Digital Policy Hub — Working Paper

Canada as a Norm Entrepreneur in Quantum Science and Technology

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Fall 2024 cohort

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Key Points

- International institutions and norms can support a country's pursuit of national interests. Although the liberal international order is under strain, some of its core institutions are demonstrating resilience against major threats. This means that countries pursuing liberal internationalist norms can still engage with institutions to promote their interests through norm entrepreneurship.

- Canada has a track record of participating in international institutions as a means of status seeking and pursuing national interests, particularly in domains where Canada is seen to have a legitimate stake in the issue.

- As a country with an established research community in the domain of quantum science and technology (S&T) and a seat at the table in many international institutions, Canada has an opportunity to promote norms of responsible use and international equality in the domains of quantum S&T.

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Introduction

A new class of quantum-enabled technologies is poised to radically disrupt political, economic and military affairs over the coming decades. As a country that boasts world-class quantum S&T research facilities, a highly educated specialist workforce and a consistent level of innovative start-ups in the sector, Canada is poised to punch above its weight in the international arena. Domestically, this new class of technologies presents an opportunity for rapid economic development in a high-value industry, as well as for bolstering of continental defence infrastructure through the application of novel sensing capabilities. Internationally, Canadian contributions will open the door for national advocacy for ethical use principles in quantum S&T. As a country that frequently projects a responsible actor image, Canada could not only service its national interest but also raise its prestige and influence on the world stage by supporting the development of new international norms. Informed by the theory of norm entrepreneurship, this working paper explores how Canada can promote ethical guidelines for quantum S&T internationally, and what benefits might reasonably be expected from these actions. As a recent World Economic Forum (WEF) report on quantum computing notes, the present moment is ripe for prioritizing the development of ethical guidelines: "quantum computing is sufficiently advanced for us to have an idea of the areas in which it will start to have an impact and what kind of impact that will be," while it "is not yet so far advanced that such principles can only be retroactive" (Coates et al. 2022, 5). Seizing this opportunity is critical, because the impacts are foreseeable but it is not yet "too late" to forestall them.

The first section of the working paper provides context for Canada's norm entrepreneurship in quantum S&T by clarifying the nature of middle-power status within the liberal international order. The second section then completes the theoretical framework by introducing norm entrepreneurship. Drawing on leading accounts of ethics in quantum S&T, the third section reviews current principles of ethical use. The recommendations and conclusion then present practical strategies that Canada may employ to navigate the issue area, as well as directions for future research.

Background on International Order

This critical moment for quantum S&T emerges as the liberal international order is bending, if not breaking, and is one in which understanding the role of institutions of liberal internationalism is important for understanding the strategy of norm entrepreneurship in the quantum domain. Liberal internationalism has long been a favoured approach for countries falling below the great-power threshold, as the strengthening of international institutions can offer a platform for the pursuit of national priorities (Abrahamsen, Andersen and Sending 2019). The presence of multilateral institutions and a rules-based system also protects smaller countries from the encroachment of greater powers. The constellation of rules and institutions formed through the interaction of liberal internationalists — crucially backstopped by American hegemony and the principle of economic openness — is sometimes called the liberal international order (Deudney and Ikenberry 1999). Contemporary crises in the *liberal international order* (Ikenberry 2018) and new waves of isolationist politics in the United States and elsewhere (Nossal 2023, 2024) have raised questions about its future as a global organizing principle. To varying degrees, however, the key institutions of the liberal international order have demonstrated institutional resilience through different "survival strategies" (Dijkstra et al. 2024; Schuette and Dijkstra 2023a).[1] Even if they are no longer at their zenith, the institutions of the liberal international order nevertheless remain valuable platforms for the pursuit of national interests and safeguards, particularly when the only alternatives are highly asymmetric bilateral relations.

