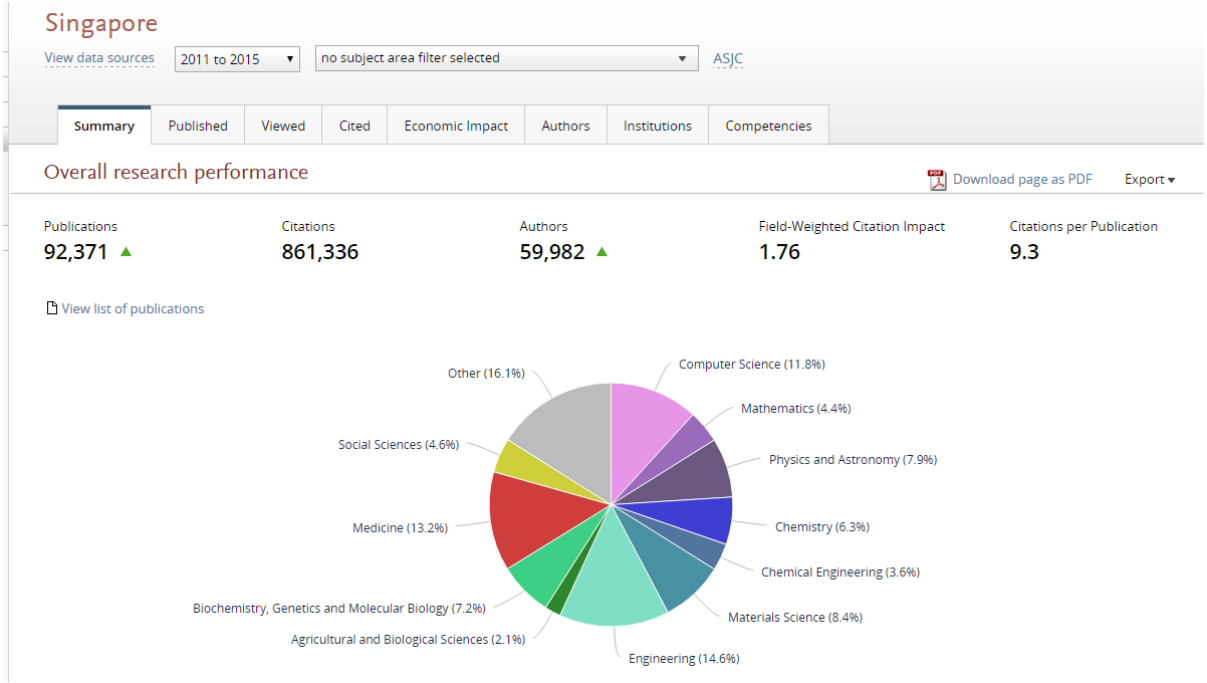

Figure 1. Singapore research performance (2011-2015) – publications, citations, authors, Field-Weighted Citation Impact, and citations per publication (screenshot from *Elsevier SciVal* database search).

5 A Field-Weighted Citation Impact of 1.00 indicates that the publications have been cited at world average for similar publications.
6 Speech by Mr Tharman Shanmugaratnam, Deputy Prime Minister and Minister for Finance, at The Ngee Ann Kongsi 170th Anniversary and SG50 Celebration Dinner, 11 March 2015.
7 Ibid.

Alignment of Research Manpower to Areas of National Priority

Based on RIE2020 industry focus group discussions, there is feedback on the lack of demand for PhD graduates in some industry clusters such as the biomedical sciences. As a result, universities in Singapore (probably globally as well) are facing the following challenges in the doctorate landscape:

- Reduction in government (Ministry of Education) funding for PhD research scholarships.
- The need to re-allocate PhD scholarships between different disciplinary fields to match industry demand. In RIE2020, there is a projected need to increase the number of Computer and Information Sciences PhDs to meet the needs of the *Smart Nation* initiative.[8] There are also proposals to pilot new Engineering Doctorate degrees for the Electronics and Marine & Offshore sectors.
- Enhancing the PhD education programme to improve employment outcomes, e.g. with appropriate transferable and quantitative skills courses, as well as internship opportunities.
- Developing professional doctorate programmes that are more aligned to industry needs. For example, NUS currently offers 2 doctorate degrees by coursework: Doctor of Pharmacy (PharmD),[9] and Duke-NUS Medical School's Doctor of Medicine (MD).[10] The Economic Development Board (EDB) also funds the Industrial Postgraduate Programme (IPP), a 4-year full-time doctoral programme leading to a thesis based on research conducted in partnership with companies.[11]

Future Strategies for the Research University

Research universities need high quality manpower to drive its ambitious research programmes; at the same time, the above challenges have exerted downward pressure on the absolute number of PhD research students. Furthermore, the shift from basic academic research to industry-related and policy-relevant projects may serve to dilute the focus on research excellence. In this changing academic environment, the research university will need to creatively explore new strategies to be relevant to national priorities as well as continue in its mission to pursue research excellence. The following are some strategies that are being considered:

- Sourcing for new external funding for PhD research scholarships, through research grants, contracts or endowment.
- Improving the quality of PhD students by raising admission standards, promoting PhD programmes to top local students, and diversifying the source of top international students. Improving the prospects of post-graduation employment in Singapore will also have a positive impact on students' decision when considering doctorate studies.
- Diversifying the research manpower needed to drive the university's research programmes in the light of a reduction in the number of PhD students, e.g. by increasing the number of Masters students, research assistants, and postdoctoral researchers.
- Developing joint PhD programmes with strategic international partners to leverage on the strengths of two (or more) institutions and expose students to cross-cultural contexts to enhance cultural learning and social networks, e.g. NUS-KCL Joint PhD Programme.

8 http://www.smartnation.sg/
9 http://www.pharmacy.nus.edu.sg/programmes/PharmD/
10 https://duke-nus.edu.sg/education/md-programme
11 http://www.gse.nus.edu.sg/ipp.html

2: Doctoral Admissions and Recruitment: Assessing Readiness to Pursue Doctoral Study

Using Transparent, Mission-based Holistic File Review to Enroll a Diverse Student Body

David G. Payne
Vice President and COO, Global Education
Educational Testing Service

When determining student readiness to pursue doctoral study, how can graduate schools enroll and graduate a diverse student body? What's the best method of evaluating the qualities needed to succeed academically while improving the number of doctorates that reflect the profound diversity of today's global village?

According to the Council of Graduate Schools (CGS) recent report, "Holistic Review in Graduate Admissions," "… decision-making at all levels of the university is becoming increasingly data-driven. To ensure that they are investing in the best students for a particular program, graduate institutions want to ensure that they are using the most predictive measures of a student's merit and likelihood to succeed in the program" (Kent & McCarthy, 2016, p. iii).

Here, holistic admissions practices — an emerging, evidence-based solution for achieving greater diversity on college and university campuses — offer a possible solution. When doctoral admissions committees are evaluating whether candidates possess the right attributes for a particular program, holistic review allows for the consideration of a range of important student attributes. Implementation, however, is not without its challenges. Consider that essentially every doctoral program uses holistic review to make final selections. Where the main interest (and problem) now lies is in how the candidate pool is trimmed before the holistic review begins. As a result, graduate programs are well advised to carefully evaluate the intended and potential unintended consequences of their admissions practices.

Challenges in implementing holistic file review

Achieving diversity with fairness and transparency has always been difficult for institutes of higher education. Earlier this year (2016), my colleague Rebecca Zwick wrote that holistic file review can be a vague and ambiguous process. Her comments addressed undergraduate admissions, but they're applicable to doctoral admission too. How should admissions committees weight and combine individual pieces of data (which can be subject to human bias)? Do all faculty at the same institution weigh criteria the same way? Would a second review of a particular student yield the same conclusion?

To illustrate her point, Zwick notes that, "… UCLA, Harvard and Berkley admissions personnel have called holistic admissions a, 'secretive' system bristling with 'unspoken directives' and 'through-the-looking-glass moments" (2016, p. 1). Likewise, according to the recent CGS report, "the graduate education community would benefit from a clearer understanding of what constitutes a truly 'holistic' graduate admissions process for master's and doctoral programs" (Kent & McCarthy, 2016, p. iv).

Admissions processes need to be transparent so that both admissions staff and applicants can understand them. Furthermore, they need to be aligned to an institution's unique mission and then operationalized between mission and practice in order to be effective (Ono, 2016).

Best practices and guidelines for holistic file review

Both the University of Cincinnati President Santa J. Ono and the CGS suggest that holistic review processes should be narrowly aligned with a graduate institution's mission and with the goals of particular master's, doctor's and professional graduate programs in order to optimize success (Kent & McCarthy, 2016; Ono, 2016).

This makes sense particularly when you consider that most successful organizations typically have a strategy that is closely aligned with the organization's mission and culture. Likewise, it's crucial that graduate schools implement transparent, mission-based admissions practices that will allow them to enroll a diverse and talented student body.

Best practices, however, remain somewhat elusive. According to the CGS report, we need, "… better data linking admissions criteria and student success … to develop what might truly be called 'best practices' for holistic review of graduate applications" (Kent & McCarthy, 2016, p. 23).

In the meantime, Ono suggests (as a guide) the following four core principles of a holistic admissions process (2016):

1. Selection criteria are broad-based, are clearly linked to school mission and goals, and promote diversity as an essential element to achieving institutional excellence.
2. A balance in applicants' experiences, attributes and academic metrics.
3. Admissions staff and committee members give individualized consideration to how each applicant may contribute to the school's learning environment and to the particular profession, weighing and balancing the range of criteria needed in a class to achieve the outcomes desired by the school.
4. Race and ethnicity may be considered as factors when making admission-related decisions only when such consideration is narrowly tailored to achieve mission-related educational interests and goals associated with student diversity, and when considered as part of a broader mix of factors, which may include personal attributes, experiential factors, demographics or other considerations.[1]

Using test scores to attract and enroll a diverse student body

Putting too much emphasis on any single indicator, such as test scores, prior grades or any other criteria is poor admissions practice. A balanced approach, such as holistic admissions processes, enables graduate schools to identify diverse individuals with varying backgrounds and experiences who have the potential for academic success. Using multiple sources of information, such as grades, recommendations, test scores and other criteria has been shown to predict student success at both undergraduate and graduate levels better than using any single indicator.

As part of an effective holistic admissions process, *proper use* of test scores can help institutions select a diverse and talented pool of graduate applicants and enrolled students. However, while other factors are more subjective and vary from one individual to another, standardized test scores are common criteria that can be used across all applicants in the admissions process. These scores offer all types and levels of graduate programs a systematic and consistent way to compare and evaluate students from different backgrounds, including international candidates.

1 Under federal law, and where permitted by state law. Adapted from the Association of American Medical Col leges (AAMC) "Roadmap to Excellence: Key Concepts for Evaluating the Impact of Medical School Holistic Admissions," 2013.

For example, Julie Posselt's research findings out of the University of Michigan, "support previous research about the importance of GRE scores … to judgments of admissibility" (2014, p. 506). Moreover, according to the recent CGS report, "when asked to describe their institution or program's use of GRE scores, the majority of respondents (70% of graduate staff, 82% all other respondents) believe their institutions place the 'appropriate' emphasis on standardized test (e.g., GRE) scores — neither too much nor too little" (Kent & McCarthy, 2016, p. 17).

Considerations regarding the GRE® General Test and other measures of student ability

CGS's research also found that "another major challenge…is that the predictive validity of many admissions criteria have not been tested. It is difficult…to definitively tie a portion of an applicant's record to future outcomes, and this is one area where more research is needed. The one exception to this rule is the *Graduate Record Examinations® (GRE®)* General test, which has been studied extensively, and yet still remains the subject of intense debate" (Kent & McCarthy, 2016, p. 7).

According to Posselt's book, *Inside Graduate Admissions, GRE®* scores are the, "one thing that we can standardize in the sea of variability in these applications" (2016, p. 32). Holistic review, however, is often only used for a subset of applicants who make it through an initial screen that may rely on GRE scores and undergraduate grade point average. Posselt found that, "drawing large numbers of applicants, faculty sacrificed the multidimensional ideal of quality … to process applications quickly …" (2016, p. 55). She found that within many programs, only those candidates with very high GRE scores are considered carefully. For holistic file review to deliver on its promise to alter the outcome of graduate admissions, it needs to be applied to a larger percentage of the applicant pool. A possible solution is to develop guidelines for looking beyond test scores in deciding which applicants should receive a full review.

My experience as a faculty member, department chair and graduate dean has taught me how important it is to consider all of the information in a student's application. Some of my very best graduate students had "nontraditional" backgrounds and experiences. Only by considering factors such as research experience, grades, work experience and other criteria can a student's likelihood for success in graduate education be fully evaluated. Holistic review, properly implemented, can help graduate schools select a talented and diverse student body.

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Assessing Doctoral Applicants at The American University in Cairo

Adham Ramadan
Dean, Graduate Studies
American University in Cairo (Egypt)

The American University in Cairo (AUC) was founded in 1919 as an English language institution of higher learning offering bachelor's degrees in a number of disciplines. AUC started its first master's degrees in the 1950's, and introduced doctoral degrees in 2010. Currently, Graduate Studies at AUC entail 44 master's programs and two doctoral programs, one in Engineering and the other in Applied Sciences. There are about 1200 graduate students representing about 18% of the total student population which is 60% female, and 90% Egyptian. The university witnessed a significant decrease in the number of international students following the Egyptian revolution of 2011, and though the numbers are increasing, they are still well below pre-2011 figures. Most graduate programs at AUC are niche programs, some of which are unique in Egypt and the MENA region. The doctoral programs are relatively small with about 25 students on average in each. The university is incorporated in the state of Delaware and is accredited by the Middle States Commission on Higher Education. Individual programs are also accredited by international professional bodies where applicable, and degrees have equivalence from the Supreme Council of Universities (SCU) in Egypt.

Within the decentralized graduate admissions system at AUC, the doctoral programs aimed, since their inception, at evaluating applicants beyond quantitative measures of demonstrated previous performance. Applicants' enthusiasm, motivation, and communication skills were deemed important to take into account. To this end, the evaluation process set in place relied on an interview with a short presentation required from applicants. The system progressed towards more of a holistic review, even if, at present, it still relies on numerical scores such as GPA and GRE.

Currently, the assessment of doctoral applicants entails a quantitative component and a qualitative one. The former, comprising GRE, GPA and English proficiency scores, is used at the initial phase of the assessment to screen and rank candidates. Strict English proficiency cutoff scores are considered essential because the majority of applicants are non-native speakers of English. These scores are used to determine the possible need of remedial English language courses to be completed prior to the start of doctoral courses. A GPA range for a completed master's degree is used as an indication of proven academic performance. GRE scores are used as a reflection of an applicant's verbal, quantitative and analytical abilities.

The qualitative assessment component is used for the final admissions decision as well as the funding decision. It comprises letters of recommendations, transcripts, the applicant's statement of purpose and research interests, and non-cognitive skills such as the applicant's enthusiasm, motivation, maturity, and verbal communication skills. These skills are assessed through an interview conducted by an interdisciplinary committee in which the applicant conducts a short presentation about prior achievements, as well as research interests for the doctoral studies. A set of criteria are used for this qualitative assessment. However detailed rubrics for each criterion are still to be developed. Applicants are not required to have

identified a dissertation advisor by this stage.

Of relevance to this qualitative assessment component is disciplinary diversity as well as the diversity of institutions of prior study. Due to the interdisciplinary nature of the doctoral programs at AUC, it is believed that a disciplinary-varied body of students is needed for optimal programs operation. In this respect, the disciplinary background and skills of applicants are also assessed as part of the qualitative assessment, with a view on what an applicant would be bringing into the program as a disciplinary skill set. Multi-disciplinary experience or skills are highly favored. Additionally, a diversity of institutions of prior study is considered important to best serve the mission of the program concerning reaching out to graduates of other institutions of higher education in Egypt. Currently, about 60% of doctoral students come from other universities in Egypt, mostly national universities.

