

# THE INNOVATIVE UNIVERSITY



## Renewing the Role of Universities in the Digital Innovation and Artificial Intelligence Ecosystem

A PROJECT LED BY

Université   
de Montréal

WITH 12 OTHER U7+ UNIVERSITIES

# A U7+ PROJECT LED BY UNIVERSITÉ DE MONTRÉAL

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## ■ FOREWORD

The U7+ brings together universities from G7 countries and beyond that are committed to academic freedom, scholarly values and fulfilling their key role as global actors. Through the U7+, universities engage in discussions leading to concrete actions to address pressing global challenges. The Covid-19 crisis is a patent reminder of the pressing need to engage globally through key institutions such as universities. Our students, faculty, researchers and staff are instrumental in defining and implementing U7+ actions.

The first U7+ summit, held in Paris alongside the July 2019 G7, was a unique opportunity for nearly 50 university leaders from 18 countries on all continents to develop a common agenda and framework for university action on global challenges.

At that summit, the Université de Montréal agreed to participate in a number of activities, and take the lead in working with 12 other universities on the challenge of Digital Innovation and Artificial Intelligence (DI&AI) in higher education. This role involves:

Exercising strong leadership, alongside tech companies and governments, in developing and promoting guidelines about how data sciences and digital innovation should be handled. To that end, our universities may seek to establish a first version of a position paper by 2020, that shall be built on the universities' best practices and whose aim is to shape technological transformations for the broad benefit of society and individual wellbeing.

The Université de Montréal is well positioned to lead this project. We previously led the [Montreal Declaration for Responsible Artificial Intelligence](#), which has been [recognized](#) as one of the world's most complete set of principles for AI development and use.

I am strongly convinced that universities have an essential role in maximizing the positive impacts and minimizing the negative effects DI&AI will have on societies.

But I also believe that universities will need to rethink their processes, strategies and even organizational models to remain key players in a world where the future is radically uncertain.

Georges Clémenceau famously said that: “war is too important to be left to the generals”. There is no doubt in my mind that DI&AI are too important to be left to firms, computer scientists and governments alone, and that there is a need for universities to co-lead initiatives with these other actors in a vibrant DI&AI ecosystem.

The creation of the DI&AI Academic+ Network, as proposed by the authors of this report, will promote cooperation between universities, public agencies, firms and civil society organizations to develop and enact collective responses to the major issues and opportunities raised by DI&AI in today's societies. It is, in my opinion, an absolute necessity.

It is also my hope that the fruitful collaborations that have developed through the production of this position paper continue well into the future.

I would like to extend my warmest thanks to the authors and collaborators of this report and look forward to further developments and cooperation among our institutions.



Guy Breton, Rector  
Université de Montréal, Canada

# EXECUTIVE SUMMARY

In this paper, we discuss how universities can become more essential players in the digital innovation and artificial intelligence (DI&AI) ecosystem and increase their capacity to support the “responsible” development and use of these technologies.

The four sections of Part I explore the different ways in which universities can change the future of DI&AI and how DI&AI might transform the world of universities. Concrete examples of innovative and inspiring academic practices related to various challenges and opportunities explored in the paper are highlighted throughout.

In section 1, we recognize that academics in the social and human sciences (SHS) have started to develop knowledge, tools and methodologies around the concept of responsible DI&AI. However, these have yet to be integrated in organizations and policy, which struggle to anticipate the societal impact of producing and using cutting-edge DI&AI systems. Collaboration between SHS scientists, their Science, Technology, Engineering and Mathematics (STEM) colleagues and non-academic actors in the DI&AI ecosystem is not yet commonplace. We explore some of the impediments to this collaboration, while stressing its increasing importance in the face of growing public mistrust of organizations operating DI&AI and collecting and using personal data. Universities have not yet adopted changes required to capitalize on their status as trust brokers and engage with civil society and other stakeholders on issues of responsible innovation.