In the Canadian case, foreign policy has long included a commitment to international institutions (Kirton 2018) and to the development of alliances with liberal democracies. Joel Sokolsky's argument that "Canada's alliance relationships…constitute nearly the sum total of Canadian defence policy" (Sokolsky 1989, 11) could as easily have been written today as decades ago. In a best case, Canadian participation in key alliances permits the pursuit of national interests, whether because those interests align with the collective goods pursued by the group or because participation offers opportunity to influence the organization's agenda. But even when Canadian participation is ineffective in pursuit of a national interest and the seat at the table becomes uncomfortable, "the only thing more unsettling to Canadian foreign and defense policy would be to not have any seat at all" (ibid., 33). This is because participation is seen as a good in and of itself, in addition to whatever goods may be produced *through* participation. Visible and meaningful participation has been an important strategy for Canada in pursuing status and asserting independence in international contexts, as Caroline Dunton (2020) discusses in her study of Canada's Security Council campaigns.[2] This appetite for participation in the international arena is not limited to governments, either. Public opinion reflects this commitment to participation in the key institutions of the liberal international order, and liberal internationalism thereby remains "deeply embedded in the Canadian public imagination" (Paris 2014, 205). The Canadian pursuit of national interest has historically turned to liberal international institutions and liberal

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1   This is not to say that all institutions have been successful in developing survival strategies (see, for example, Schuette and Dijkstra 2023b), but even when particular institutions fail there is some evidence that the international cooperation practices established within the institution may lead to a successor organization (Dijkstra, Debre and Heinkelmann-Wild 2024).

2   For the counterpoint, see the concern about Canada being omitted from the trilateral (Australia, United Kingdom, United States) AUKUS pact (Carvin and Juneau 2023; Vucetic 2023).

democratic allies in order to build international agreement around matters of concern to Canada. In addition to the potential for specific national interest objectives to be reached, the exercise itself places Canada at the centre of international conversations in a way that raises the country's profile.

Despite rising geopolitical tensions and challenges to international institutions, there are direct and indirect benefits from Canadian participation in international institutions. Successful promotion of priorities through these platforms can help build international consensus around initiatives that Canada supports. Participation helps to confer general legitimacy on Canada as an actor on the international stage, and this status seeking can reaffirm Canadian independence. Too small economically to compete on dollar-for-dollar terms, and too weak militarily to impose its will, Canada remains best suited to pursue its national interests by finding opportunities to build consensus around its priorities among allied nations and friendly institutions. One specific strategy for pursuing this goal, norm entrepreneurship, is discussed in the next section.

Norm Entrepreneurship

The concept of a "norm" has a long-standing history in international relations theory. In the early decades of the discipline, eminent figures such as E. H. Carr ([1939] 2001) and Hans J. Morgenthau (1946) argued that attempts to understand international politics without appreciating normative matters are destined to fail. However, the incoming behavioural revolution of the decades that followed[3] led to less attention being paid to questions of norms. As Martha Finnemore and Kathryn Sikkink summarized in their oft-cited article "International Norm Dynamics and Political Change," "normative and ideational phenomena were difficult to measure and so tended to be pushed aside for methodological reasons" (1998, 889). In short, because intersubjectively constructed standards of behaviour were difficult to quantify, they were often assumed away as statistical approaches rose to prominence. As constructivist approaches to international relations proliferated through the 1980s (see, for example, Wendt 1987; Onuf 1989), these questions of social meanings and beliefs attracted greater attention.

Finnemore and Sikkink (1998) offer a consensus definition of norms and describe their life cycle. They note that the commonly held definition of a norm — which they offer as "a standard of appropriate behavior for actors with a given identity" — runs into some issues of describing social processes shared with other similar concepts, and suggest emphasizing the singular-standard nature of a norm, compared to the more complex composite nature of institutions such as sovereignty or slavery that encompass multiple norms (ibid., 891). The theory of the norm life cycle provides a model for how these social standards for action become widespread in the international context:[4] "The first stage is 'norm emergence'; the second stage involves broad norm acceptance, which we term, following Cass Sunstein, a 'norm cascade'; and the third stage involves internalization. The first two stages are divided by a threshold or 'tipping' point, at which a critical mass of relevant state actors adopt the norm" (ibid., 895).

The life cycle, it should be acknowledged, is not a given process once begun; it is thoroughly social from start to finish. Even at the first stage, the norms do not exist as ideas that self-construct but are constructed by the key actors of the first stage —

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3   For examples of the debate around normative versus behavioural accounts during this era, see Bull (1966) and Kaplan (1966).