Other aspects of diversity that might represent a priority within a US context, namely ethnic and gender diversity are of lesser significance. Ethnic diversity is not of relevance within the Egyptian context, as for gender diversity, the number of applicants to the programs and that of enrolled students is majorly female (about 65%), similarly to the general trend of students in bachelor's and master's degrees at AUC, and of students in graduate studies in Egypt. One continuing challenge the doctoral programs at AUC are facing is the number of international students, which currently stands at less than 5%.

Two external factors will continue to present challenges to the effectiveness of the qualitative assessment component, particularly in addressing requirements for diversified disciplinary backgrounds. Both factors are resulting from SCU requirements for the granting of equivalence to the AUC doctoral degrees, and are national requirements. The first factor entails the requirement of completion of a thesis-based master's degree for the possible admission of an applicant to the doctoral degree. This limits the possible access to the AUC programs by applicants with only bachelor's degrees or international master's degrees with no thesis requirements. The second factor necessitates that applicants to the Engineering doctoral program would have completed engineering bachelor's and master's degrees, thus limiting the pool of possible applicants.

The current assessment approach at AUC is believed to incorporate the main components of a holistic assessment. It is found to offer a fair insight into the applicants' readiness to doctoral studies. However, it is not without limitations, and opportunities for improvement have been identified. These encompass a better formulation of program recruitment goals and their improved alignment with the assessment process; the development of rubrics for each of the criteria used in the qualitative assessment component; a better structuring of the interview process with the aim of ensuring a methodically consistent coverage of all identified aspects of the qualitative assessment component; and the review of the weight given to quantitative measures of GRE and GPA in applicants' assessment. One area in need of particular attention is the development of correlation methods between admission assessment and students' performance and completion rates.

The funding model used for the two doctoral programs at AUC entails central funding only. Individual funding opportunities available to faculty members at AUC have, so far, not allowed the inclusion of funding of doctoral students. In consequence, external funding opportunities are pursued centrally through the two programs and the Office of the Dean of Graduate Studies. A number of named fellowships are currently available, some of which are associated with a specific research focus, typically aligned with identified national challenges.

The award of the available fellowships is based on the same assessment process as used for admission decisions, with the fellowships typically being awarded to applicants most highly ranked as a result of this process. Fellowships associated with a specific research focus are similarly awarded, but to applicants with research interests aligned with the specific focus. To this end, these applicants are required to develop and present a preliminary research proposal, which is evaluated by the relevant members of the assessment committee. Maintaining a fellowship is based on acceptable progress determined by performance in courses, and regular reports about research progress endorsed by the student's dissertation committee. It is believed that this model will need review when opportunities develop for faculty members to be able to offer support to doctoral students through individual grants.

In conclusion, the current system of applicants' assessment includes the main attributes of a holistic approach, but requires further enhancement. The funding model applied at present does not challenge the implementation of this assessment system.

The Evaluation of Students' Study Objectives in Doctoral Program Admissions

Yaguang Wang
Executive Dean of the Graduate School
Shanghai Jiao Tong University (China)

Doctoral education is a major and important source of top innovative talents for the country, as well as the most essential part in educational institutions' cultivation process of outstanding talents. Currently, one of the main tasks in higher education reform and development process is to improve doctoral education, out of which admission is greatly critical.

Studies have indicated that students' personal factors can exert important impact on the quality of doctoral education. A students' study objective is one of these personal factors, because it would play the role of activation, guidance, maintenance and stimulation throughout the whole Ph.D period. In this sense, we consider it necessary to evaluate Ph.D applicants' study objectives in admission process as the first quality control method.

Mainly, there are three kinds of students enrolled as doctoral candidates in Shanghai Jiao Tong University (SJTU), for which we take distinct ways to evaluate their study objectives.

1. *Undergraduates who are going to be directly enrolled into Ph.D programs (doctoral students with Bachelor Degree)*

For these students, SJTU hosts admission summer camps to assess their study objectives and potential. The summer camps could organize various activities for students, such as academic lectures/salon, campus visit, experiential education and training, interview meetings, etc.

The camps usually last for several days or even weeks, during which the professors probe into and assess students' learning passion and motivation, research interests, and academic potential. Taken together with their academic performance in undergraduate studies, the admission committee could thus get an overview of each student's study objective, and even, judge whether s/he is suitable for Ph.D studies.

2. *Students in master's leading to Ph.D. programs*

For these students, SJTU mainly evaluates their study objectives and potential based on their academic and research performances during the master's program period. After about one and half years of study, some master's program students can apply to study in the Ph.D. program without needing to finish the master's program. For these applicants, the departmental admission committee can assess his/her study objective according to applicant's academic performance, research achievements and supervisor's evaluation, etc.

3. *General master's degree graduates (doctoral students with Master's Degree)*

These students' study objectives are mainly assessed by the interview in the post-graduate entrance exams as well as on their research achievements obtained in their master's study. SJTU is also taking efforts to promote an 'application -assessment' system, which emphasizes assessment of the applicants' comprehensive competences. More specifically, applicants first submit all necessary documents to the university application system, including detailed CV, academic publications, master's thesis, reference letters, and research proposals, etc. If

their submitted documents pass the preliminary review, applicants can directly attend the final interview without need to take the writing entrance exam. The departmental admission committee will be in charge of the final interview, in which the role of teamwork and group decision-making will be highlighted, and professors are given more autonomy in assessment and selection. From the interview, the committee attempts to provide a comprehensive profile of the applicants, evaluating their entire performances including scientific literacy, personality, innovativeness, potentiality, collaborativeness, mental health, and even their behaviors, expressions, and etiquette.

SJTU has started to promote structural interviews in recent years by organizing several paralleled faculty panels, each consisting of 3 to 5 professors. Structural interviews have personal modules and professional modules. Personal modules evaluate applicants' personal background knowledge, research ability, and comprehensive competence. In addition to professional ability, emotional intelligence assessment has also received increasing attention.

The current measures to evaluate students' study objectives in Ph.D program admissions aim to find appropriate applicants for scientific research, and guarantee the quality of education. However, some talented students would have to give up their education dreams and turn to the job market after graduation due to personal financial problems. Thus, to provide proper scholarship and financial support systems, it is very important to promote doctoral education, and it helps to encourage students to conduct their study, research and innovation with a sense of security.

SJTU provides full-time doctoral students with various scholarships and stipends for four years, including national grants, academic scholarship, and research stipend, etc. Meanwhile, the university also offers "Scholarship for Excellent New Doctoral Students", and asks each School to establish their own proper scholarship system as well. Currently, Ph.D candidates in SJTU receive an average of 4,000 Yuan/month after waiving the tuition fee, from government, university, and supervisors. It is basically equivalent to local people's monthly living expenses.

a) Basic subsidies from the government include national grants and academic scholarships, each enrolled student has this support.

b) Stipends for students undertaking scientific research and teaching assistant positions. Supervisors and departments shall decide the exact amount. For qualified doctoral students, the total amount of stipend paid per academic year should be no less than the university minimal standard; for the unqualified doctoral students in the evaluation, supervisors can lower the payment accordingly.

c) Various types of funds (e.g. innovation fund, research fund, conference travel fund, etc.).These funds are closely associated with respective research projects and research activity, featuring personalization in education.

The scholarship system is one external factor in admission enrollment from which students are also enabled to voluntarily undertake the social responsibility of knowledge innovation and value creation. As the connecting bridge between supervisors and their doctoral students, the scholarship system makes great contributions to the implementation of a responsibility system and closer interactions between supervisors and students, the promotion in scientific research cooperation and the creation of a healthy educational environment.

Issues in the Selection and Funding of Doctoral Candidates

Kate Wright
Dean of the Graduate Research School
University of Western Australia

How well do current application requirements assess readiness?
With the globalisation of education and diversification of doctoral cohorts, assessing applications from potential candidates has become more challenging. Within the Australian context, students applying for a PhD place will be assessed on a combination of academic achievement and research experience. It is expected that applicants will have undertaken some research during their undergraduate or masters courses leading to the production of a written dissertation. At my own institution, candidates must demonstrate "research preparedness" which is generally assessed by their proposed supervisor through the reading of a dissertation, thesis or publication. This is in combination with the requirement for a degree equivalent to an Australian Honours degree with grade 1 or 2A.

Increasingly, candidates apply with non-standard backgrounds, which can make comparison with our criteria more difficult. Assessment of local student, with a recent Australian Honours Degree or Masters, is straightforward as we can read the thesis and have a good feel for the quality of the institution. However, for those applicants who have international or non-standard qualifications, the assessment can be much more difficult. Issues arise in comparing an Honours 1 from UWA with:

- a four-year Bachelors or Coursework Masters from an international university that does not feature in any of the rankings such as ARWU, or has a low profile
- the work experience of a mature age student with an undergraduate or postgraduate qualification dating back 10 or more years

Assessing research preparedness will be problematic where a thesis is in a language other than English or where the work experience cannot easily be classified as "research".

Taking a metrics based approach provides comfort to assessors, particularly those from the science and engineering disciplines, but less so to those in the arts and humanities. However, too heavy a reliance on university rankings and other metrics based indicators may blind us to the ability of the student and their potential to undertake independent research.

There are a number of strategies to take when assessing student's preparedness for research that can go some way to addressing the issues noted above. Perhaps one of the simplest is for supervisors to interview all potential candidates, and this is the norm in some institutions. Having a conversation with a student or sending them a journal article to critique is to be recommended as it can assist in gauging levels of enthusiasm, competence and language skills. With the easy availability of video conferencing, interviews can generally be arranged regardless of the student's location. Where there is concern over research capability then mandating coursework (not an integral part of an Australian PhD) in research methods, communication skills etc. with clear performance expectations, is encouraged. UWA offers Research Preliminary courses available to students who are deemed to have potential but

lack research experience. Coursework is also useful for those who have been outside of the university system for some time and may otherwise struggle to re-integrate into student life.

How are doctoral students funded? How does that affect doctoral admissions?
Education is big business, and in Australia, is the third largest export industry. Universities make money from student fees to offset the cost of other teaching and research in areas that do not attract sufficient funding. Thus there is a drive to recruit full fee-paying students from overseas with Deans International having targets in terms of new enrolments.

Domestic students undertaking HDR studies in Australian public universities do not generally pay fees, instead each university receives funding from the Commonwealth Government to offset part of the cost of research training. Many domestic and a few international students will also receive a Commonwealth scholarship to cover their living costs but the number of applicants for such scholarships is always much greater than the number available. The shortage of scholarships is one of the main barriers to students taking up offers of admission, particularly for those from overseas who are unable to attract sponsorship or scholarships to cover fees as well as living expenses. In Australia the average age of a doctoral student is around 36 years, hence many will have family and/or home mortgage commitments that make it difficult to study without some form of support. It is not uncommon for domestic students to study part time for their doctoral degree so that they are able to work full time, although this arrangement does not lend itself to projects involving laboratory or fieldwork.

The drive to attract more international fee-paying students needs to be balanced against the need to ensure that those students admitted have the capacity to undertake independent research and that supervisors are aware of the additional challenges they may face. These include pressures of limited funding of fees, difficulties in integrating into Australian life, and language competency.

In summary, funding or lack of, does affect admissions, as the bulk of doctoral students will require some financial support throughout their candidature. Considerations of quality can cause some angst within an institution where the targets of the International Office are at odds with faculty who only wish to take on the best. Assessment of who is or will be the best however is still problematic.

3: Doctoral Mentoring & Supervision

Doctoral Mentoring & Supervision at the University of São Paulo (USP): From Personal Collaboration towards Institutional Relationship

Vahan Agopyan
Vice-President
University of São Paulo (Brazil)

The traditional way to supervise a doctoral candidate is the 'hands on' approach, where the student develops the research work together with his/her supervisor; by doing so, the student is more likely to learn how to carry on a successful research activity. Although this may be considered an old and unpretentious way of training, it is still consistently applied in our present days.

A regulation for graduate education was established in Brazil in 1967; however, the process is slowly changing from a personal student-supervisor arrangement towards a more institutional approach. Following the aforementioned rule, universities began to establish a more adequate graduate studies structure. For instance, at the University of S. Paulo, the student applies for a graduate program, and only upon acceptance, he/she can choose a supervisor (sometimes more than one) to guide the respective research work. Moreover, the program coordinator is responsible to control the quality of the activities, including the quality of the thesis. The coordinator is expected to report the program performance to the central authorities of the university (Provost of Graduate Studies) and also to the Ministry of Education Agency (CAPES). These reports are evaluated, and positive results are compulsory for the continuation of the program. In addition to the individual research grants awarded to each faculty, CAPES also supports programs directly by means of scholarships and further financial aid. USP helps the programs in a similar manner with university internal grants.

Graduate students, understandably, seek to work with supervisors within research area more attractive to them. However, as different programs deal with extensive specific areas of knowledge, graduate students may be allocated to work with another supervisor, if research facilities, for instance, are prone to be more suitable. In sum, the research subject is primarily defined by the appointed supervisor, but the coordinator can help the student with a more detailed choice, suggesting the supervisor and conducting the student to a more suitably defined research subject; thus, sometimes the research work can be carried on with the support of two faculty advisors.

The above-defined procedure appears to follow the previously mentioned "hands on" principle; that is, once the supervisor is defined, the student works directly with his/her mentor. However there is a relevant change, concerning the role of a new player: the program coordinator. It is expected that the coordinator, with the support of the program committee, will follow the improvement of activities and make all necessary changes.

Each graduate program selects its supervisors among faculty members with good performance in research activities and with a successful record in conducting research students. This procedure takes place because program evaluation is strongly based on the research activities of supervisors (published papers, citation indexes, research grants). Perhaps, this approach is not the most efficient way to select supervisors, but at least, it serves

as an assurance to graduate students that they will work under someone with a good record on conducting research work.

May it be noted that one question rises out of this approach: is a good researcher also a capable supervisor? In the present time, someone who can satisfactorily conduct research-work is also considered to have the ability to prepare future researchers. This concept can be accepted and may hold true in many cases; however, in order to coach a new researcher, the advisor is not only supposed to show how to perform research work, but also to train students to be able to conduct future research work on their own, with a higher degree of complexity.

Standard research "liturgy" – which includes planning, organization, working and leading groups, the relationship among group members, accepted accuracy of the data, recognition of the limits of the study, proper analysis of the results, and last but least, ethics – is not always adequately delivered to students who join an already existing research group, under the guidance of a group leader (the supervisor). The supervisor has to expand the time dedicated to these topics for a more adequate researcher preparation. Many programs at USP have specific classes on training for research activities, which are intended to assist with student preparation, though frequently, it is not enough. Sometimes these classes include training on how to prepare research projects, plan experimental research activities, analysis of results (with or without statistics) and many other useful subjects; however, classroom activities cannot replace the practice that a student experiences during actual research work.

At USP, young faculty members usually begin by mentoring undergraduate students, then they start working with master students, and finally they may work with doctorate candidates. This gradual increase of mentoring tasks is supposed to train faculty members to become better supervisors. From my point of view, this process is necessary, and yet not enough to assure an adequate preparation of a future supervisor. Based upon my experience, as Provost for Graduate Studies, having dealt with more than six thousand supervisors, I can assure that the process is quite good, considering that I have had to handle less than twenty problem situations, during a four-year period. Nevertheless, I can also confirm that the process can be improved and, by doing so, the quality standard will be significantly enhanced. The supervisor plays an essential role in the preparation of researchers, and for this reason I strongly encourage leaders of Graduate Studies to improve and systemize training programs for supervisors.

It must be clear that the proposed training for faculty members – towards becoming supervisors – shall not concentrate on how to carry on research work, but rather on how supervisors can teach students to behave as proper researchers. If the program does not have specific classes on how to do research work, the bases of research activities have to be presented to students through further literature, complementary readings, and clearly stated, it cannot be taken for granted that students will acquire this knowledge during their work – these topics must be discussed during supervision and mentoring meetings. It is also the supervisor's task to guide his/her students towards a good relationship among colleagues, not only restricted to the research group, but also to perform properly in a working group *per se*. Ethical behavior must always be encouraged and discussed with the students.