**RECOMMENDATION 1:** Universities should systematically assess their capacities in SHS and develop strategies to increase their ability to support and promote the use of transdisciplinary SHS knowledge within the DI&AI ecosystem.

**RECOMMENDATION 2:** To support responsible DI&AI innovation, universities should develop and implement strategies and competency-based training that will foster collaborative partnerships and cross-fertilization between SHS and STEM trainees and researchers, within and outside universities.

**RECOMMENDATION 3:** Universities should develop a strategy to support their role as third-party trust brokers within the broader ecosystem for responsible DI&AI. Initiatives to support the participation of various publics in the definition of responsible DI&AI are a manifestation of this civic leadership agenda.

Section 2 explores the importance of transforming the processes governing university research. Traditional safeguards and standards are impractical and inadequate for academic DI&AI research. Shortcomings are seen in the difficulties faced by researchers in obtaining informed consent at scale, and by Institutional Review Boards in evaluating the ethical dimensions of DI&AI research projects. New approaches must be designed and implemented if universities are to maintain their value in an increasingly complex DI&AI research environment that includes powerful industrial players. Universities collaborate with these firms, but also compete with them for talent. And collaboration can challenge academic values: most of the data researchers need is now produced outside of universities; however current partnership models do not always protect the right to disseminate and comment research results. These challenges emphasize that DI&AI is as much a social issue as an engineering challenge and stress the need for universities to champion interdisciplinary and international research.

**RECOMMENDATION 4:** Universities should play a co-leading role in exploring and developing innovative data governance models within the DI&AI ecosystem.

**RECOMMENDATION 5:** Universities and, more broadly, public research centres should develop an explicit strategy to harness the potential of public and open data for DI&AI research.

## RESPONSIBLE DI&AI

The “transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products.”

**RECOMMENDATION 6:** Universities and the private sector should explore innovative partnerships that value responsible research practices and guide researchers in their application.

**RECOMMENDATION 7:** Universities should promote the development and implementation of research standards and guidelines that support independent and responsible research within the DI&AI ecosystem.

**RECOMMENDATION 8:** Universities should go global in their partnerships with other institutions and partners to promote the development and implementation of inclusive research within the DI&AI ecosystem.

Section 3 discusses the transformation of university education. First, departmental frontiers mean that curricula do not presently offer students enough opportunities to acquire the combination of digital competencies and soft skills they need to navigate the changing requirements of the job market in the DI&AI era. Second, students are seldom equipped with the competencies required to develop DI&AI innovations that consider the needs and expectations of end users. STEM researchers in particular lack opportunities to develop an understanding of the societal context of technology use. Third, the biases built into many DI&AI tools can be attributed to the underrepresentation of groups such as women and visible minorities in the field. This points to factors such as admission parameters and faculty diversity that universities should address vigorously.

**RECOMMENDATION 9:** Universities should collaborate to develop innovative online and on-campus courses and programs to increase digital literacy, adaptability and resilience in students and workers.

**RECOMMENDATION 10:** Universities should embed ethics and SHS literacy across the curricula for tech students, notably by using transdisciplinary learning experiences, to support responsible DI&AI research and innovation.

**RECOMMENDATION 11:** Universities should develop innovative and vigorous strategies to promote equity and diversity in STEM courses and programs, and more specifically in DI&AI domains.

Section 4 delves into how universities use DI&AI themselves. DI&AI represent an opportunity for universities, giving them the capacity to rethink current processes and elaborate new business strategies. MOOCs, for example, enhance the scalability and affordability of university courses, and AI could significantly change the process of evaluating student applications. But the rise of DI&AI also risks disrupting the higher education sector by enabling new organizations in some fields to gain market share at the expense of universities. Powerful algorithms could enable virtual providers of education services to tailor lessons, exercises and support according to the needs of each individual learner.

**RECOMMENDATION 12:** Universities should study how DI&AI will impact their business models and implement strategies and processes to enhance the positive effects of DI&AI on their organization.

