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**HIGHLY QUALIFIED PERSONNEL STUDY  
CONDENSED FINAL REPORT**

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***Prepared by:***

R.A. Malatest & Associates Ltd.

500 – 294 Albert Street  
Ottawa, ON K1P 6E6

Phone: 613-688-1847, 102

Fax: 613-288-1278

Web: [www.malatest.com](http://www.malatest.com)

**Prepared for:  
COMPUTE ONTARIO**

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## EXECUTIVE SUMMARY

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Advanced research and development computing (AR&DC) is increasingly being seen as a central driver to innovation across a wide array of research fields. To support innovation, Ontario needs to ensure that it attracts, retains and develops enough highly qualified personnel (HQP) to support current and future demands for AR&DC in the province. The objective of this study was to examine HQP in Ontario to better understand their number, demographics, educational backgrounds and skills gaps. Further, the study examined the challenges academia and the private sector face in attracting, retaining and developing the HQP the province requires.

The findings show that HQP are not homogenous and differ along two dimensions. First, HQP consist of two equally important sub-groups: those that use AR&DC to conduct research and those that support those users with expertise in AR&DC. Second, HQP differ based on whether they are employed in academia or the private sector. For instance, in academia a master's degree is often required; it is not required in the private sector.

The study identified a series of 6 foundational skills that HQP need to develop to varying degrees: computational thinking skills; computing technical skills; domain specific skills; integration skills; organizational skills; and teamwork and communication skills. Teamwork and communication skills are particularly important as they allow for gaps in skills to be mitigated by having researchers work together effectively. However, teamwork and communication skills were identified as the ones in the greatest need of further development among Ontario's HQP. HQP are often self-taught, although formal means of developing these foundational skills are becoming more common.

Based on the information available, the current study estimated that 530 companies are currently involved with AR&DC across the province, employing about 1,700 individuals in the private sector working with AR&DC. These include both domestic and foreign training HQP and are predominantly male. It is roughly estimated that about an equal number work in academia.

Based on survey responses, the number employed in the private sector is expected to grow substantially over the next 5 years. By 2023, Ontario could be home to 2,000 companies and 5,600 individuals working with AR&DC.

Given this expected growth, it is concerning to find that there may already be shortages of HQP in the province. Academia, and to a lesser extent the private sector, are already experiencing challenges in attracting, retaining and developing HQP. They are struggling to offer competitive employment conditions and pay, which only exacerbate negative opinions about AR&DC as a viable and meaningful career path. What is perhaps reassuring is that peer organizations in the US and Europe are experiencing the same pressures.

There is an opportunity for Ontario to take the lead in attracting, retaining and developing HQP. To support Compute Ontario to take up this challenge, this report provides 12 recommendations that will give direction to their efforts in supporting Ontario with the HQP it needs.

## RECOMMENDATIONS FOR COMPUTE ONTARIO

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If Ontario is to become a globally recognized centre for AR&DC, it will need to attract, retain and develop a highly-skilled and ambitious workforce of HQP. To support Ontario in meeting this goal, the following 12 recommendations have been put forward based on the findings of the HQP study.

To support attracting talent:

- 1) Promote an image of AR&DC as a meaningful career path:** Some experts spoke about the image of AR&DC not being perceived as attractive to youth. Some expressed that there is a need to make AR&DC “sexy”. In particular, some indicated that AR&DC is not seen as valuable or as meaningful as other academic paths. Unless the brand is changed, it will be difficult to attract top talent to AR&DC. There is a need to change AR&DC’s image by demonstrating that it has value to society. Compute Ontario needs to promote how AR&DC will help with societal problems that affect us all, such as modeling climate change and supporting medical advances.
- 2) Support women working with AR&DC:** Women are underrepresented in AR&DC positions and righting that disequilibrium will help grow Ontario’s AR&DC workforce. Further, should women continue to struggle to enter these positions in other jurisdictions, addressing this issue may help Ontario attract the brightest female AR&DC talent. Compute Ontario should encourage women to join the AR&DC workforce by creating opportunities for women to work with AR&DC, sharing their experiences, developing role models and breaking down barriers. Compute Ontario could also encourage academia and the private sector to support shared parental leave, flexible work hours and networking opportunities in an effort to mitigate women’s barriers to entry.
- 3) Increase recognition for HQP working with AR&DC:** There is a need for better recognition of individuals working with AR&DC, both in the academia and the private sector. Compute Ontario should introduce official recognition programs to highlight how AR&DC has advanced a domain’s body of knowledge and how that knowledge has led to positive societal change. Compute Ontario could achieve this through publishing success stories, launching awards programs for HQP and offering scholarships to AR&DC students. Further, Compute Ontario should work with its academic partners to promote the full recognition of individuals in AR&DC roles, such as ensuring that they are named in publications.
- 4) Promote AR&DC in social sciences and humanities:** In particular, there is consensus that the social sciences and the humanities are lagging in their application of AR&DC, despite recognition that it is a powerful tool driving high impact research in these areas. Compute Ontario should communicate the successes of AR&DC in these areas to promote it as a leading research tool. Compute Ontario could offer scholarships to support social scientists and humanities researchers conducting research through a computational lens.