The long-established personal relationship between supervisors and students are to be preserved, but it can also be improved through collective activities within the program and, in particular, with the engagement of the coordinator, who can help students with the selection of supervisors and monitor their progress up until the final examination. Well-trained supervisors are of utmost importance for the success of a graduate program.

How the HKU Graduate School Prepares Supervisors to Mentor Graduate Students

Mee-Len Chye
Dean, Graduate School
The University of Hong Kong

At the University of Hong Kong (HKU) graduate research education is student-centered and is a shared responsibility amongst the Graduate School, Faculties and Departments. The Graduate School at HKU has taken a number of steps to prepare Assistant Professors in supervising graduate research students. In the past year, we initiated "*Mandatory Supervisor Training Workshops*" for new academic staff members and attendance is compulsory, together with that on "*Responsible Conduct of Research*", to be completed within 12 months after arrival, before they are eligible for graduate student supervision. The "*Mandatory Supervisor Training Workshops*" is a combined endeavor in supervisor training between the Graduate School and each of the ten Faculties at HKU. Besides Assistant Professors, current HKU research supervisors are welcome to participate in these workshops that are co-organized annually.

At workshop sessions, senior academics are invited to share with the new Assistant Professors their past experiences on discipline-specific problems related to supervision, while the Dean/Associate Dean from the Graduate School will discuss more generic issues and inform new staff on the support it provides to supervisors and students, as well as address any queries on supervision and other issues. Much information is provided as a handbook available online including checklists on "*Good Practices for Faculty Higher Degrees Committees on Supervision*", "*Good Practices for Supervisors*" and "*Departmental Induction Programs for Research Students*". Also provided are "*Guidelines on Handling Appeals from Student Whose Candidature is Terminated Within the Probationary Period*".

In "*Good Practices for Supervisors*", we remind supervisors that they should be good role models and demonstrate commitment to research and scholarship to better lead and supervise the work of others. As supervision extends beyond ensuring timely PhD completion, supervisors must impart during the PhD candidature, the importance of professional conduct, safety and ethics and instill a research culture that meets the highest international standards. Supervisors too, must relay a need to enhance the student's personal and professional growth during the PhD candidature.

To achieve good supervision, we have set up Co-supervisor/Mentor/Supervisory Panels. The person who has the ultimate responsibility for each student is the primary supervisor helped by co-supervisor(s)/mentor(s). A co-supervisor is always appointed when the proposed supervisor is supervising a research student for the first time. We encourage co-supervision to promote inter-disciplinarity research and collaboration across Faculties. Co-supervisors often possess special skills that are complementary to the primary supervisor's in the student research project. A mentor is always appointed if there is no co-supervisor. Both give continuity in guidance when the primary supervisor is on leave and provide support at times of conflict between the student and primary supervisor. We inform supervisors on "*The Supervisory Relationship*" on what the University expects of research students, supervisors and Departmental Research Postgraduate Committees.

The Faculties and Departments are delegated the responsibility in conducting induction programs to welcome and orientate new students. We recognize that non-local students, who may encounter greater problems, must be provided with ample support. We aim to best cater to the needs of international students by reminding supervisors to be aware that an international student may face problems when adjusting to life in Hong Kong and refer the student to extra-departmental resources such as the Postgraduate Student Association and the Centre of Development and Resources for Students (CEDARS); the latter holds a weekly support group. CEDARS also provide support in Counselling and Person Enrichment services. The Departments and supervisors are charged with the task of ensuring that students are properly educated and trained in the safe execution of experiments. New students attend "*Safety Workshops*" and the "*Orientation Program of the Graduate School*". They are encouraged to contact the Postgraduate Student Association where opportunities are available to meet students from other disciplines and partake in social activities.

To optimize success in student research, the Graduate School advises supervisors to hold regular (at least once per month) meetings with students. Each meeting should incorporate an agenda of research work and a timetable for its implementation, to ensure students submit on time. The Graduate School also provides opportunities for students to acquire transferable skills (writing, language, teamwork, statistical analysis, innovation and entrepreneurship) before they graduate. Supervisors have to ensure that their students make annual presentations of their work within the department and provide feedback on their communication skills. To encourage scholarly pursuits, the University has designated funds for "*Conference and Travel Support*" to enable student participation beyond the intellectual life of the University at international conferences, up to two times per PhD candidature, provided a presentation is made at each meeting. Recently, we have launched a "*Pilot Internationalization Scheme*" to promote international collaborative research and engagement.

Supervisors and students independently provide a bi-annual report of research. Supervisors should record the frequency of meetings with students especially with those making unsatisfactory progress because documentary evidence including written warnings may prove useful later. The Departmental Research Postgraduate Committee and the Faculty will need such documentation to endorse non-confirmation of candidature, extension of the probationary period or discontinuation. Students must also fulfill coursework requirements to achieve confirmation of candidature. Other than discipline-specific coursework, the Graduate School offers 4 main compulsory courses on "*Thesis Writing*", "*Research Ethics*", "*Transferable Skills*" and "*Research Methods*" as well as many workshops on improving speaking, writing, inter-diciplinarity, innovation, and entrepreneurship skills throughout the year.

Finally the Graduate School and CEDARs organize "*Career Talks*" to help students consider academic-tracked and non-academic tracked careers. All new students have to undergo a course to acquire a "*Certificate of Teaching and Learning in Higher Education*" before they start as teaching assistants. Not surprisingly, HKU with a tradition of being closely intertwined in Education the past century, has a relatively high proportion (68%) of PhD graduates who stay on in Education, be it at schools or universities in Hong Kong and abroad, contributing as researchers, teachers or administrators.

Doctoral Mentoring and Supervision

Richard (Dick) Strugnell
Pro Vice Chancellor, Graduate Research
University of Melbourne (Australia)

Abstract
Good supervision is a cornerstone of effective research training within the PhD. The qualities of a good Supervisor are difficult to capture and comprise both innate traits such as empathy, and skills learned through experience. While all Supervisors should have an awareness of the University's policies and processes that govern doctorate supervision, research training and the PhD degree, good Supervisors are differentiated by their capacity to accept accountability and make adequate time for their mentees, to provide clear, thoughtful feedback, and to assist with career development. When such practice develops at scale, a local 'completion culture' may be established, leading to better outcomes.

Qualities of Good Supervisors
The PhD is of variable duration in different countries. Completion of the doctorate may require coursework, and may have a prerequisite for publication of peer-reviewed articles. What is common to all PhDs though is the requirement for **supervised**, usually independent research, which generates new knowledge and is presented in the form of a thesis.

The advising or supervision of PhD candidates in this definitive research activity forms part of a typical academic's position description. Depending on the nature of the academic appointment, and the workload that is attached to the appointment, graduate research supervision may be seen as a right of an academic, or an obligation, or both. While the training in supervision that academics receive, the system support, the number of candidates to be supervised, and the assistance Supervisors obtain from co-Supervisors and advisory panels may differ between institutions, the principal or primary Supervisor is usually held accountable at some level for the performance of their mentees. Increasingly, as litigious PhD candidates understand better the real (including opportunity) costs of taking on a research doctorate, this accountability will be tested outside of the academy. It is important therefore that supervisors continue to reflect on and improve their performance, and treat doctorate supervision as an earned privilege, not a right nor an obligation.

The Times Higher Education supplement in April 2013 published an article by Tara Brabazon[1] which sought to advise potential candidates on the selection of PhD Supervisors; it was written from an Australian perspective. These criteria are paraphrased below, and include many elements identified by James and Baldwin[2] in their still relevant and clearly written Eleven Practices of Effective Postgraduate Supervisors (1999), and reprised by Denholm and Evans (2007)[3]:

1. A key predictor of a good Supervisor is a record of having completed students
2. The candidate must select the Supervisor, not have a Supervisor provided

1 https://www.timeshighereducation.com/features/10-truths-a-phd-supervisor-will-never-tell-you/2005513.article

2 http://melbourne-cshe.unimelb.edu.au/__data/assets/pdf_file/0004/1761502/11practices.pdf

3 *Supervising Doctorates Downunder: Keys to effective supervision*. Denhold, C & Evans T (2007) ACER Press.

3. Great researchers are attractive, but great researchers are often very busy people
4. Look for Supervisors who will protect you from the bureaucratic elements of the system
5. Look for Supervisors who publish with, but not exclusively so, their mentees
6. Be aware that co-Supervisors can help, and hinder progress
7. Find a Supervisor who is active in your project area (a name in the field, rather than simply a big name)
8. A little teaching helps career development, find a Supervisor who supports limited teaching
9. Weekly Supervisions are the most effective
10. Vest your supervision in Supervisors with strong, positive character traits (decent, reliable etc.)

While these elements may not include the full extent of best practice, they point to the key components of good supervision: a mentor who is: - experienced, aligned, accessible, considerate, systematic, clear and objective, connected, and holistic in outlook.

Rachel Webster, a senior Melbourne astrophysicist who won a Nature award for Mentoring in Science amongst many other accolades, once reminded me that it is:

> "*not her task to be liked by the PhD candidates she supervises, but rather to be as effective a mentor as she can be*"

Good supervision therefore is likely to be a blend of innate personality traits, which cannot be acquired, such as empathy, combined with experience and attention to detail, discipline expertise, and an ability to make and communicate "tough decisions" to often sensitive candidates.

The Supervisory Load

It has been suggested that the description of the number of mentees supported by individual Supervisors as a "supervisory load" casts a pejorative shadow, making supervision seem an obligation. However, most institutions wrestle with the concept of what constitutes the optimal or maximal load. The truth is that some Supervisors struggle with a single, perhaps difficult, mentee while others who are well organised with fewer other academic duties, can effectively supervise 10 or more PhD candidates. What is important is that sufficient time is made available for each candidate, that feedback is provided in a timely manner, that any advice is well documented and clear, and that candidates accept this advice because it is considered and properly argued. It makes sense not to over burden individuals with too many candidates, though Graduate Deans often call on individuals identified as "Salvage Supervisors" who can rescue candidates from a broken, ineffective supervision dyad.

Supervisor training and Supervisor Registers

Given the intrinsic nature of many key traits of supervision, how effective is "Supervisor training"? Many Universities steer away from providing "training" as Supervisors often take offence at the suggestion they need to be "trained". Such "training" is almost always less about those key personality traits likely to predict effectiveness, but instead usually addresses the institutional *rules* regarding supervision, selection of students, technical aspects of PhD candidature and completion, and various milestones along this journey. Insofar that Universities are increasingly analysed internally and externally for performance,

and candidature progression and support is governed by such rules, it is important that all Supervisors understand these specific expectations placed on them and their candidates, and the University processes through which e.g. "unsatisfactory progress" is managed. Beyond this technical support though, it is clearly difficult to "train" Supervisors to become more effective. How then to improve performance? From our experience, improved effectiveness is driven by the "completion culture" that exists in the local academic unit, and this somewhat intangible environment, though relatively simply identified with good systems, is less well understood.

Supervisor Registers can leverage the investment into any technical 'training' of Supervisors; they also provide a mechanism through which it is possible to limit or remove Supervision rights. The latter is problematic on a number of fronts – the position descriptions for academic staff often enshrine graduate research supervision as a key responsibility and it can be argued that removal of this opportunity is career limiting. Unlike good performance, recognition of poor supervision performance often takes many years and a series of supervision cycles, where not all mentees may be equally impacted. There may be some mentees operating under a Supervisor who are well aligned and very happy with their minimal support, while others flounder.

The importance of measuring research training performance, including supervision

The metrics for measuring supervision performance in research training are imperfect. Strictly quantitative aspects such as completion rates do not speak to quality of the experience and training, and the best measures of quality are not simply published outputs; they include destination and career development and trajectory, all hard to quantify. Having said this, there is a good argument to measure and report on timely completion rate as a proxy for engagement of candidate and supervisor and, ultimately the conversion of limited resources like Fellowships into PhD completions in a time-based analysis (i.e. rate). This can be done at the level of the Supervisor if systems are appropriately configured.

While in the UK there is now institutional accountability for PhD performance measured by timely completion rates, and reflected by external resource allocation, much of the rest of the world has limited direct feedback loops that capture and reward good PhD training outcomes. External funding for research training in Australia does not currently follow performance beyond using the aggregated number of completions as a blunt tool, though completion-linked internal redistribution of external funding resources is one means of supporting PhD performance improvement.

Supervision and the local completion culture

A "completion culture" within faculties, schools and departments can be demonstrated in nuanced analyses of completion performance within institutions. It may appear as a 'spike' of outperformance that may rest with a single individual, or several individuals, who demonstrate repeated research training success measured by completion rates and quality research outputs produced by their mentees. These 'pockets' of local positive "completion culture" will not follow strict HASS and STEM lines – there may be individual Supervisors whose performance is considerably better than the norm for the academic unit or discipline more generally; such Supervisors should be identified, lauded then thoroughly analysed for their *modus operandi*. Fortunately, these positive behaviours sometimes spread to colleagues establishing a local culture of completion, which in turn drives better supervision performance at the unit level.

We have much to learn about supervision practice from these leading Supervisors – the frequency and form of supervisions, the use of co-supervision, individual versus joint or group supervisions, when and how feedback is provided. Such individuals often have well developed antennae for selecting quality candidates, practice a sophisticated approach to interviewing potential students, develop a strong cohort with peer support, and are seen as tough but fair, inclusive and outcome driven by their mentees. Disappointingly to Machiavelli, these research training leaders are neither loved nor feared, but instead are very highly respected by their mentees and colleagues alike.

Conclusions

While the PhD remains centred on a supervised independent research program, Supervisors of these graduate research projects will be needed. Supervisors must combine an understanding of high quality research, the need for training, be able to view the candidature through the eyes of student and seek to develop the careers of their mentees, before their own, all the while understanding that the PhD is simply a research degree, not the *magnum opus* for most candidates.

A Study on the Supervisor-Doctoral Student Relationship: From the Perspective of Process Quality on Doctoral Education

Tao Tao
Executive Dean of the Graduate School
Xiamen University (China)

Supervision is one of the determinant factors affecting the quality of postgraduate education. The relationship between doctoral student and supervisor is critical to the success of student's learning experience and the satisfaction of both participants. We designed two questionnaires respectively to new PhD students and the graduates and have been doing this survey regularly since 2015. From the data collected, we analyzed the students' perceptions of supervisory relationship and the influence facts, divided the types of supervisor-doctoral student relationship, and evaluated the effectiveness of their supervision. Doctoral students' perceptions of the relationship can be useful for providing detailed feedbacks to supervisors aiming at improving the quality of their supervision.

Context of the development of graduate education in Chinese research universities
In the national policy, graduate education is viewed as the way to cultivate high-level talents with creativity for strengthening the nation's competitiveness in the global knowledge economy. The PhD enrollment rate grew rapidly between 1999 and 2003. Though the growth slowed down after that period, the number of academic doctorates earned has surpassed that in the United States since 2008. Although China is the largest PhD factory in the world, the quality of the graduates is not consistent. The problems of postgraduate education in XMU faced over the last decade may be typical in most Chinese research universities. The management system lacked quality control: not only the graduate programs did not emphasize much on developing research innovation capacity, but also there was no clear mechanism for weeding out poor students. Many PhD supervisors were not qualified, who generally paid more attentions on enrollment quota than on quality guidance process. The relationship between doctoral students and supervisors was in tension. We launched a series of graduate education reforms in 2012. Since then, many initiatives have been being implemented in graduate programs, such as a change in resource allocation (supervisors bear PhD students' training expenses by their research grants), course structure reformation and supervisor training.