**RECOMMENDATION 13:** Universities should produce a practical guide on steps universities can take to become responsible and efficient users of DI&AI and better carry out their missions. This guide would emphasize DI&AI practices that have been successfully experimented or adopted by universities across and outside the U7+ network, the challenges they faced and the solutions they implemented. It should also help universities identify the expertise they will need to use DI&AI as a lever for change.

**RECOMMENDATION 14:** Universities should create knowledge exchange forums and online courses on the topic of DI&AI. These should be tailored for different university players (e.g. forum for researchers, forum for CIOs or Chief DI&AI Officers, forum for employees).

Part II of the paper presents the DI&AI Academic+ Network, a new entity designed to promote cooperation between universities, public agencies, firms and civil society organizations, in order to develop collective responses to the issues and opportunities raised by DI&AI.

We describe the importance of networks as a means to assemble the conditions of collaborative governance across autonomous yet interdependent organizations and groups.

The Academic+ Network goals are to promote dialogue and research on responsible DI&AI; develop, share and promote best practices and tools that contribute to embedding responsible innovation principles and mechanisms; develop innovative solutions through collaborative research on responsible DI&AI; and speak as a single voice on core DI&AI issues.

Finally, we describe how the Network would operate. Universities would adhere to the Network on a voluntary basis, with participation fees staggered according to the resources of a university's country of origin. A steering committee comprising representatives from four universities along with four non-academic members would be created to develop the Network's plan and program of activities, as well as the framework used to evaluate network performance.

**RECOMMENDATION 15:** The U7+ universities will formally decide at their next meeting whether to host a network of universities dedicated to responsible DI&AI innovation. Universities that collaborated on this position paper have already expressed their interest in participating in such a network.

**RECOMMENDATION 16:** A steering committee will be formed at the next U7+ meeting with the mandate to develop a business and activity plan for the network within six months. This steering committee will make concrete proposals on financial, governance and operational matters, as well as identify program priorities for the network. Right from the start, the DI&AI Academic+ Network will benefit from administrative and strategic support to ensure its viability and success in the initial phase of development.

# ■ INTRODUCTION

In the foreword to *The Age of Digital Interdependence*, Melinda Gates and Jack Ma, who co-chair the UN Secretary-General's High-level Panel on Digital Cooperation, underlined the demanding task of forging a digital ecosystem that is highly inclusive and aligned with broad societal goals:

***We urgently need to lay the foundations of an inclusive digital economy and society for all. We need to focus our energies on policies and investments that will enable people to use technology to build better lives and a more peaceful, trusting world. Making this vision a reality will require all stakeholders to find new ways of working together.***

In this position paper, we provide a modest response to the invitation extended by Ms. Gates and Mr. Ma. It represents the work of a group of researchers from 13 universities, who committed within a short time frame to consider how universities—as institutions with their own missions, assets and challenges—should play their part in the digital world.

The paper explores the roles played by universities within the expanding ecosystem of responsible digital innovation and artificial intelligence (hereafter DI&AI, defined in the box below). More specifically, we discuss how universities can become more essential players in this ecosystem and increase their capacity to nurture and promote DI&AI through collaboration with other institutions, such as firms or non-governmental organizations (NGOs), without compromising their unique contribution.

This focus arises from the observation that (1) people and societies are in the midst of a powerful and transformative technological transition accelerated by AI; and (2) the social sciences and humanities have a key role to play in informing and shaping that transition to reduce the risk of discrepancies, time lags and misalignments with broader societal goals.

In the context of massive proliferation of DI&AI innovations, two main institutional functions of universities – strongly associated with assets they have developed in the social sciences and humanities – become prominent. Universities may not have a monopoly over these essential and interdependent functions, but are well positioned to support them within the DI&AI ecosystem.

First, universities serve as engines of trust. In an era of information overload and fake news, universities can actively participate in shaping a well-informed and critical stance at the interface of societies and DI&AI. To be such “critical friends”, universities need to govern by example, developing best practices in technology development and use within each of their missions (education, research and community service). Second, universities promote institutional reflexivity, and can participate in the construction of societal capacity to approach change and innovation in a more deliberate and self-conscious manner.