4   Although they also state that norm dynamics can be observed within domestic contexts.

norm entrepreneurs.[5] These actors "are critical for norm emergence because they call attention to issues or even 'create' issues by using language that names, interprets, and dramatizes them" (ibid., 897). If these creative efforts are unsuccessful, the norm may proceed smoothly through its cascade, hit a critical mass of adherents and then become internalized; if the norm entrepreneurs are unsuccessful in finding compelling frames and fora, the norm will wither before spreading.

Although the consent of powerful nations to a norm can offer an important boost to the norm cascade, the work of norm entrepreneurship can be undertaken by less mighty countries. Christine Ingebritsen (2002) discusses the norm entrepreneurship efforts of Scandinavian countries, arguing not only that norm entrepreneurship was an effective strategy to pursue influence on the global stage (given their relative military weakness and economic dependence) but also that there are opportunities for national strengths to be leveraged as a sort of legitimacy. Associations of Scandinavian cities with peace talks and historical investments in humanitarian aid, Ingebritsen argues, provide cover for these countries to play an outsized role in discourses of peace and humanitarianism (ibid.).

The success of a norm can also be determined in part by its fitness for the context; in recent decades, this has meant its coherence with the liberal international order. Alignment of a norm with broader normative structures of the international order can increase the resilience of norms to non-compliance and even overt challenge, providing an opportunity for modification, replacement or re-emergence rather than certain death (Percy and Sandholtz 2022). Even if it is directly challenged, a norm that aligns with the broader precepts of the liberal international order will be more resilient because of the broader support of its normative context (see, for example, Panke and Petersohn 2017). In this way, a norm entrepreneur who is able to identify and articulate the fitness of a given norm with the liberal international order[6] could reasonably foresee not only an easier path through the norm cascade — as the norm would, in theory, be "preaching to the choir" — but also a greater resilience for that norm, as the broader normative context would support its continuation. Successful norm entrepreneurship that leads to enduring influence can be an important strategy for middle powers in pursuing national interest, provided that the priorities of the middle powers are generally aligned with those of the dominant international order at that time.

A prima facie review of Canada's standing as a potential norm entrepreneur within the domain of quantum S&T policy is favourable. Canada is a participant in a number of key international organizations, such as the North Atlantic Treaty Organization (NATO) and the Five Eyes intelligence alliance, and is set to chair the Group of Seven (G7) in 2025, which offers an opportunity to leverage institutional positioning for agenda-setting purposes (Forrest, Samson and Laflamme 2024). Canada has a record of status seeking through international engagement, including through international organizations. Perhaps most importantly within the specific domain of quantum S&T — as Ingebritsen (2002) reminds us in the case of Scandinavian norm entrepreneurship vis-à-vis environmental and peace issues — the strength of Canada's domestic quantum S&T ecosystem provides domain-specific legitimacy to Canadian norm entrepreneurship on the matter. This is reinforced by the specific emphases on ethics in the guiding

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5   To this end, Finnemore and Sikkink say that "norms do not appear out of thin air; they are actively built by agents having strong notions about appropriate or desirable behavior in their communities" (1998, 896).

6   At the same time, however, the alignment of norms with liberal internationalism can also place a target on them, as illiberal authoritarian states may contest norms that infringe on their world view (Bettiza and Lewis 2020; Kreuder-Sonnen 2019; Aydın-Düzgit 2023).

documents of Canada's approach to quantum strategy.[7] In addition to the generic-case benefits for international engagement outlined in the previous section, there is a specific-case rationale for norm entrepreneurship as regards quantum S&T, given Canada's legitimacy in the domain and stated commitment to ethics therein. These factors provide a plausible argument for Canadian norm entrepreneurship to support international ethics in the domain of quantum S&T. The next section reviews existing literature to propose guiding principles for that normative engagement.