Definition of "Supervisor" and "Mentor" and the position of these two roles
In the western context, supervisor/supervision and mentor/mentoring are relatively two different concepts, the former refers to a professional relationship while the later a personal relationship. Mentors are usually viewed as role models and friends who always give students suggestions on life goal and career development, as well as psychosocial support. Supervisors' most important responsibility is to facilitate students to be independent professional researchers or practitioners in their fields, focusing on skill acquisition but not on the other aspects. In China, the supervisors' qualification is awarded by graduate schools so that they have accountability to the organizations. We have introduced thesis committees, set-up rotation systems, and intensified quality control like performance evaluations on supervisor's guidance behaviors. But this relationship in Chinese culture is different from the

western contractual relationship in which the supervisor's duties are explicit. In our tradition, we value prudence and put ethics and personal principles of handling affairs in priority. Therefore, it's really hard to judge and evaluate moralities. The ultimate goal of supervisory relationship in China has been parent-children relationship, as we call the supervisor "Shifu (father)" in an intimate relationship.

A quantitative research on supervisory relationship in Xiamen University

Questionnaire one to new PhD students is based on an adaptation of "role perception rating scale" (Moses, 1985) and "ideal mentor scale" (Gail, 2003). Questionnaire two to graduates who just received their PhD degrees is based on an adaptation of the "questionnaire on supervisor-doctoral student interaction" (Mainhard, 2009) and "postgraduate research experience questionnaire" (Marsh, 2002). After a pilot study, we revised them to fit the Chinese culture background. The findings can be concluded as following:

1. Most valued factors considered when select supervisor: supervisor's academic level, student's interests coincide with supervisor's research directions, and supervisor's character.

2. Dimension of supervisor's **integrity**: in students' perceptions, they think that the ideal supervisor would "value me as a whole person but not as a labor", "dedicate to work", and "be a role model". From the students' experience, they really appreciate that their supervisors did these. Some items are scored relatively low in Q1, but are highly rated in Q2, such as "my supervisor prefers to cooperate with others than compete with them". Some items are scored high in Q1, but get relatively low evaluation in Q2, such as "respect the intellectual property rights of others". The result shows that supervisors prefer to play a professional role than a personal one. They don't emphasize much on the functions in emotional and psychological health levels, and seldom talk to students about values and life goals.

3. Dimension of supervisor's **guidance**: in students' perceptions, they expect their supervisors to "give good guidance in topic selection and refinement", "involve me in his/her research projects", "meet with me on a regular basis", "encourage and assist me to publish papers", and "give me financial support to attend conference". From the students' experience, it shows that supervisors relatively do well in guiding students on research topic selection and refinement, assisting publish papers, interpreting research methods and techniques, giving specific research assignments, providing suggestions and assistances on career development. Therefore, they don't do well in helping students plan research timetable, form research framework in thesis writing, give helpful feedback and give guidance on literature search.

4. Dimension of **relationship**: most supervisors belong to Type I (leadership and helping), but still many belong to Type II (understanding and freedom). It shows that although the relationship is based on cooperation more than on opposition, the dominance of supervisors seems not to be enough or their responsibilities are not explicitly defined so that some students are in the condition of laissez-faire.

5. **Roles** of supervisors: students expect the relation can be based on equivalence and reciprocity (act as research partners and colleagues, or as friends). But in fact, most supervisors play the role as a master in apprenticeship relations while least act as a boss in employment relations.

6. **Effectiveness** of guidance: supervisors have positive influence on students' research attitude and academic ethics. Students agree that their professional knowledge and the capabilities on logical analysis and making plans have been increased, but their self-evaluation on the abilities of frontier tracing and practical problem solving are low.

We can draw the conclusion that supervisor's personal identity is very important to the effectiveness of their supervision. That's why we need well-organized training to help the supervisors develop a conceptual framework and then eventually introduce contract on their responsibilities to guide doctoral students.

Doctoral Supervision: Experience in Tsinghua University

Qiang Yao
Dean of the Graduate School
Tsinghua University (China)

What role do mentors/supervisors have in defining a doctorate?
Tsinghua defines the roles of supervisors in "Academic Guideline for Supervisors of Tsinghua" (2016) as:

1) Be a teacher with both knowledge and moral integrity.
2) Dedicate to education; give students meticulous guidance.
3) Respect scientific practice; follow the rules of education.
4) Be erudite mentor and helpful friend with students.

From 1981 to 1993, new Ph.D. supervisors were all selected and authorized by the Academic Degrees Committee of the State Council (ADCSC). From 1994, the ADCSC delegated the power of Ph.D. supervisor authorization to the degree awarding universities and colleges. Since then Tsinghua began to do it regularly, typically once a year. In 2011, Tsinghua officially ceased the university level activities to qualify and admit Ph.D. supervisors, and authorized the branches of the Academic Degrees Committee of Tsinghua University to do so.

Since 2016, Tsinghua welcomes all tenure or tenure track faculty as Ph.D. supervisors if they will, for the tough hiring inspection will ensure their qualification. The statistics data shows that 59% of our Ph.D. supervisors are younger than 50, and 98% of them are Ph.D. degrees earners. Figure 1 shows the doctoral education statistics of Tsinghua (2006-2015) and it can be seen that the amount of supervisor are increased over the past decade. Taking SCI paper published as one of the outcomes, it also can be seen in Figure 2 that student named as the first author of most paper in Tsinghua.

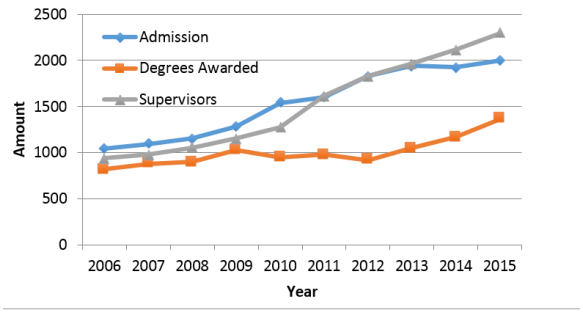

Fig 1. Doctoral Education Statistics of Tsinghua (2006-2015)

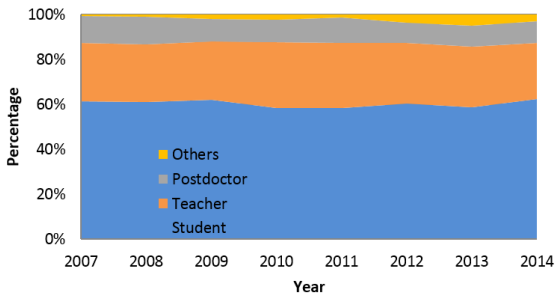

Fig 2. SCI papers published by Tsinghua (2007-2015)

What kind of training is available for doctoral supervisors?
Tsinghua built up a supervisor training system in early 1990s (The Duties and Obligations of Supervisors in Tsinghua University, 1990). Before 2010, the Graduate School organized training programs for new Ph.D. supervisors every year. Excellent supervisors from Tsinghua and outside Tsinghua were invited to share their experience and the institutional policies were explained to help new supervisors get familiar with the situation and do better jobs in cultivating students. From 2011 to 2016, the supervisor authorizing system was reformed

and the responsibility of new supervisors training was delegated to individual schools and departments.

In 2016, the Graduate School is planning to restart the university-wide training program for new supervisors, which will be redesigned in collaboration with individual schools and departments.

How to assess the quality of mentoring?
Tsinghua built up to collect the feedback from graduate students. The Student survey upon graduation system was online during 2006 to 2014. From 2015, an updated system, called Doctoral students learning and development survey system was built.

All doctoral students are required to take questionnaire survey, which is designed to understand their learning experience in Tsinghua, every year till they graduate. This longitudinal survey collects information on students' real demands and status of development and progress during the doctoral training process. An individualized report based on the survey data will be given to students to help them improve their studies. The survey also provides a way to students to express their actual feelings and suggestions to their programs.

Tsinghua also have a system named "The Erudite Mentor and Beneficial Companion Campaign" to find out the most helpful mentors. This campaign is sponsored by the Graduate Student Union of Tsinghua University and aims at selecting the most remarkable graduate mentors by all graduate students in Tsinghua University. The selection takes place once every two years and each time about 45 award-winning mentors and 10 special laureates are selected. Since 1998, this campaign has been held 15 times and awarded 1117 prizes to 613 mentors in total. By now, The Erudite Mentor and Beneficial Companion Campaign has become one of the most influential student activities on campus which made great contributions to creating a positive academic atmosphere in our university.

Tsinghua has built accountability mechanism on quality failure as well. For the supervisors who are in breach of duty, based on situation and attitude, the reprimands will be advised by school and department, considered by the Graduate School, approved and executed by the University.

According to the doctoral degree earners from 2006 to 2014, most doctoral students discussed problems with their supervisors at least once a month. The interaction became more frequent in recent years. And about 50% of doctoral students interacted with their supervisors every week in 2013 and 2014.

It also was reported by current doctoral students that 80% of continuing doctoral students in academic year 2015-2016 agreed that their supervisors enlightened and encouraged them to explore the research area in depth, and 75% of the students agreed that their supervisors provided suggestions and advices on career development.

4: Career Preparation & Innovations in Doctoral Curricula and Training

Transversal Skills Training for Doctoral Students in a Latin-American context: Experiences and challenges of the Doctoral College of the Pontificia Universidad Católica de Chile

Jani Brouwer
Director, Doctoral College UC
Pontificia Universidad Católica de Chile

Introduction:
The development of research and other skills during the doctoral training period is recognized by research students, academic staff, sponsoring organizations, employers and doctoral graduates. These skills improve the research student´s ability to complete the research degree successfully.

The development and application of such skills is a significant element in the research graduate´s capability for sustaining learning throughout his or her career, whether in an academic role or in other employment.

Research students are encouraged to take ownership and responsibility for their own learning, during and after their program of study, and to recognize the value of developing transferable skills.

Experience of the Doctoral College UC
The Doctoral College, in Spanish Colegio de Programas Doctorales (CPD) from the Pontificia Catholic University of Chile (UC) is part of the Vice-Presidency for Research. Its mission is to ensure the quality of its 34 doctoral programs, promote policies and mechanism to facilitate curricular flexibility, interdisciplinary training and international exposure of its approximately 1300 students.

The Doctoral College provides competitive scholarships and upon its establishment as an academic unit in 2015 teaches and coordinates Transversal Skills Workshops and English courses for doctoral students to enrich their doctoral training and increase and diversify their employment opportunities.

The courses and workshops offered by CPD are coordinated with other divisions and academic units such as English UC, the Center for Professional Development and UC Libraries. The subjects studied provide practical tools to develop skills in scientific communication, technology transfer, intellectual property and command of a second language, among other fields. All matters addressed seek to make graduates bear a distinguishing seal in their relationship with the scientific, social and productive environment through their leadership abilities and the internationalization of their study programs.

In its new regulations for doctoral studies the university recognizes the acquisition of transferable skills (two of a compulsory character; English Language Training and Ethics and Research Integrity) in parallel with the academic assessment of the research student´s progress.

Some examples:[1]

1. *Workshop on Ethics and Integrity in Research*
   Upon completing the workshop, students receive an internationally acknowledged certificate (Compulsory).
2. Technology Transfer and Intellectual Property Workshop
3. Workshop on Academic Presentations in English; Workshop on Academic Writing in English; Workshop on English Academic Writing in the Humanities; Workshop on Academic Writing in English for Science and Technology.
4. Development of Teaching Skills Workshop
5. English courses (compulsory)

Other non-compulsory Workshops, Courses and Support Services for Doctoral Students

Academic Writing Center English UC

This is a service provided by English UC that consists of self-study activities to develop the ability to write scientific manuscripts in English by carrying out activities that are suited in difficulty to the student's level of knowledge level.

Workshops employment preparation

The Center for Professional Development (CDP) is a unit of the Office of Student Affairs (DAE) which provides advisory services and guidance to students who are in the process of transition between completing their university studies (undergraduate or graduate) and joining the labor market. A team of labor psychologists draws up an annual program of free workshops to help students in different areas. The workshops offered so far include: "Your project and professional profile: self-knowledge and technical competencies"; "Evolution of the labor market"; "Writing an effective curriculum vitae"; "The job interview" and "Psychological tests" among others.

Workshop on Library Services UC / SIBUC

Challenges

Ensure that the participation in transferable training workshops are not so intensive or time-consuming as to affect the research student´s ability to complete.

Develop ways of formally recognizing the acquisition of compulsory and non-compulsory skills in parallel with, or as part of, the academic assessment of the research student´s progress.

1 *Guide for Doctoral Students Doctoral College UC*: Chapter 3.4: Development of Transversal Skills pp. 34-41

Connecting Doctoral Student Needs with Professional Development Opportunities to Promote Career Success

Karen Butler-Purry
Associate Provost for Graduate and Professional Studies
Texas A&M University (United States)

Texas A&M University (TAMU) uses several data sources to determine student needs related to professional development. Three such sources include graduate student climate surveys, graduating student surveys, and professional development participant surveys. In Spring 2012, Texas A&M conducted their first climate survey focused solely on graduate students. Response rates showed that approximately 15.5% of enrolled graduate students (51% doctoral and 49% master's students) took the survey. One group of the survey questions centered on the availability of and participation in various professional development opportunities. In addition, over 90% of Texas A&M University doctoral students complete a graduating student survey containing the core AAUDE (American Association of Universities Data Exchange) doctoral student exit survey questions along with some additional questions specific to TAMU. The doctoral survey includes questions about students' teaching assistant and research assistant experiences, and also explores student use of and perceived value of various professional development resources.

ORCID (Open Researcher and Contributor ID) records of graduate students represent a third data source mined by TAMU. ORCID records contain students' biographical and bibliographical data. Previously Texas A&M minted ORCID identifiers for all graduate students during their first semester of enrollment. We followed up with various strategies to encourage students to maintain and update their records throughout their matriculation at Texas A&M and beyond to successfully manage their professional identities. ORCID identifiers are no longer minted by the university; therefore, our outreach now focuses on encouraging students to claim their ORCID identifiers during matriculation or at the time they submit their theses or dissertations. With permission from students, the university can pull data from ORCID records to examine student professional development participation and career outcomes to identify successful professional development programs and/or gaps.

Findings from the aforementioned data sources revealed that some groups of students participated in opportunities more frequently than others. Many students were not aware of the professional development opportunities available to them in their department, college or even at the university level. Also, some students reported inadequate access to resources and services due to location, schedule conflicts, and lack of online access.

Hence, the Office of Graduate and Professional Studies developed an on-line Graduate Student Professional Development Portal which contains an aggregate of professional development opportunities offered across campus. Furthermore, several Texas A&M offices providing support to graduate students joined forces to create a coordinated professional development program called G.R.A.D. (Graduate Resources and Development for Aggies) Aggies. G.R.A.D. Aggies organized its professional development programs into four areas: Academic Development, Leadership and Communication Development, Instruction and Assessment and lastly Career Development. These four key competencies which cut across academic disciplines and degree programs originated from graduate student professional

development literature, peer institution best practices, and feedback from graduate program directors, advisors and students. The G.R.A.D. Aggies program supports the Texas A&M institutional Quality Enhancement Plan and provides high-impact learning experiences while also promoting a commitment to learning for a lifetime in graduate and professional students. In the 2015-16 academic year, G.R.A.D. Aggies launched professional development certificates (PDCs). The PDC offerings come in three levels: basic, intermediate, and advanced. Students earn Professional Development Units (PDUs) through participating in G.R.A.D. Aggies activities and completing an associated reflection/feedback or quiz assignment for each workshop in our eCampus learning management system.

The National Association of Colleges and Employers has identified 7 competencies required to make a successful transition from graduate level education to the workforce. These include critical thinking and problem solving, oral/written communication skills, ability to work in teams, information technology application, leadership, professionalism and work ethic, and career management skills. Many graduate degree programs provide training in some of these critical skills but very rarely offer training in all. According to the 2014 National Science Foundation (NSF) Survey of Earned Doctorates (SED) data, 65% of Texas A&M's doctoral graduates secured employment in non-academic positions at time of graduation. Further, 74% of our science and engineering doctoral graduates obtained employment in industry, government, or non-profits at time of graduation. Therefore, in addition to the broad G.R.A.D. Aggies initiative, several STEM- focused programs have been developed at Texas A&M prioritizing academic and non-academic career pathways.