This paper identifies and analyzes the specific roles universities should assume within the DI&AI ecosystem, pursuing several lines of inquiry that each lead to a set of recommendations.

Part 1 examines the impact of DI&AI on the future of universities, their core missions and aspirations. It starts by exploring the role of universities in the production and circulation of knowledge about DI&AI in society, and the potential for them to participate in networks composed of firms, individuals, public agencies and NGOs to achieve pre-defined outcomes in terms of responsible DI&AI. It then looks at how such technologies transform

## RESPONSIBLE DI&AI: A DEFINITION

**For the purposes of this paper, responsible DI&AI is understood as “a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).”<sup>33</sup> The vision of responsible DI&AI implies inclusiveness in terms of gender, cultural and social groups and countries with different levels of resources. In order to reap maximum benefit, and avoid potential pitfalls, universities must accept to be challenged by other players in order to position themselves as one of many valid actors within the emerging and expanding DI&AI ecosystem.**

research and teaching habits and environments and how universities might develop a responsible approach to DI&AI in these missions. Lastly, it analyses how universities will be impacted as users of these technologies, stressing the need for them to support the design and implementation of novel and effective practices and safeguards.

Part 2 describes how networks would help universities play their role in DI&AI more effectively. It suggests a network model whose implementation could help create the institutional conditions to support both the transformation of universities and the expansion of their role as advocates, stewards and developers of innovative solutions for responsible DI&AI innovation.

Further work will be needed to assess the practicability of some of these recommendations and define conditions required for universities to increase their impact on the evolving digital world. Our ambition in this paper is to lay the groundwork for essential and pressing efforts that will require the adoption of candid approaches by universities and the creation of solid local and international networks of researchers.

# ■ PART I: DI&AI AND THE FUTURE OF UNIVERSITIES

## SECTION 1: Universities and knowledge systems in the digital world

DI&AI is currently high on the innovation and research agenda of many countries.<sup>4</sup> For example, machine-learning systems are now used for image analysis, real-time language translation, autonomous driving, fraud detection and disease diagnosis.<sup>5</sup> With the rapid diffusion of digital innovations and intelligent systems, hype, hope and fears emerge around the implications of DI&AI for society and the economy.<sup>6, 7, 8</sup>

DI&AI applications bring benefits, but also have unanticipated and undesirable consequences. Facial recognition tools, for instance, can be used to monitor individuals and surreptitiously gather information about their political preferences.<sup>9</sup> Experts worry that applications developed to fight Covid-19 or other viruses will “enable popular repression and strengthen illiberal regimes<sup>10</sup>.” Deep learning can be employed to deceive the public by generating convincing images that support the spread of fake news.<sup>11</sup> These phenomena call for an expansion of the knowledge system associated with the digital world, in which social and human sciences (SHS) scholarship and effective knowledge translation practices play a key role.<sup>12, 13</sup>

### ZOOM IN

#### USING AND VALUING SHS KNOWLEDGE

Researchers at **University Paris-Saclay** launched the project “**Bad Nudge-Bad Robot?**” to explore the ethical implications of connected objects (such as conversational agents) and raise awareness among technology developers and users about the potential danger of “nudges” (subtle influences on human cognition and action).

In December 2018, **Osaka University** supported an international symposium “Image of Human Being in the Age of Artificial Intelligence” that gathered top executives from international organizations (the Assistant Director-General of UNESCO and the Director for Science, Technology and Innovation of the OECD) as well as scholars and practitioners from multiples fields (philosophy, ethics, anthropology, jurisprudence, constitutional law, competition law, information law, communications law, economics, business management, neuroscience, informatics, computer science, digital engineering, and science communications). Key issues regarding DI&AI were discussed among scholars and experts and international agencies.