Ethical Considerations in Quantum S&T

Although much of the research work in quantum S&T broadly falls into the domain of technical innovation rather than social analysis, a growing chorus now calls for the necessity of ethical reflection on the domain of quantum S&T as a whole. This emerging debate is concerned with how existing ethical frameworks developed for non-quantum technologies[8] (among other forms of human interactions) might extend to quantum technologies that occupy similar socio-technical niches, and with identifying which capabilities of quantum S&T are sufficiently novel to merit entirely new ethical guidelines (Kop 2021b). Integrating ethics throughout the research life cycle can have multiple benefits, including in the selection of use cases for development and the identification of potential impacts (Kop 2021a). Different frameworks for responsible research and innovation practices have been proposed, with common calls for broad stakeholder dialogues; public consultations and reporting on taxpayer-funded research; and open opportunities for feedback on government policies relating to quantum S&T strategies (Coenen and Grunwald 2017). Although we might conventionally assume that the primary outcome of the advancement of an ethical agenda into the quantum S&T debate might be the limiting of certain areas being explored, the potential impact of an ethics debate in quantum S&T is about "carrots" as well as "sticks." For example, the WEF's report *Quantum for Society* outlines how particular quantum S&T use cases can be supported in pursuit of the United Nations Sustainable Development Goals — surely a call to ethics-driven policy making, even if the term "ethics" is absent from the report (Converso, Hain and Sarkar 2024). The WEF's adoption of existing ethical guidelines to inform actions in quantum S&T would fall into Kop's (2021b) existing-framework approach.[9]

One reason why the discussion around responsibility and clear ethical guidance in the domain of quantum S&T development emerges is because many of the relevant technologies are considered dual use, in that they have applications in both civilian

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7   Stakeholder consultations for the National Quantum Strategy called for Canadian efforts to promote ethical use guidelines and to fund research into the ethical implications of quantum S&T (Innovation, Science and Economic Development 2022, 8, 20), although it is worth noting that no resources were allocated to this aim. Quantum 2030, the quantum S&T implementation plan released by the Department of National Defence, highlights "ethical use of quantum science and technology" as a central risk consideration (Department of National Defence 2023, 16). See also Murphy (2024).

8   For example, the application of Responsible Research Innovation frameworks in the United Kingdom's quantum S&T initiatives (see, for example, Inglesant et al. 2021; Ten Holter, Inglesant and Jirotka 2023).

9   Ethical guidelines for quantum S&T *directly* reflecting quantum properties might learn from the work of Karen Barad and their commentators (see Barad 2007; Voelkner and Zanotti 2023; Murphy 2022), although this approach remains to be written.

and military contexts.[10] Quantum S&T is not extraordinary in this context, and as a recent EU working paper notes, "technologies used in the context of security and defence capabilities increasingly originate in the civilian domain, where private sector investments are higher, indirect costs are lower and R&D cycles faster" (European Commission 2024, 5). The case of quantum S&T policy follows discussions of many dual-use technologies, and governmental regulations limit the possibilities of exporting certain technologies related to quantum computers in Canada, as well as in many allied nations (Sparkes 2024). Export controls on dual-use technologies can be important ways to protect societies from the negative impacts of technologies being used by adversaries for military purposes, but they can also stifle innovation by limiting partnerships and collaborations between international partners. An important opportunity for ethical leadership in the domain of quantum S&T is for Canada to promote a common export controls framework for nations within Canada's key alliances. Domestically, this will reduce the regulatory burden for the quantum industry in Canada by harmonizing the guidelines for collaboration across a wide range of allied nations, instead of having different guidelines for, for example, Five Eyes, non-Five Eyes NATO and other allied countries.