One example is Texas A&M's recently funded NSF Division of Graduate Education supplement award for improving graduate student preparedness for entering the workforce which aims to address this shortcoming. The project goal includes implementing and assessing a one-year pilot program designed to "close the gap" between discipline-specific training and the wider set of transferable skills desired by employers of STEM doctoral students. The program employs a unique, personalized approach focusing on deficiencies each student self-identifies up front that need work in order to achieve career success. The program targets currently enrolled NSF Graduate Research Fellowship Program (GRFP) recipients and also NSF GRFP honorable mentions at Texas A&M University. The program provides development of a personalized career/professional development plan, participation in a TAMU career boot camp, field trips to industry and various types of institutions, an on-campus career fair, G.R.A.D. Aggies activities, and an off-campus career/professional development activity. Presently, developing assessment instruments to gauge the effectiveness of the career readiness activities is underway.

Another example of our STEM-focused professional development efforts includes the Texas A&M System Alliance for Graduate Education and the Professoriate (TAMUS AGEP) project. Texas A&M University serves as the lead institution in this alliance of five PhD-granting institutions in STEM fields. AGEP aims to develop multiple paths to the doctorate and professoriate for students from underrepresented minority populations by successfully developing and sustaining large-scale, distributed yet interconnected STEM communities among the five diverse alliance institutions. AGEP program activities aim to increase participation, reduce barriers, and promote success of URM doctoral students preparing for careers in the professoriate. The TAMUS AGEP program "curriculum" centers around learning objectives connected to the four professional development competencies.

How Do We Get There from Here and Why Should We Do It?: Facilitating Graduate Curricula Change

Barbara Crow
Dean of Graduate Studies
York University (Canada)

York University is located in the largest city in Canada. The University has over 50,000 students, 45,000 undergraduate and 6,000 graduate students. We have the fourth largest number of graduate students in the province and our students receive an overwhelming proportion of the financial support through unionized labour. We offer 105 graduate degrees and 34 graduate diplomas (masters, n=62; and doctoral, n=42) with 1,616 part-time and 2,530 full-time master's students and 254 part-time and 1,644 full-time doctoral students, for a total number of graduate students of 6,044. Despite the fact that we have been offering graduate programming since the University opened in 1959, the most significant growth in the last decade was largely the result of provincial initiatives to grow graduate education.

From the perspective of your institution and/or country: Despite evidence from a range of sources and the growing organization of doctoral students who do not want and/or have not succeeded in securing tenure track positions, many faculty colleagues are not interested in the requests for integration of professional training in curricula. In order to engage with colleagues, we have: a) shared research literature and bibliographies on topic; b) linked to post-doctoral sites; c) created PhD networking events; d) offered professional skills development at the Faculty level; and e) encouraged units to integrate professional skills in curricula and learning outcomes.

Opportunities

- Collaboration across the universities (please see mygradskills) to provide standardized knowledge and expectations regarding professional skills in relation to graduate education. The universities would be benefit from a shared commitment on the value and contributions of doctoral studies.
- Institutional commitment to integrate and update professional skills training throughout graduate curriculum
- Development and resource allocation for professional skills animation in graduate school and Faculties
- Clearing house of resources of programming and innovation in graduate professional skills
- Inventory of occupational trajectories that have required and benefitted from doctoral training

5: Doctoral Dissertations and Capstones

Is This a Dissertation?

Marie Audette
Associate Vice-President Research and Innovation
Université Laval (Canada)

The past few decades have witnessed important changes in the research ecosystem worldwide, including Canada a research ecosystem enabling the PhD graduates to meet their aspirations, in any discipline, inside or outside the academy. Conversations around the structure of doctoral programs, the nature of doctoral research and the formats of the doctoral dissertation have thus multiplied, and the Canadian Association for Graduate Studies (CAGS) has taken a leadership role by focussing its recent annual conferences on rethinking the PhD, by advocating for the importance of doctoral education for Canadian society, and by taking part in several initiatives across Canada and abroad.[1] Chaired by Deans Susan Porter and Lisa Young from University of British Columbia and University of Calgary respectively, CAGS formed a working group in 2016 that has produced a concept paper around the purpose, content, structure and assessment of the doctoral dissertation. This paper will form the basis of a consultation to be held in Canadian universities, with the conclusions and recommendations available in 2017.

The dissertation is generally described in universities' rules and regulations as a scholarly work bringing an original and significant contribution to knowledge. Chapter-based or manuscript-based dissertations are still the standard, depending on the discipline. In the Arts, research-creation activities have driven the emergence of new forms of dissertation comprising a creative production component (recital, multimedia setting, novel…), and a written component contributing to further the knowledge in artistic practices. Recently, the Humanities have pushed to renew the structures of the PhD and the format of the dissertation. The Institute for the Public Life of Arts and Ideas based at McGill University (Montreal, Québec) has published a *White paper on the Future of the PhD in the Humanities*.[2] Along with their recommendation to implement new doctoral curricula, they also advocate for a "radical change by replacing the thesis with a coherent ensemble of projects, which can include single-author and collaborative essays, electronic archives or other kinds of digital scholarly resources, editions, translations, works of scholarship in range of forms, oriented toward multiple audiences". In doing so, they propose to better prepare the graduates for the Humanities of the 21st century and reinforce their societal importance, while addressing the chronic problems of academic unemployment, time to completion and graduation rates (~50%). Two "Future Humanities" conferences were organised in May 2015 and 2016, in Montreal and Ottawa, respectively,[3][4] bringing together graduate students and faculty members to keep alive the conversations and ensure that the recommendations are implemented in Canadian universities. The landscape is slowly changing but the direction is given.

1 http://www.cags.ca/gradeducation.php
2 Institute for the Public Life of Arts and Ideas, McGill University (2013)
3 Future Humanities 2015, McGill University, Montreal, May 2015
4 Future Humanities 2016, Carleton University, Ottawa, May 2016

The University of British Columbia has recently launched a pilot project, the UBC Public Scholar Initiative[5][6], which integrates a broader form of scholarship oriented toward the society, and new dissertation components (patent application, policy or consulting reports, evaluation tools, performances, etc.) identified as artifacts of societal and intellectual value, that must be critically analysed and situated within a given field.

Writing and completing a dissertation, no matter the format, requires mobilising transferable skills linked to personal effectiveness (perseverance, time management, prioritisation, self-confidence) long viewed as collateral assets developed by particularly successful (strong) students, but being now better supported by graduate schools via specific activities such as writing boot camps, seminars, summer schools or online courses. Employers particularly seek these transferable skills. For many students, writing a dissertation also requires mastering English (or French) as a second or a third language. In the context of increased internationalization, globalization and mobility, polyglot employees are highly valued.

The skills developed by a researcher throughout his/her training and via continuing professional development have been described by groups such as Vitae[7] in the UK or Adoc Talent[8] in France. The research ecosystem of the 21st century emphasizes the development of skillsets related to collaborative, inter-, trans- and multidisciplinary work, to better solve societal problems of increasing complexity, whereas the digital technology and new communication media are reshaping diffusion of knowledge. The existing model of a "good dissertation" must thus be revisited and expanded to take into account the needs and the reality of the contemporary scholar. The students' experiences now include internship within industry or non-profit making organizations, public outreach activities, technological or social innovation, and entrepreneurship activities, among others, that are unfortunately not integrated enough in the doctoral curricula and are excluded from the dissertation in general.

PhD graduates want their doctoral work to have an impact, in their field, in society, for their future. A doctoral portfolio comprising a series of scholarly productions would be best suited to support their entry into workforce. The dissertation would thus constitute a passport toward diverse careers. However, we should keep in mind that some doctoral students come from the work place. For instance, the 2016 CAGS winner for the best dissertation award in Humanities, Arts and Social Sciences has already an established career as a writer, editor, cartographer and graphic artist.[9] His fruitful career was indeed the passport for a successful doctoral path in History. There is thus a need for flexibility. Non-traditional formats not only may coexist with traditional ones, but they should. According to the student's needs and personality, writing a book length dissertation or a series of scientific articles are the best learning experience, because writing a dissertation is a learning experience.

Rethinking the purpose of the doctoral education of the dissertation and the role of doctoral graduates for society is not without raising controversies or at least bringing questions about the coherence of the dissertation. Will it include loosely related studies? How to assess

5 UBC Public Scholars Initiative, consulted 2016-09-20

6 http://www.cags.ca/documents/publications/3rdparty/PorterPhelpsPSI.pdf

7 https://www.vitae.ac.uk/vitae-publications/rdf-related/researcher-development-framework-rdf-vitae.pdf/view

8 Barthelemy Durette, Marina Fournier & Matthieu Laffon (2014), The core competencies of PhDs. Studies in Higher Education, DOI : 10.1080/03075079.2014.968540

9 http://www.cags.ca/news53.php - .V-Qv4DvCp34

the quality and the rigor of new forms of scholarship? The students are key players in the universities' research activities, as demonstrated by Larivière, who showed they contributed to one third of publication output in the province of Quebec, between 2000-2007.[10] What will be the consequences of "diluting" manuscript-based dissertation for universities' research? It will be important to carefully delineate the changes to be brought and to listen to colleagues and students. The consultation to be held by CAGS in 2017 in Canadian universities should shed additional light on our community's expectations and help graduate schools to play their role as leaders in the transformation process.

10 Vincent Larivière (2012), On the shoulder of students ? The contribution of PhD students to the advancement of knowledge. Scientometrics, 90(2), 461-483

More than an Admission Ticket to the Academic Club: The Doctoral Dissertation as a Vehicle for Development and Measurement of Graduate Attributes and Future Employment

Alastair McEwan
Dean, The Graduate School
University of Queensland (Australia)

Although all states, with the exception of Queensland, established Universities before Federation of Australia as a nation (in 1901) it was not until after World War II that PhD programs began. The Australian model for the PhD has similar characteristics to the practices in the United Kingdom from which the model evolved. These characteristics include relatively short duration (3-4 years), variable amounts of coursework, dependent on the discipline, and a focus from the beginning of candidature on the research topic that is linked to the production of a thesis. Although there is some variability in the form of the thesis around the world, examination includes an assessment of the quality of the thesis by external examiners and of the capability of the candidate via an oral examination. In contrast most Australian PhD theses are examined 'by correspondence' with the thesis being sent to two external examiners who provide a written assessment of the thesis. Although there is provision for an oral examination uptake of this opportunity is low (around 5% at the University of Queensland). This atypical situation, arising from Australia's geographical isolation, has led to an emphasis on thesis quality and perfectibility, since this is the only measure of whether a candidate should be awarded a doctorate. However, the 'thesis by correspondence' approach that is linked to the production of a proto-monograph is being destabilized by the 'thesis with publications' thesis format that has emerged in Australia over the last decade.

Production of a 'thesis with publications' is increasingly popular across Australia, especially in the STEM disciplines. This reflects the reality that peer-reviewed research publications are considered to represent the real enabler in the employment marketplace, on the assumption that the PhD graduate is destined to continue as a researcher in their discipline. At the UQ we have accommodated the 'thesis with publications' into the traditional proto-monograph format by requiring candidates to present their published papers in author-accepted manuscript form that enables them to be modified following review by examiners and by requiring them to write a connecting narrative and conclusion chapter that maintains the unity of the thesis. The present situation is not sustainable; increasingly candidates refuse to make changes suggested by examiners on the grounds that their work has already been peer-reviewed for publication and there is a varying degree of compliance with the requirement to provide a connecting narrative. The solution is to move to mandatory oral examinations that measure the quality of the candidate and her/his outputs and at UQ this will be instituted progressively over the next 3-4 years. Although there are fewer examples of 'thesis with publications' in HASS disciplines the proto-monograph is seen by candidates and advisors as a precursor of a publication that can establish the reputation of the author in academia and enhance future employment opportunities in this sector. Particularly in the humanities the thesis is also considered an important contribution to the creation and preservation of

new knowledge. UQ already has an alternative thesis format policy that enables students to produce a thesis that includes:

- written material that is not academic prose (such as a musical composition or a creative work of fiction)
- non-written material that is recorded in another format (such as a multimedia presentation or a musical recording)
- an event fixed in time or space (such as a drama performance, a musical performance or an art exhibition)

From the perspective of STEM and HASS academics the purpose of the thesis is continues to be linked to production of the next generation of academics and researchers in area that are cognate with their discipline; the form of this thesis is secondary in importance. Given the lack of employment opportunities for PhD graduates in academia there is a pressing need to reimagine the purpose of the PhD from a career building perspective and to promote the capabilities and attributes that it develops to employers outside of academia. Seen from this perspective the doctoral dissertation is only one of several measures of a candidate's ability and there is a need to develop an understanding of what the thesis can tell us about a PhD graduate in terms of attributes beyond disciplinary knowledge and capability. UQ's policy for development of transferable skills includes:

- Capacity to communicate ideas effectively to a range of audiences inside and outside the field of study or discipline and to the wider community
- Ability to work collaboratively and effectively with others, within a range of teams and contexts, respecting individual roles and responsibilities
- Ability to apply analytical and critical thinking skills to investigate problems and develop inventive solutions,
- Ability to lead projects within or across disciplines
- Ability to write coherently and convincingly

Some of these attributes can be developed during the production of the thesis and measured as part of the thesis examination. In addition to a report on the quality of the research produced by a candidate examiners are asked to score (above, at or below expectations) in relation to areas including originality and the ability to develop the research narrative in a clear and convincing way. This approach is at an early stage at UQ but it can be developed and used to promote writing and communication skills during the PhD. In the context of the role of the dissertation in the employment marketplace the dissertation should be regarded as one of several activities and experiences that enables a PhD candidate to build a portfolio that describes their attributes and capabilities. Some skills are facile since they can be delivered via training (commercialisation skills, for example). However, transferable skills need to be measured in relation to student activity: during the their candidature, during a placement or internship, for example, and as mentioned above the thesis examination assessment should form part of that portfolio that describes attributes and capabilities. At UQ the aim is to record training activities and experiences using the Australian Higher Education Graduation Statement (AHEGS) that sits all students receive in addition to their PhD testamur. This is currently under-utilised. However, to have impact that is more than mere tokenism there is a need to develop these capabilities as part of an e-Portfolio of graduate student development.

Although we are all aware of the view that we are training too many PhDs on account of the limited availability of academic positions many advisors continue to have a very narrow vision of the PhD as being purely about research outputs and this is the greatest barrier to change. The challenge is to work with advisors to get them to appreciate the broader attributes that the student is developing during their research and the production of a thesis.

In the context big data, digital interactions may be of value in promoting collaborative interactions between researchers. However, correlation, inference and 'value free' analytics are not in themselves a substitute for theory and should not displace the 'hypothetical way of progress'.[1]

1 Huszagh V. A. & Infante J. P. (1989) *Nature 338*, 109

Rethinking the Ph.D. Thesis

Christopher Sindt
Vice Provost, Graduate and Professional Studies
Saint Mary's College of California (United States)

For over 150 years, the dissertation has been the primary object of the research enterprise: it is where students demonstrate their emergence as professionals qualified for university teaching; it is where students demonstrate critical thinking, writing, and disciplinary skills at a high level; and perhaps most important and appropriate, it is where students contextualize and differentiate new knowledge that makes a contribution to the field and to society.

The Ph.D. is considered the highest academic degree and distinguished from other doctorates by its claim to produce new basic research that expands the field in specific and concrete ways (as opposed to applied research related to improved professional practice). Learning outcomes associated with this degree level typically include the ability to make discoveries as well as communicate it." These outcomes are largely demonstrated in the dissertation, where the student synthesizes the learning accomplished in coursework and/or research laboratories in a sustained, original, and well-articulated piece of writing. The completion of the dissertation demonstrates the candidate's ability to understand and summarize a major problem in the field, and to successfully make a contribution to understanding the issue.