To support retaining individuals in AR&DC positions:

- 5) Support longer-term employment in academia:** Compute Ontario should communicate with its post-secondary partners and the governments that fund them that AR&DC positions based on research projects will not develop globally-competitive HQP. Ontario universities need to have long-term funding strategies to retain individuals working with AR&DC. Long-term funding for

research initiatives will improve job security, make AR&DC a more viable career path and help develop a more skilled workforce for Ontario.

- 6) **Nurture Ontario's HQP community:** Compute Ontario should become the standard bearer for the AR&DC community in Ontario. Compute Ontario could create a sense of community among HQP by hosting networking events and competitions. For instance, Compute Ontario could launch problem solving contests or host events akin to hackathons.
- 7) **Establish Ontario as a globally-recognized hub for AR&DC:** Compute Ontario could work beyond Ontario to brand Ontario as a global AR&DC leader. For instance, Compute Ontario would not have to limit the above network to Ontario. It could host AR&DC events that attract HQP from around the world so that the global AR&DC community engages with the AR&DC community in Ontario. In seeing Ontario as an AR&DC hub, HQP will be less likely to leave (or at least more readily replaced by incoming HQP).
- 8) **Market Ontario as a leading place to live:** In competing for world-class HQP, Compute Ontario may be able to leverage its enviable quality of life. Few places in the world can boast as Ontario can about its access to nature, its cultural wealth and its inviting cities. Compute Ontario could communicate that both Toronto and Ottawa are regularly ranked among the best cities in the world to live (for instance, according to Mercer's annual Quality of Living Survey).<sup>1</sup> EPCC has been successful in promoting Edinburgh as one of the world's most livable cities. Compute Ontario could do well to follow that lead to attract and retain the best and brightest.

To support developing HQP:

- 9) **Provide more educational opportunities to develop computing technical skills and computational thinking skills:** Compute Ontario should lobby the Ministry of Education to include more computing technical skills and computational thinking skills development in the public school curriculum. Further, Compute Ontario should work with its partner post-secondary institutions to build upon the basic computing technical skills and computational thinking skills of their students to develop skills related to AR&DC. With these foundations in place, bright Ontario students will be better able to develop the other foundational skills required to work successfully with AR&DC.
- 10) **Establish campus champions:** Compute Ontario should emulate the work done by XSEDE<sup>2</sup> in the US and work with universities and colleges to have an HQP at each institution take the lead in promoting the development of an AR&DC ecosystem among their peers and students. Further, support the development of these champions so that they are at the leading edge of AR&DC. Provide networking and peer-to-peer development of these champions by providing communication channels and opportunities to meet face to face to learn from one another.
- 11) **Support the development of AR&DC curricula:** A single curricula for AR&DC may not be viable given that research domains approach AR&DC differently. Rather Compute Ontario could support the development of HQP by working with experts to develop a specific AR&DC courses to become core curricula for each research domain. Compute Ontario should work with experts to develop core curricula for each research domain that would cover AR&DC topics spanning the continuum from beginners through to HQP levels.

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<sup>1</sup> For more information, see Mercer's website: [www.mercer.com/newsroom/2018-quality-of-living-survey.html](http://www.mercer.com/newsroom/2018-quality-of-living-survey.html)

<sup>2</sup> For more information, see XSEDE's website: [www.xsede.org](http://www.xsede.org)

**12) Entrench teamwork and communication skills:** The product of Ontario's HQP will be maximized if they can work together, sharing their expertise and mitigating their shortcomings. Teamwork and communication skills were not only identified as being critical, but also lacking among many HQP. Compute Ontario should work with academia and the private sector to encourage the development of HQP's teamwork and communication skills so that they are as developed as their computing technical skills and domain specific skills. For instance, Compute Ontario could support the development of multidisciplinary research teams.