One of the major ethical problems presented by quantum computing is the potential breakdown of conventional encryption protocols, which would threaten state secrecy and individual privacy alike, and create an especially acute threat for low-income countries. The high cost of a transition to post-quantum cryptography protocols is a disproportionately high burden for countries where budgets are already stretched and existing state capacity is limited. In a scenario where bad actors in advanced economies develop quantum computing capacity, cyberattacks on low-income countries may effectively hold key institutions as cyber hostages, while also compromising vast tranches of personal information. The United States Agency for International Development (USAID) has proposed that quantum cybersecurity become a focal point for development assistance through a quantum risk audit program, which would both identify vulnerabilities in existing digital infrastructure and develop transition plans (USAID 2023, 4, 34–35).[11] This form of international collaboration would help to mitigate the potential bifurcation of the world into countries with quantum-safe capabilities and countries that are radically vulnerable. The scale of the threat against vulnerable nations in this bifurcation scenario could open opportunities for substantial threats and coercion by bad actors. Given the prevalence of "harvest now, decrypt later" strategies — where actors collect encrypted data with a plan for future decryption when quantum computing capacity permits — these threats against quantum-vulnerable nations do not wait for Q-Day,[12] but may already exist. Because this international assistance program would have a core mission of capacity building, it shares significant similarities with two existing capacity-building programs housed in the International Security and Political Affairs Branch of Global Affairs Canada: the Counter-Terrorism Capacity Building Program and the Anti-Crime Capacity Building Program.[13] These existing capacity-

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10 The specific definition of "dual use" remains contested and is used here in a general sense to describe technologies that have applications in both military and civilian contexts. For interdisciplinary perspectives, see Górski and Spier (2010).

11 The USAID proposal included conducting the audit, supporting talent development in low-income countries, and fostering partnerships with private sector non-governmental organizations to support quantum-safe digital infrastructure development. In some cases, alternative strategies such as the banning of all third-party permissions or walling off sensitive information from external network connectivity may be the most financially viable strategy (see, for example, Raheman 2022). Please note that the working paper was written before the rapid downsizing of international assistance by Donald Trump.

12 In the world of cybersecurity, "Q-Day" is the time at which quantum computing power will be sufficiently advanced as to compromise conventional encryption. For more, see Munroe (2024).

13 For a review of the legal, operational and budgetary profile of the programs, see the recent report from the National Security and Intelligence Committee of Parliamentarians (2022, chapter 4).

building programs are already focused on bolstering technical capacity in priority countries, and provide a model for the extension of a new quantum-focused effort.

As a more future-facing concern, inequitable distribution of quantum capabilities worldwide may intensify existing economic inequalities. The promised power of quantum computing to support a wide range of industrial development through optimization, search, simulation and so on means that the already economically advantaged nations who develop quantum capacity will reinforce their economic advantage over time (de Wolf 2017, 274–75). Should global inequality be exacerbated by rich nations reinforcing their advantage through the force multiplier of quantum computing across various industrial use cases, the disadvantages of the quantum have-not nations will only be retrenched (including both the cyber vulnerability discussed above, as well as a reduced economic footprint hindering future efforts to develop quantum or quantum-safe capabilities). The impacts of economic inequality on other indicators of well-being are established and widespread, and the promotion of equitable access to technologies offers an opportunity not only for Canadian corporations to find new export markets, but also to pre-emptively avoid the potential second-order impacts on human health and societal well-being. The ethical case for this action is not only the primary one of promoting well-being, but also a secondary, pragmatic argument that remedial action after the negative impacts of inequality have been felt will likely be much more costly. Similarly, the ethical case for reducing cyber vulnerability is not only the altruistic motive for helping others to avoid harm, but also a pragmatic concern that preventing security problems from arising can help mitigate the likelihood of costlier future interventions over a longer time horizon.

Formal policy decisions around quantum S&T will — in the vast majority of democratic nations — be determined by non-experts elected by largely non-expert populations. Although this is to a certain degree inevitable, as a nation entirely consisting of quantum scientists is impractical, there is a risk of either technocracy or kakistocracy (respectively, rule by technical experts or rule by the ignorant). In order to ensure robust debate and informed democratic oversight, a cornerstone of any approach to ethics in quantum S&T must be education (Arrow, Marsh and Meyer 2023). As Pieter E. Vermaas remarked in an editorial introduction to a special edition of the journal *Ethics and Information Technology*, "a preamble to a societal debate is that all participants understand quantum technologies to a reasonable degree, and the current framing of quantum theory as enigmatic is not helpful for arriv[ing] at this understanding" (2017, 245). Just as the Canadian Armed Forces has recognized that a general level of quantum literacy is desirable within trades affected by prioritized quantum technologies (Department of National Defence 2023, 16), there is a similar need within political spheres for an increase in general quantum literacy to ensure that politicians can effectively debate the political stakes of quantum.[14] Through the twin efforts of more accessible science communication in policy debates and improved baseline quantum literacy among political actors, the prospects for effective democratic oversight of national quantum strategies are primed for substantial improvement. The WEF, however, goes further in promoting education as a pathway for informed debate, suggesting that "open dialogue and engagement with the public about quantum computing may contribute to socially responsible and ethical development and use of quantum technologies, as an informed public may expect this technology to be used for the common good and public benefit" (Coates et al. 2022, 19). Given the promise of wide-ranging revolutionary impacts, it is important that actors in various sectors — not merely those directly working in quantum S&T — are aware of the potential impacts of quantum technologies on their circle of competence. By raising a baseline quantum