The dissertation is also the location of significant challenges to graduate student success. The Ph.D. completion rate in the United States is roughly 50% and the average time-to-degree is eight years. I would like to suggest that the dissertation phase of the doctorate is a key contributor to these distressing statistics. Graduate students in this phase report feelings of isolation, a loss of purpose, and a disconnection from both the practical application of the research and the professional value of completion.

Further, we have heard significant debate in the past ten years about the utility of a culminating project that does not replicate the heterogeneity of the scholarly market. The diverse set of scholarly fields aligned with the Ph.D. allows for a range of established publication formats—from lab reports to scholarly articles to professional performance. The long, written dissertation is mostly a closed system—a single author alone with her research and results and ideas, while the scholarly community is just that, a community or network of researchers who work together in labs or use new technologies to stay connected about their developing ideas. Meanwhile, the professional workplace increasingly values teamwork and collaboration, and professions outside of academia especially value the demonstrated ability of an applicant to bring disciplinary expertise to work in interdisciplinary teams.

The primary cultural barrier in rethinking the dissertation is the strong conservative impulses inscribed into academia. The professoriate replaces itself by asking graduate students to repeat the experience they had as students. This is understood in part to be a challenge to the student, a high bar to pass in order to enter the ranks of the professoriate. It is also partly due to the fact that university-level educators are not required to think about the best ways students learn.

Though change has been slow, several innovative practices related to the dissertation are starting to find traction: the portfolio model, in which students produce several publishable journal articles rather than a sustained monograph; collaborative and interdisciplinary authorship of the dissertation; and alternative and mixed media, incorporating video, audio, and open source elements. There are also several innovations bringing the work of the dissertation student into contact with the public discourse: the "two-minute" dissertation, in which candidates produce and practice a brief elevator pitch about their research; the requirement for a lay abstract as a preface to the dissertation; and, presentations within universities to other disciplinary communities. In these examples, students are asked to think about the broader impact of their work.

One possible avenue for exploration is to look to applied doctoral degrees, such as the Ed.D. At Saint Mary's College of California, the Ed.D in Educational Leadership is the site of innovative, community-centered dissertation projects that connect to the profession and demonstrate higher-level learning. In this program, students engage in three rounds of research practice through university-community partnerships and research in their own work settings. In the first cycle, focused on collaborative inquiry, students work in small teams on focused research questions with community partners; in the second cycle, community-based research, students work with a school, agency or nonprofit organization to jointly develop a research project that will meet the needs of the organization, while developing important research skills (typically interviewing, survey construction and data analysis). In the third cycle, students engage in participatory action research within their work setting on projects aimed at creating sustainable change through collaboration; students use research and leadership skills, working to forge a collaborative team, often in distinction to the established norms of power and privilege in the organization. The dissertation typically expands on the participatory action research project, providing more thorough theoretical, methodological and analytical grounding and reflection. This model is iterative, collaborate, and community based: students build networks of support in their program and engage with partners around societal or community problems. By the time of the dissertation, there are multiple partners engaged in the outcomes and the success of the project.

In conclusion, we need to celebrate these innovations and create further dialogue to advance creativity about the culminating project--and this entire phase of the doctoral degree. We need to move the doctoral student experience toward open systems that incorporate multiple communities: open source documents, blogs, chat rooms, human to human networks, and sponsored research communities. We need to help students feel connected while researching, thinking and writing, and we need to help students learn how their work is connected to the public good.

6: How Do Doctoral Assessment & Career Tracking Influence Definitions of Doctoral Education?

Enhance Programs, Improve Work Integration of Graduates, and Highlight the Contributions to Society of Doctoral Students: Example of Québec Project to Survey Doctoral Skills

Philippe-Edwin Bélanger
Director, Graduate and Postdoctoral Studies
Université du Québec (Canada)

Enrolment in doctoral programs is rising at an unprecedented rate around the world, and Québec is no exception. The numbers enrolling in a PhD have increased by 150% in the last 20 years (CREPUQ, 2006). What's more, the proportion of entrants completing their programs and earning PhDs has also risen, from 48.7% in 1987–1988 to 61.2% in 2010–2011 (Ministère de l'Éducation et de l'Enseignement supérieur [MEES], 2013).

Nevertheless, the completion rate and duration of study for doctoral programs remain worrying (cf. Tamburri, 2013). According to data compiled by MEES, the PhD completion rates for all fields combined are 25.8% after five years of study, 40.1% after six years of study and 56.6% after eight years of study (MEES, 2016). Average doctoral program duration as reported by most Québec universities is around four years.

Furthermore, studies indicate shrinking employment opportunities in the university education sector, which is what a doctorate traditionally prepares students for, despite the fact that Québec graduates are facing less competition for access to university faculty positions than their American counterparts (Nicolas et al., 2008, p. 52 sqq.). Between 1991 and 2005, Québec faculty grew by only 7%. That's one percentage point lower than the Canadian average and 19 percentage points lower than the American average (ibid.).

Even assuming that employment prospects for university professors improve in the coming years, there is nothing to suggest an improvement in the proportion of doctoral graduates entering these positions relative to the total number of PhD holders (ibid).

While only a minority of doctoral program graduates hold teaching positions (20% according to the Conference Board of Canada [2015]), we are seeing a rise in the postdoctoral enrolment rate, particularly in the life sciences (Mitchell et. al., 2013). A 2013 survey by the Canadian Association of Postdoctoral Scholars revealed that although the majority of postdoc scholars see their programs as a first step toward employment in an academic institution, most of them will not be hired by a university (ibid., p. 3).

That means the main source of employment opportunities for those completing doctoral studies is outside the academic world. Nevertheless, there is little data on the quality of positions occupied by PhD holders or their level of satisfaction with these positions.

Data collected by Auriol (2007) on how satisfied PhD program graduates are with their employment status reveal that the majority are happy with their jobs, but that satisfaction correlates more to what their positions offer (e.g., intellectual stimulation, autonomy) than employment conditions (e.g., income) (ibid., p. 20). In addition, the MEES Relance survey of

PhD holders (2012) found that about 45% of those with PhDs believe that the work they do requires a lower level of education.

On the other hand, non-academic employers don't always consider a PhD an asset (Rynor, 2016). According to some, doctorate-level skills are too difficult to adapt to a real work environment to meet their needs. Employers say they want graduates who are not only experts in their field, but can also apply their knowledge, manage projects, work in a team, and communicate effectively, to give just a few examples (cf. Kehm, 2004; Kot & Hendel, 2012; and Nerad, 2004).

The German model offers some possible solutions. In Germany, universities work with public and private organizations as well as NGOs in many ways, including internships. Making internships part of doctoral programs could be a step toward better cooperation between academia and the work world (Doré, 2015).

However, further research into this issue is required, specifically in Quebec, to assess how work experience and scholarships affect the acquisition of doctoral skills.

The issues raised by work integration after completing a doctoral program have prompted several academic partners to undertake a pan-Quebec study of the skills of PhD students and graduates to collect more data on the skills acquired in doctoral programs and the perceptions of graduates, professors, and employers.

The study's overall long-term objective is to make it easier to understand the skills acquired in doctoral programs and how students and graduates of those programs apply their skills. More specifically, the skills developed and used by doctoral students and graduates will be identified and put into perspective in relation to the skills needed in the public, private, and association sectors as well as the skills expected by academic institutions that offer doctoral programs and by organizations that provide student scholarships and internships.

The results of this study will provide professors, academic institutions, granting agencies, and governments with courses of action and strategies to explore the roles of training programs, internships, and research environments in developing doctorate-level skills. In addition, these results will give Quebec's employers and the general public a better understanding of the skills developed by doctoral students and graduates, who are assets for public and private organizations and society in general.

Furthermore, the results of this study will offer students and graduates an opportunity to appreciate the range of skills acquired through doctoral programs and perhaps help guide their life and work choices.

Tracking and Delivering Doctoral Careers

Luke Georghiou
Vice-President for Research and Innovation
University of Manchester (United Kingdom)

The value of a doctoral education is manifested in many ways but in most instances it is expressed through the vehicle of the researcher's subsequent career. For those following the conventional academic path there are already interesting questions to be asked about how well equipped they have been for the increasing variety which success in today's universities demands. If we consider the growing group who find destinations beyond higher education, or beyond research, the need to understand and improve the contribution of the doctoral path becomes even more pressing. Key questions include the scale and shape of future demand in the labour market, international and inter-sectoral mobility and the expectations and actualities of employment at different career stages. In this presentation I will consider firstly what we know about the process of tracking, secondly what existing studies are telling us about pathways and destinations, and finally what implications this has for doctoral education in Europe.

Turning first to the methodology of tracking, the pioneering work of OECD and its collaborators in the European Union-funded KnowINNO project set out very clearly the options and challenges.[1] These include defining and structuring the target population, critically, the sources needed to build a sampling frame, and the strategies for the surveys themselves. Different approaches offer advantages and disadvantages. Hence, surveys of recent graduates are likely to produce a high response but offer little beyond the nature of the first destination. Longitudinal cohort surveys offer the best chance to link education and subsequent stages over time but response rates may decay over time while the experiences of entrants from outside the cohort (e.g. migrants) will not be captured. Retrospective surveys carry increasing risk of fading memory of the detail of the educational phase. A recurring difficulty in any such study is that a sample population is likely to have an inherent bias towards inclusion of those who have remained in or close to the research system and are identifiable through their publications, networks or by means of relatively simple search procedures.

At the University of Manchester we triangulate across three different datasets, mixing elements of all three of the above approaches. Hence career intentions are surveyed via our progress monitoring system at the point of submission of their thesis. To this we can add data from the national survey 'Destinations of Leavers from Higher Education' which is executed according to a national statistical template and provides responses relating to career destinations 6 months after graduation. The third element seeks to build a longer-term dataset on destinations and uses a survey of supervisors to update alumni records that then form the basis of a biennial survey. This third element is at an early stage but is intended to inform recruitment strategies, researcher training and development provision and doctoral programme structure.

1 Auriol, L., M. Schaaper and B. Felix (2012), "Mapping Careers and Mobility of Doctorate Holders: Draft Guidelines, Model Questionnaire and Indicators – Third Edition", *OECD Science, Technology and Industry Working Papers*, 2012/07, OECD Publishing. http://dx.doi.org/10.1787/5k4dnq2h4n5c-en

Studies that focus on the earlier post-completion years tend to show large proportions in research posts. Since it is unlikely that most of those in that system will find tenured academic posts it may be that surveys are exaggerating the numbers that eventually remain in research, reinforced by our earlier conjecture that there is a bias in tracking methodologies. For example a survey by the European Science Foundation with a seven-year frame showed only 12% had careers outside research and 35% held tenured posts.[2] Unsurprisingly tenure was strongly linked to age and academic productivity was associated with job security. The lengthy period of temporary employment that characterizes the majority of careers belies the view research posts can be dismissed as a transitory phase. For many they represent a substantial part of their working lives and reflect the decline of single lifetime careers more generally. An implication is that more support needs to given both during and after the doctorate to increase the quality of this type of employment and to widen the possibility of beneficial exit to other career paths.

A 2016 survey by Vitae of researchers who leave research posts in higher education indicated another phenomenon, a substantial group who remain in the research system in professional and administrative roles either in higher education or in related bodies such as funding and technology transfer agencies.[3] This path too has implications for doctoral training. It is already accepted that training should include gaining knowledge and skills in such areas as intellectual property management and enterprise to equip them as researchers. Less common is a formal training in research policy and management. There is a strong argument that these disciplines would benefit both those who remain directly performing research and those whose path is to operate the wider research and innovation ecosystem.

The third group is composed of those who have left academic life for careers in industry, government or the third sector, either as an initial choice or following a post-doctoral phase. More work needs to be done on the ways in which a doctorate supports such careers but some key elements include not only the qualitative and quantitative transferable skills that are rightly now seen as essential but also capabilities that are intrinsic to the doctorate itself, including a capacity for critical and original thought, management of uncertainty and an openness to evidence-based solutions. An absorptive capacity for research findings is greatly enhanced by research experience.

2 European Science Foundation, Career Tacking of Doctorate Holders – Pilot Project Report
3 Haynes, K., Metcalfe, J. and Yilmaz, M. (2016) What do research staff do next? CRAC, Vitae

What Our Doctoral Alumni Tell Us Can Foster Program Improvement

Barbara A. Knuth
Senior Vice Provost and
Dean of the Graduate School
Cornell University (United States)

The Graduate School at Cornell University regularly collects information from doctoral alumni. We seek to learn about the careers our alumni have pursued after graduation, their perceptions of how well their Cornell doctoral education prepared them, and their suggestions regarding how Cornell doctoral education might be improved to better prepare our current students for their future career paths. The aggregate data we report make visible the diversity of careers available to doctoral students, and provide statistics to support faculty grant applications for various sponsors who want to know faculty are paying attention to career outcomes.

Our instrument is the Doctoral Alumni Career Outcomes Survey that we have administered to the most recent 20 years of Cornell doctoral alumni (n=9,975), supplemented with internet-derived data for survey non-respondents, using a search-match technique with various lists (e.g., LinkedIn) and search engines (e.g., Google). The survey response rate is about 28% overall, but varies by cohort, with the more recent alumni responding at higher rates (e.g., 51% for 2 years post-graduation) compared to more distant alumni (e.g., 19% for 20 years post-graduation). The search of public web sites produced employment and location information for an additional 40% of the original 9,975 alumni (40%). No information was found for the remaining 3,198 alumni (32% of the original 9,975). We will continue to implement the survey periodically to the most recent 20-years of alumni, adding new participants as they enter the ranks of alumni (at 2 years post-graduation), and resurveying selected cohorts about every 5 years, and will continue the search of public web sites.

Our Doctoral Alumni Career Outcomes Survey questions focus on several themes using closed-ended questions: current employment status and type of employer; location of employment; salary range; how closely the current position relates to the graduate degree earned at Cornell; how well the Cornell education prepared the alumna/alumnus for their current position; how satisfied they are with their current position; whether they would pursue the same degree again, in the same field, and at Cornell; the importance of various factors in securing the first job after graduating (e.g., quality of academic work reputation of the graduate program, etc.); and the importance of various aspects of doctoral education for current students entering the job market in the individual's field (e.g., teaching skills, writing skills, knowledge of research methods, etc.). The survey instrument concludes with an open-text response question seeking suggestions about any aspect of doctoral education they would like to see changed for students entering jobs in their field. These comments are some of the most useful insights for our purposes of program improvement.

Understanding Doctoral Alumni Experiences and Perceptions
Using Tableau, we portray the alumni career data in a series of dashboards. Data can be filtered by graduate discipline (Humanities and Arts, Life Sciences, Physical Sciences and Engineering, and Social Sciences), graduate field (degree program), survey year, and degree

year. The closed-ended response data can also be aggregated or sorted by gender, citizenship status (U.S. or international), and within U.S. citizenship by underrepresented minority status.

From the alumni data we learn about employment sectors and locations. 97% of Cornell doctoral alumni in this data set work in one of three major employment sectors, Education (64%: 49% tenure-track; 15% non-tenure-track), Business/Non-Profit (26%), and Government (7%), but this varies by discipline. Alumni from physical sciences and engineering are most likely to work outside of education, in business/non-profit sectors (about 50%), with slightly less in Education. Humanities and Arts (nearly 90%) and Social Sciences (about 75%) alumni are most likely to work in Education. Life Sciences alumni are also likely to work in Education (nearly 60%), and are the group most likely to work in Government (over 10%). About 77% of these alumni are employed within the U.S., and 23% are employed outside the U.S. About 94% of U.S. citizen alumni, and about 48% of international alumni work in the U.S. About 6% of U.S. citizen alumni work outside the U.S., as do about 52% of international alumni. Salary data were collected in 14 categories that incremented from $30,000 or less (in U.S. dollars) to $250,000 and above. Medians and distributions vary by discipline; each discipline had alumni in the highest and lowest categories. The median for physical sciences and engineering was the highest, at $90K-$100K, and the lowest for humanities and arts, at $60K-$70K, with social sciences ($80K-$90K) and life sciences ($70K-$80K) in the middle. These data can be analyzed further by time-since-degree and other factors.