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14   In addition to a lack of baseline quantum literacy, the prospects for public debate are hampered by the increasingly intense use of threat-related framing language (Murphy and Parsons 2024).

literacy among a diverse set of stakeholders, a richer public debate can help inform policy discussions and democratic oversight. A promising first effort to this end has been the Canadian partnership between the research funding agency Mitacs and the Qubo quantum education group; this collaboration has seen a variety of quantum S&T workshops offered as professional development opportunities for early-career researchers in a wide range of non-quantum fields (Swayne 2024). Although covering only a small proportion of the overall Canadian population, the integration of quantum S&T educational opportunities across sectors and disciplines is a promising first step toward building a stronger baseline of quantum literacy across the whole of society. The integration of quantum literacy modules into existing training and support programs would further help improve the overall familiarity of a wide range of stakeholders with quantum S&T.

Recommendations

- **Canada should promote harmonization of dual-use guidelines and export controls across its major alliances,** including NATO, the Five Eyes and the G7, to ensure a coherent approach between allied nations, mitigate risk of ally-developed technologies being used against allied nations and minimize the regulatory burden for innovators in the sector. The year 2025 presents a significant opportunity for this work, as Canada holds the G7 chair and can place quantum S&T regulation as a central agenda item. These conversations should include experts from industry and technical academic research, but also researchers and practitioners attuned to the social impact of quantum S&T development. Instead of leaving quantum S&T conversations to take place within policy silos or domestic contexts, incorporating discussions around quantum S&T policy on the agenda of international institutions will help promote the norm of international collaboration for ethical use of these powerful technologies.

- **National expertise at the intersection of quantum computing and cybersecurity places Canada in a prime position to play a proactive role in identifying quantum-enabled cyber vulnerabilities for low- and middle-income countries, and in advocating for international partnerships to shore up risks identified through these audits.** As outlined by USAID, this effort may further benefit from international funding of educational opportunities for in-country technical capacity. Such investments in human resources may have spinoff effects of future economic development to mitigate inequality in economic opportunity created by quantum S&T. This program could be housed under Global Affairs Canada and modelled after the two existing capacity-building programs discussed earlier in this paper. By establishing this program, Canada would be in a place to promote international assistance for quantum-readiness as a norm.

- **Education for non-experts must be a cornerstone of ethics conversations around quantum S&T, domestically and internationally.** Canada can advocate for accessible science communication principles to be followed in the development of quantum S&T policy, to ensure more effective engagement by non-expert political leaders. Baseline quantum literacy training should be scaled up in diverse sectors (with an explicit emphasis on bridging the gap between non-scientific fields and quantum technology awareness). This model can then be advocated for in the context of educational components of international development programs.

Conclusion

In the course of raising its international profile even further in the domain of quantum S&T, there is an opportunity for Canada to recommit to its strategy of liberal internationalism. Given the stakes of quantum S&T disruption in terms of both economic opportunity and security concern, these efforts for norm entrepreneurship are not about the promotion of one particular partisan vision or another, but are rather a strategic engagement with international institutions to promote Canadian interests and safeguards against misuse. The ethics of quantum technology and guidelines for responsible use are still unsettled, which adds a sense of dangerous uncertainty to the social disruption that these technologies are likely to cause. Further research on the social impacts of these technologies can help inform policy discussions as they develop, but the first step must be to promote the norm of quantum S&T as a domain where international collaboration can support the ethical use of technological development.

Acknowledgements

About the Author

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