We also learn about alumni perceptions. Nearly 80% of alumni report their Cornell doctoral education prepared them very well or extremely well for their current career, with another 15% indicating their education prepared them well. Nearly half report being very satisfied with their current position; nearly 45% report being satisfied. About 75% report their work is closely related to their Cornell degree, and over 20% report their work is somewhat related. Over 65% would definitely pursue a doctoral degree again, and nearly 25% probably would. About 50% definitely would select the same field of study again (34% probably would), and over 50% definitely would select Cornell again (37% probably would).

Alumni report that the most important factors in helping them land their first career job were perceived quality of academic work (78% said very important), reputation of Cornell (67% very important), and the reputation of the specific graduate program (59%). The most important elements of doctoral education for students entering the alumna/alumnus graduate field were academic or professional writing skills (78% very important) and knowledge of research methods (78% very important), presentation of work at a professional conference (70% very important), knowledge of analytic techniques (69% very important), and experience working collaboratively with colleagues (63%). These data provide justification for increasing centrally-provided professional development programs by the Graduate School, such as writing workshops and boot-camps, and provide evidence of the importance of other Graduate School programs, such as providing conference travel grants for doctoral students who are presenting their work at professional and scientific meetings.

Using Doctoral Alumni Data for Program Improvement

While it is interesting to consider these data in aggregate for the university overall, or at the level of discipline, the real utility of many of these data lies at the level of the degree program, where faculty directors of graduate studies can work with their graduate faculty to consider the data for their program, compare to similar, peer programs at Cornell, and compare to their aggregated discipline at Cornell. And, indeed, the data do vary among

degree programs, although “writing” seems to be universally important across all disciplines and programs, from the perspective of alumni.

Each graduate degree program at Cornell has autonomy and responsibility for its curriculum, overseen by the graduate faculty of that field. This alumni information also provides an opportunity to identify successful alumni in a variety of professional sectors, and invite them back to campus to interact with and mentor current students. When successful alumni make observations about the importance of collaboration, writing, quantitative skills, leadership, and entrepreneurial skills, and the importance of career preparation for a variety of potential career paths in management, business, industry, government employment, non-profits, and non-professorial sectors of higher education, faculty take notice and are stimulated to consider appropriate changes and improvements to their programs.

Biographical Sketches of Participants

Professor Vahan Agopyan

Vahan Agopyan is professor of Materials and Components for Construction of Polytechnic School, University of São Paulo and vice-president of the University. Professor Agopyan is a graduate in Civil Engineering from the Polytechnic School, University of São Paulo (1974), Master of Urban Engineering and Civil Construction from the Polytechnic School, University of São Paulo (1978) and PhD in Civil Engineering from the University of London King's College (1982). Professor Agopyan's previous activities include: Provost for Graduate Studies of the USP, Dean of the Polytechnic School of USP, CEO of the Technological Research Institute of the State of S. Paulo, Vice President of CIB - International Council for Research and Innovation in Building and Construction. Professor Agopyan has research experience in civil construction, with emphasis on materials and components, working mainly with fiber-reinforced materials, recent studies on quality and sustainability of Construction. Commander of the National Order of Scientific Merit (Brazil), Distinguished Engineer of the Year (Institute of Engineering), Personality of Technology (Union of Engineers), Honorable Citizen of the City of S. Paulo and member of the National Academy of Engineering (Brazil) and of the Pan-American Academy of Engineering.

Professor Marie Audette

Marie Audette holds a Ph.D. in Biochemistry from Université Laval, in Québec. After a post-doctoral training realized at the Ludwig Institute for Cancer Research and the Swiss Institute for Experimental Cancer Research, in Lausanne (Switzerland), she was back in Quebec City in 1987. She is actually full professor at the Department of Molecular Biology, Medical Biochemistry and Pathology from the Faculty of Medicine. Research scholar from the Fonds de la recherche en santé du Québec between 1987 and 2006, she worked on cell adhesion molecules, mainly supported by the Natural Sciences and Engineering Research Council (NSERC). She was director of the master and doctorate programs in Physiology-Endocrinology from the same university for several years dean of graduate studies between 2007 and 2015 and was president of the Quebec Graduate Dean's association and the Canadian Association for Graduate Studies (CAGS). Since July 2015, she is Associate Vice-president Research and Innovation, at Université Laval, while being past-president of CAGS. Marie Audette also holds a bachelor degree in Music. She acts on different boards of directors of cultural or scientific organisms.

Professor Philippe-Edwin Bélanger

Philippe-Edwin Bélanger was appointed director of graduate and postdoctoral studies at Institut national de la recherche scientifique on January 2012. He is responsible for curriculum management, administrative support for students and postdoctoral fellows, the registrar's office, student services, and management of scholarship programs. Mr. Bélanger studied political science and public administration. From 2002 to 2012, he worked at Fonds de recherche du Québec - Nature et technologies, overseeing the organization's scholarship programs and France-Québec partnership. An active contributor to his professional community, Mr. Bélanger is currently President of the steering committee of the Québec Graduate Studies Dean Association and a member of the Canadian Association for Graduate Studies. He also sat on the Conseil supérieur de l'éducation du Québec's commission on university education and research, from 2008 to 2011.

Professor Hans-Joachim Bungartz

Hans-Joachim Bungartz is a full professor of informatics and mathematics at TUM, where he holds the Scientific Computing chair in the Informatics Department. Dr. Bungartz earned degrees in mathematics and informatics and a PhD as well as his habilitation in informatics, all from TUM. He became associate professor of mathematics at University of Augsburg, full professor of informatics at University of Stuttgart, and returned to TUM in 2005. Since 2008, he has also been affiliated with the Department of Mechanical Engineering at University of Belgrade, Serbia. Since 2013, Dr. Bungartz has served as both Dean of Informatics and TUM Graduate Dean, heading TUM Graduate School and being in charge of doctoral education TUM-wide. In both functions, he is member of TUM's Extended Board of Management. Dr. Bungartz has served or serves on several editorial boards, and he was a member of the scientific directorate of Leibniz Institute for Informatics Schloss Dagstuhl. He is involved in various national and international review and advisory board activities. In 2011, he was elected chairman of the German National Research and Educational Network (DFN). Furthermore, Dr. Bungartz is a board member of Leibniz Supercomputing Centre. Recently, Dr. Bungartz has been appointed a steering committee member of the Council for Doctoral Education of the European University Association. His research interests are where computational engineering, scientific computing, and supercomputing meet. He works on parallel numerical algorithms, hardware-aware numerics, high-dimensional problems, data analytics, and aspects of HPC software, with fields of application such as computational fluid dynamics. Most of his projects have been interdisciplinary ones. As an example, he coordinates DFG's Priority Program Software for Exascale Computing.

Professor Jani Brouwer

Jani Brouwer is Director of the Doctoral College at the Vice-Presidency for Research of the Pontificia Universidad Católica de Chile (PUC). She obtained her PhD in Sciences of Education at the University of Amsterdam in the Netherlands. As Director of the Doctoral College she is responsible for the management and coordination of activities related to doctoral studies at PUC. This includes ensuring the quality of its 34 doctoral programs and promoting UC policies and methods to enable curricular flexibility, interdisciplinarity and internationalization of doctoral training. Before taking on her position at PUC, Jani worked for UNICEF, Fundación Andes and then at CONICYT, Chile's National Commission for Scientific and Technological Research, in charge of the coordination of the Basal Financing Programme for Centres of Excellence and the direction of the Graduate Scholarship Programme in 2010. She lives and works in Chile since 1991. She also worked in Bogotá, Colombia as a lecturer in Sociology and Education Methodology at the Jorge Tadeo Lozano University.

Dr. Karen Butler-Purry

Karen Butler-Purry is Associate Provost for Graduate and Professional Studies at Texas A&M University, a position she has held since 2010. In addition, Butler-Purry is a professor in the department of electrical and computer engineering, having served at all faculty levels beginning with an initial appointment as visiting assistant professor of electrical engineering in 1994. Butler-Purry has vast experiences in graduate education as a faculty member, administrator, researcher and program leader. From 2001-2004, she served as Assistant Dean for Graduate Programs in the College of Engineering and served as Associate Department Head in the Electrical and Computer Engineering Department from 2008-2010. Further,

Butler-Purry has directed several fellowship and education projects promoting recruitment, retention and capacities on committees for the college, university and professional societies. Dr. Butler-Purry developed a successful research program with funding from federal agencies such as NSF and ONR, and industry funding from electric utility companies. She has supervised policies regarding university graduate student support funds, which resulted in a plan that prioritized providing sufficient support to best attract the brightest doctoral students while at the same time allowing individual colleges to better align the funds with their specific strategic priorities. Also under Butler-Purry's leadership, the TAMU Office of Graduate and Professional Studies (OGAPS) added a new university initiate to promote and support graduate student participation in professional development opportunities aligned closely with the university's novel Quality Enhancement Plan, Aggies Commit to Learning for a Lifetime.

Professor Carlos Gilberto Carlotti, Jr.

Carlos Gilberto Carlotti, Jr. is a medical doctor and graduated from Ribeirao Preto Medical School of University of São Paulo. His specialty is neurosurgery. Prof. Carlotti holds a PhD degree in Surgery, with a post-doctorate at the Brain Tumour Research Centre, University of Toronto, Canada. He is currently a full professor at the Ribeirao Preto Medical School of University of São Paulo, where he was the Dean and Director of the University Hospital. Since 2016 Prof. Carlotti has been the Provost of Graduate Studies of University of São Paulo.

Professor Mee-Len Chye

Mee-Len Chye, the Wilson and Amelia Wong Professor in Plant Biotechnology, is the Dean of the Graduate School at the University of Hong Kong (HKU). She completed her B.Sc. at the University of Malaya, and her Ph.D. on a Commonwealth Scholarship at the University of Melbourne. Following her postdoctoral training in Plant Molecular Biology at the Rockefeller University (New York) and the Institute of Molecular and Cell Biology (Singapore), she joined the University of Hong Kong in 1993 and was promoted to Professor in 2005. She has been awarded an Edward Clarence Dyason Universitas 21 Fellowship (2004/05), a HKU Outstanding University Researcher Award (2006/07), a Croucher Senior Research Fellowship (2007/08), and an Eileen Mary Harris Scholarship (2013). She serves on the editorial boards of Planta (Springer), Frontiers in Plant Metabolism & Chemodiversity and Frontiers in Plant Physiology. Members of her laboratory at the School of Biological Sciences, HKU, work on acyl-CoA-binding proteins in plant lipid metabolism using Arabidopsis as a model plant, and investigate the use of these proteins in conferring stress tolerance in transgenic plants. Findings from her research will be applicable for crop improvement in agriculture.

Professor Barbara Crow

Barbara Crow is the Dean, Graduate Studies. She is currently Chair of the Ontario Council of Graduate Studies, Board Member of the Canadian Association of Graduate Studies and the Senior Women Academic Administrators of Canada and was the president of the Canadian Women's Studies Association. Her research interests are in the social, cultural, political and economic implications of digital technologies. She has edited collections on mobile technologies, US radical feminism, and Canadian Women's Studies. She has worked on a number of large-scale interdisciplinary grants with engineers, designers, artists and communication scholars to produce technical and cultural content for mobile experiences. She is one of the

co-founders of the Mobile Media Lab, co-founding editor of wi: a journal of mobile media. She is a co-investigator on a Social Science and Humanities Major Partnership Grant, "Ageing, Communication and Technology," http:// actproject.ca

Professor Denise Cuthbert

Denise Cuthbert is the Dean of the School of Graduate Research at RMIT and Convenor of the Australian Council of Graduate Research (ACGR). Denise's work in the field of graduate research education and her supervision of higher degree by research candidates have been recognised with several awards. In 2006, she was awarded the Faculty of Arts Excellence in Research Supervision Award at Monash University. This was followed in 2007 with her receipt of both the Vice-Chancellor's Prize for Postgraduate Supervision and a Carrick Citation for Outstanding Contribution to Student Learning for 'exemplary practice in graduate supervision' and 'outstanding academic leadership in graduate research education in the humanities, arts and social sciences.' She has initiated a range of highly successful programs for the support of postgraduate research supervisors and their supervisors. Denise is an accomplished supervisor, with over 40 candidates successfully graduating under her supervision of which the majority are PhDs and high publication rates among her candidates. Denise is also keenly committed to the development of research cultures in disciplines and fields which are 'new to research' and to the processes of cultural and institutional change involved in establishing research cultures in former teaching only or teaching intensive institutions. She has had experience of research development work in settings such as South Africa, Malaysia, Vietnam and the Philippines.

Professor Bernadette Franco

Bernadette Franco graduated from the Faculty of Pharmaceutical Sciences of University of São Paulo, Brazil. Prof. Franco holds a PhD Degree in Food Science, also from University of São Paulo, with a post-doctorate at Kansas State University, USA. Her specialty is food microbiology. She is currently a full professor at the the Faculty of Pharmaceutical Sciences of University of São Paulo, Brazil. Prof. Franco was provost of Graduate Studies at the University of São Paulo between 2014 and 2016.

Professor Luke Georghiou

Luke Georghiou B.Sc., Ph.D., MAE, FRSA is Vice-President for Research and Innovation at the University of Manchester where he is responsible for the University's research strategy and performance, doctoral education, business engagement and commercialisation activities. He holds the chair of Science and Technology Policy and Management in Manchester Business School. His research interests include evaluation of R&D and innovation policy (particularly in relation to the use of public procurement and other demand-side measures), foresight, national and international science policy, and management of innovation. He has chaired or been a member of several high profile committees including the Aho Group and the European Commission's Expert Group on ERA Rationales, and is currently a member of the RISE High Level Group. He has an extensive list of publications including articles in Nature, Science and the Harvard Business Review. He is a member of the Academia Europaea. He is Scientific Co-Champion of ESOF2016, Europe's largest pan-scientific conference and Chairman of the European Universities Association Council for Doctoral Education.

Ms. Katherine C. Hazelrigg

Katherine Hazelrigg joined the Council of Graduate Students in 2015 as the communications manager. Her responsibilities at the Council include website content management, development of print and electronic communications, social media, webinars, and media relations. Prior to joining CGS, she was a program assistant and communications coordinator at the Association of Public and Land-grant Universities (APLU), where she managed communications, event planning, projects, and grants in the Office of Research, Innovation, and STEM Policy. Katherine spent several years teaching English 101 and Introduction to Literature courses at the University of Maryland, College Park, while earning an M.A. in English; she received a B.A. in English with a minor in French from The Pennsylvania State University's Schreyer Honors College.

Dr. Barbara A. Knuth

Barbara A. Knuth was appointed Vice Provost and Dean of the Graduate School at Cornell University in 2010. She was promoted to Senior Vice Provost in October 2014. She oversees more than 90 graduate fields that include approximately 1,800 graduate faculty across ten colleges and schools, 5,100 graduate and professional students, and 600 post-docs. She served previously as Senior Associate Dean of the College of Agriculture and Life Sciences at Cornell (2007-2010), and Chair of the Department of Natural Resources (2002-2007). Under Dean Knuth's leadership, the Graduate School offers strong professional development programs focusing on core competencies of leadership, communication, personal development, teaching, and career development, emphasizing transferrable skills relevant to career paths in academia, business, government, and non-profit sectors. Flagship programs focus on writing skills and the creation of writing communities on campus, faculty-led diversity recruitment efforts, future faculty development, student financial literacy, career development, and data visualization for monitoring student milestones and evaluating and improving student experiences. The Graduate School partners with the Cornell Center for Teaching Excellence, Career Services, and the Knight Institute for Writing in the Disciplines, and is part of the multi-institution Center for the Integration of Research, Teaching, and Learning (CIRTL). Under her leadership, the Graduate School restructured its staff, launched a new web site, improved its information technology, increased its media presence, and expanded its assessment efforts. Knuth served on the Ocean Studies Board of the U.S. National Academies and is a past president of the American Fisheries Society and Past-Chair of the Council of Graduate Schools Board of Directors. She is a professor of natural resource policy in the College of Agriculture and Life Sciences at Cornell University.

Professor Alastair McEwan

Alastair McEwan is Dean of the Graduate School and Pro-Vice Chancellor (Research) at the University of Queensland. He was awarded his PhD in Biochemistry from the University of Birmingham, U.K. and undertook postdoctoral training at the University of Illinois at Urbana-Champaign. He joined the University of Queensland in 1993 and has served in several leadership roles including Head, School of Chemistry and Molecular Biosciences and Deputy Dean, Faculty of Science. He continues to lead a research program in bacterial physiology and pathogenesis. He is currently Chair of the Group of Eight Deans of Graduate School in Australia.

Professor Shireen Motala

Shireen Motala is the Senior Director of the Postgraduate School within the Research and Innovation Division, University of Johannesburg. She is part of the Executive Leadership Group at the UJ. Prior to joining UJ in 2010, Professor Motala, was the Director of the Education Policy Unit at the University of the Witwatersrand. Her academic qualifications include: a BA (University of Durban-Westville), a B Social Science Honours (University of Cape Town), an MA (University of Warwick), a PGCE (University of London) and a PhD (University of the Witwatersrand) She is currently UJ's representative on the international body, the Council Graduate Schools and participates in the Universitas 21 activities. She has held numerous leadership roles related to Higher Education including: Chairperson of the Education Policy Consortium (2006-2010), Chairperson of the UNESCO South African Commission (2001-2006), and first inaugural president of the South African Research Association (SAERA) (2013-2014).She continues to be an executive member of SAERA. In 2010 she was appointed by the Minster of Higher Education and Training to serve on the Council of Higher Education (CHE) and re-appointed in 2015 to the Council and to the Executive Committee of the CHE. In 2013, she served on the Ministerial Committee to review the national Senior Certificate examination, focussing specifically on promotion requirements. She is currently a trustee on the Boards of the Centre for Education Development, and the South African Institute for Distance Education. An NRF (National Research Foundation) rated researcher, she has initiated collaborations between universities across Africa and with Asia and Europe, and this has led to the formation of long-term regional and international partnerships. Her research record is substantial and includes publications in journals and books and editorship of local and international journals. Her research interests and expertise have been in the areas of education financing and school reform, access and equity, education quality and the internationalisation of higher education.

Dr. Suzanne Ortega

Suzanne Ortega became the sixth President of the Council of Graduate Schools on July 1, 2014. Prior to assuming her current position, she served as the University of North Carolina Senior Vice President for Academic Affairs (2011-14). Previous appointments included the Executive Vice President and Provost at the University of New Mexico, Vice Provost and Graduate Dean at the University of Washington, and the University of Missouri. Dr. Ortega's masters and doctoral degrees in sociology were completed at Vanderbilt University. With primary research interests in mental health epidemiology, health services, and race and ethnic relations, Dr. Ortega is the author or co-author of numerous journal articles, book chapters, and an introductory sociology text, now in its 8th edition. An award winning teacher, Dr. Ortega has also served on a number of review panels for NSF and NIH and has been the principal investigator or co-investigator on grants totaling more than $6 million in state and federal funds. Dr. Ortega serves or has served on a number of professional association boards, committees, including, the Executive Boards of the Council of Graduate Schools, the Graduate Record Exam (GRE), the National Academies of Science Committee on the Assessment of the Research Doctorate, the National Science Foundation's Human Resources Expert Panel, the North Carolina E-learning Commission, the North Carolina Public School Forum, the UNC TV Foundation, and the UNC Press Board of Governors.

Dr. David Payne

David Payne is the Vice President and COO of the Global Education Division at ETS. David heads the GRE® and TOEFL® Programs, as well as higher education assessments such as the ETS® Major Field Tests, ETS® Proficiency Profile and SuccessNavigator®. He also led efforts to create the comprehensive HEIghten™ assessment suite for general education student learning outcomes. Payne works closely with the GRE and TOEFL Boards, undergraduate and graduate education organizations and colleges, universities and public education systems. He also helps to identify assessment needs in the higher education and professional markets - both domestic and international - and to develop external relationships. Prior to joining ETS in 2003, Payne was Vice Provost and Dean of the Graduate School at SUNY Binghamton and was a tenured professor in the department of psychology. Payne holds bachelor's and master's degrees in experimental psychology from SUNY Cortland and a Ph.D. in Cognitive Psychology from Purdue University. He is a Fellow of the American Psychological Association and the Association for Psychological Science. He has published five books, nine book chapters and more than 100 articles, technical reports and papers.

Dr. Susan Porter

Susan Porter is Dean and Vice-Provost, Graduate and Postdoctoral Studies at the University of British Columbia (UBC). UBC is a public university with approximately 10,000 graduate students, 900 postdoctoral fellows, and 40,000 undergraduates. A strong focus of Dr. Porter's throughout her 16 years in various graduate administrative positions has been the preparation of graduate students and postdoctoral fellows for their lives as scholars after their studies. She led the revision and expansion of comprehensive programs of student and postdoctoral development offerings with over 3000 participants annually, and has focused recent attention on the PhD degree. As part of this latter focus, she has led a conversation and various initiatives at UBC to 'reimagine the PhD', and in particular to support students in integrating a breadth of career-relevant scholarship into their program and dissertations. She is also the Vice-President of the Canadian Association for Graduate Studies, and is co-leading a national task force on the future of the doctoral dissertation. She is a Clinical Professor in the Department of Pathology and Laboratory Medicine, with a background in both basic and clinical molecular genetics.

Professor Adham Ramadan

Adham Ramadan, a Professor of Chemistry, was appointed Dean of Graduate Studies at The American University in Cairo (AUC) in January 2014. He served as Chair of the Department of Chemistry, AUC, from 2010 to 2013. As Dean of Graduate Studies, he initiated a university-wide review of the graduate admissions system and the graduate fellowship award system, as well as worked on the enhancement of university-wide metrics for assessing the performance of graduate programs. His updated university-level coordination of graduate programs, leading to the development of a Graduate Studies Handbook. The most recent initiatives he is involved in include the strategic implementation of blended and online learning for graduate programs, as well as the enhancement of programs for transferable skills for graduate students.

Dr. Christopher Sindt

Christopher Sindt is the vice provost for graduate and professional studies and dean of the Kalmanovitz School of Education at Saint Mary's College of California. He has served as vice provost since 2011. Sindt is a professor of English and has held positions as associate dean of the School of Liberal Arts and the program director of the MFA Program in Creative Writing. In 2011-2012, he served as an American Council on Education Fellow with a placement at the University of California, Davis. Sindt earned his M.A. and Ph.D. in English from the University of California, Davis, and a B.A. in English from the University of California, Los Angeles. He has been the recipient of numerous awards and fellowships for his poetry, including the James D. Phelan award and fellowships at the Macdowell Colony and the Blue Mountain Center. He is the author of three collections of poetry, most recently the forthcoming System and Population. Sindt currently serves on the Board of Directors of the Squaw Valley Community of Writers.

Dr. Mark J. T. Smith

Mark J. T. Smith received the B.S. degree from MIT and the M.S. and Ph.D. degrees from the Georgia Institute of Technology, all in electrical engineering. He joined the electrical and computer engineering (ECE) faculty at Georgia Tech in 1984, where he remained for the next 18 years. While working primarily on the Atlanta campus, he spent several terms in 1991-93 on the Institute's European campus in Metz, France. Five years later he served a four-year term as Executive Assistant to the President of Georgia Tech. In January, 2003, he joined the faculty at Purdue University as head of the ECE School. A current member of the Board, Smith has been engaged with the national ECE Department Heads Association, where he served as secretary/treasurer, vice president and president in 2005-2008. In 2009, Smith was appointed Dean of the Purdue University Graduate School. Presently, he is Chair of the Board of the Council of Graduate Schools and a member of the GRE Board of Directors. Dean Smith's scholarly interests are in the area of digital signal processing. He is a Fellow of the IEEE and a former IEEE Distinguished Lecturer. He has authored many technical papers, six international standards publications, three textbooks, and two edited books, the most recent of which is the 2014 edited book GPS for Graduate School—Students Share Their Stories. In addition to his professional activities, Dr. Smith's past includes Olympic competition and U.S. national gold medals in the sport of fencing.

Professor Richard (Dick) Strugnell

Richard (Dick) Strugnell has been Pro Vice-Chancellor (Graduate Research) at the University of Melbourne since 2008. Dick's role is to support the Deputy Vice-Chancellor (Research) in the development of University policy regarding research training, to help faculties and University Services in providing support to the research training cohort, to analyse performance of the research training, and to identify areas where performance improvements can be made. As Pro Vice-Chancellor (International Research), Professor Strugnell is accountable for the University's International Research Strategy, as articulated in the Research at Melbourne plan. The plan includes measures such as the University's International Research and Research Training Fund (IRRTF) to support enhanced research engagement with the top institutions in the key countries identified in the Research at Melbourne research strategy. The nex-

us between research training and research engagement with celebrated institutions in China, India, Brazil, Chile and Germany is provided for through the development of joint doctoral degrees, and research networks and doctoral training groups supported by the IRRTF.
Dick is a microbiologist with a research interest in disease-causing bacteria and in the development of vaccines against bacterial infections. His research is supported by the NHMRC and ARC and his laboratory at the Doherty Institute includes a core group of post-docs and graduate researchers. He undertook his PhD training at Monash and post-doctoral research at University of Birmingham and the Wellcome Research Laboratories in the UK, and at Monash University.

Professor Tao Tao

Tao Tao has been executive dean of the Graduate School in Xiamen University since 2012. Formerly, he was vice dean of the Graduate School for 4 years. Since 2013, he launched a comprehensive reform to improve the quality of graduate education in Xiamen University to catch up with the international standards for excellence. Based on assessment of the achievement, He was awarded the CSADGE's (Chinese Society of Academic Degrees and Graduate Education) "outstanding contribution award" in 2015. Dr. Tao Tao obtained his Ph.D. from Case Western Reserve University (USA) in 2000 and did his post-doc training in McGill University (Canada) from 2001-2003. He joined the School of Life Sciences, Xiamen University in 2004. He has won 6 NSFC (National Natural Science Foundation of China) grants and many other competitive research grants such as "973" and "863" projects. He published more than 40 papers in peer-reviewed journals and has been on the editoral board of journal BBA-MCR since 2011.

Ms. Xiaoyue Wang

Ms. Xiaoyue Wang graduated from Peking University with a BA in Chinese Literature in 1987and got her MA in Modern Chinese in 1995. She worked in the Graduate School of Peking University from July 1987. She served as Director of Provost Office at Peking University from Dec. 2004 to Sept. 2010. She has been the Director of Secretariat of Association of Chinese Graduate Schools (ACGS) from Oct. 2013.

Professor Yaguang Wang

Yaguang Wang, distinguished professor in mathematics, and executive vice dean of the Graduate School at Shanghai Jiao Tong University. He obtained his Ph.D. degree in Department of Mathematics at Fudan University, Shanghai in July 1992, since then he has been working in Department of Mathematics at Shanghai Jiao Tong University, where he became a full professor in 1998. He was the Lise-Meitner postdoc at Innsbruck University of Austria from Oct. 1995 to Dec. 1996. As guest professor, he has visited more than 20 universities in USA, France, Germany, Austria, Switzerland, Japan, Korea and Hong Kong, including that he was a guest professor at Northwestern University, USA from Sept. 2008 to April 2009. His research mainly focuses on analysis of partial differential equations and applications. From Oct.2009 to Sept. 2014, he has been served as the deputy chair in Department of Mathematics, and in June 2014 he was appointed as the executive vice dean of the Graduate School at SJTU.

Professor Kate Wright

Kate Wright is Dean of the Graduate Research School and has responsibility for leadership and management of research training across the university. Kate obtained an Honours Degree in Geology and a PhD in Mineral Physics from University College London, UK. Prior to moving to Australia, she was a Royal Society University Research Fellow, at the University of Manchester and at the Royal Institution in London. On moving to Perth in 2004, Kate continued her research at Curtin University as Professor of Mineral Chemistry and in 2010 took on the role of Dean of Research for the Faculty of Science and Engineering. She was appointed as Associate Deputy Vice-Chancellor Research Training later in 2011. Kate took on her current role at the University of Western Australia in March 2016. Her key research interests centre around the study of microscopic defects in minerals and their influence on macroscopic behaviour.

Professor Qiang Yao

Qiang Yao is Professor of Combustion Science and Engineering in the Department of Thermal Engineering at Tsinghua University. Professor Yao is the Chang Jiang scholar and Vice Provost and Dean of Graduate School. Prof. Yao has cultivated a group of excellent graduate students. His research interests include: i) combustion theory and technology especially pulverized coal combustion; ii) Clean Coal Technology; iii) Combustion emission and its control; iv)Particulate Matters formation and characteristics and v) renewable energy.
He is the Yangzi distinguished Professor and Director of the key laboratory of thermal science and power engineering, Ministry of education; he is the Director of Tsinghai-Rito EES Research Center. He is also the director of the laboratory for low carbon energy, Tsinghua University and executive director of the Low Carbon Energy University Alliance among Tsinghua-Cambridge-MIT. He is a member of the board of directors, the combustion institute and director of the Chinese section of the combustion institute. He is also director of the experts group of energy saving and emission control, Ministry of science and technology, chief scientist of 973 project and a member of advanced energy technology experts group of 863(high tech program), Ministry of science and technology. He is now a co- author of over 200 journal papers and held more than 20 Chinese Patents in the clean coal combustion and air pollution control and also co-author of 2 books and 2 textbooks in the combustion and clean coal technology areas.

Professor Brenda Yeoh

Brenda S.A. Yeoh is Professor (Provost's Chair), Department of Geography, as well as the Dean of the Faculty of Arts and Social Sciences, National University of Singapore. She is also the Research Leader of the Asian Migration Cluster at the Asia Research Institute, NUS. She is on the Commission on Population and Vulnerability, International Geographical Union; and External Examiner for Bachelor of Social Sciences curriculum and 'FOSS' undergraduate courses at the University of Hong Kong. She has been appointed to the URA Architectural Heritage Awards (AHA) Assessment Committee; Center for Aging, Research and Education (CARE); Urban Redevelopment Authority (URA) Board; Research Advisory Panel (RAP), National Population and Talent Division, Prime Minister's Office; National Collection Advisory Panel (NCAP), National Heritage Board; National Council on Problem Gambling (NCPG). She chairs the Heritage Advisory Panel (HAP), National Heritage Board. Within NUS, she is on the Management Boards of East Asian Institute and the Interactive and

Digital Media Institute (IDMI). She is also on the Board of Directors for NUS Press. Professor Yeoh's research interests include the politics of space in colonial and postcolonial cities and she also has considerable experience working on a wide range of migration research in Asia, including key themes such as cosmopolitanism and highly skilled talent migration; gender, social reproduction and care migration; migration, national identity and citizenship issues; globalising universities and international student mobilities; and cultural politics, family dynamics and international marriage migrants. She has published widely in these fields.

COUNCIL OF GRADUATE SCHOOLS
One Dupont Circle NW
Suite 230
Washington, DC 20036
www.cgsnet.org

UNIVERSITY OF SÃO PAULO
Rua da Reitoria, 374 - 4º andar
São Paulo - SP Brazil 05508-220
www.usp.br