In 2019, **HEC Paris** and **École Polytechnique** launched a joint project with the French Supreme Court and the DATA AI Institute to conduct an interdisciplinary assessment of the potential uses of AI in the Court system. The project emerged as an alternative to privately run projects which, in many cases, seek to profit from the expertise and data available in the Courts. In addition to providing access to state-of-the-art research, this project also enables Courts to reflect and work on long term goals for their digital transformation. The project included a commitment to ethical and explainable AI, including the publication of algorithms that were effectively implemented.

Several governments have launched “AI frameworks” in the past few years to spur economic and technological growth through digital transformation.<sup>14</sup> These frameworks range from the “US executive order on AI leadership” and China’s “Next Generation AI Development Plan” to the European Commission’s “White Paper on AI” and the “Pan-Canadian AI Strategy.” In these strategies, university-industry partnerships in AI R&D are considered central to accelerating knowledge spillover and innovation. This type of collaboration can and should be expanded to the SHS domain.

Partnerships based on knowledge exchange and co-development between and among universities, societies and organizations or industries are common in fields such as engineering, health and computer science. However, they have been much less present, historically, in the SHS sector.<sup>15</sup> Competing or alternate narratives around the role of universities in society (for example the Modes of knowledge production<sup>16</sup> and the Triple Helix<sup>17</sup>) have stimulated growing interest in the idea that universities should play a more active role in systems of research and innovation, and that this role should transcend their current boundaries.

## ZOOM IN

### COLLABORATIVE RESEARCH AND INNOVATION IN HEALTH SCIENCES

Over the years, several universities around the world have developed centres for collaboration and co-production in health research and innovation that seek to enhance patient and public engagement alongside professional researchers and innovators.

**The University College London** has a [Centre for co-production in health research](#).

**The University of Montreal** is one of the initiators of the [Centre of Excellence on Partnership with Patients and the Public \(CEPPP\)](#), a global pioneer in the development of new practices to integrate the knowledge and experience of patients and families into health research and innovation.

Labour market studies show that SHS graduates in Canada work in all sectors.<sup>18</sup> There is an opportunity for industries and developers in the DI&AI ecosystem to employ these graduates to support the development of in-house capacities for responsible DI&AI. Moreover, universities can work with these firms to create partnership positions or chairs for highly qualified doctoral and post-doctoral SHS graduates, or embed these researchers within firms.

While the benefits that SHS researchers bring to firms are widely recognized, institutional factors specific to academic work and processes may limit the circulation of knowledge between universities, on the one hand, and private and public organizations on the other.<sup>19</sup> For example, studies have shown that tackling non-academic challenges often places scholars at a disadvantage in academic career paths that focus almost exclusively on reaching narrow disciplinary goals, raising funds, and publishing.<sup>20</sup>

Entrepreneurs and experts we consulted also mentioned a certain disconnect between the DI&AI research conducted in academic centres and the research that companies and start-ups need or have the capacity to exploit. Making timely use of research findings is considered difficult. A better balance is needed between the curiosity-driven research in universities and problem-driven research aligned with the needs of developers and users.

To address these issues, universities have started to develop tools and methodologies that can accelerate knowledge exchange around the production and use of DI&AI. This knowledge can relate to DI&AI programming techniques, but also to the social, ethical and legal tools and processes that are critical to the responsible development and integration of DI&AI technologies into organizational settings.

The disconnect between AI research conducted in STEM departments and the research on AI issues undertaken by SHS researchers is another obstacle to knowledge exchange.<sup>21</sup> While publications on AI have increased steadily over the past half century, SHS researchers have not kept pace, as seen in the low numbers of references in recent SHS studies on AI. Moreover, an increasing proportion of AI research is conducted within industry, which tends to limit dissemination of research results to academic departments and public agencies.<sup>22</sup>

The increasing gap between STEM and SHS research means that researchers and policy-makers may have trouble anticipating the societal implications of producing and using cutting-edge AI systems. This situation underlines the importance of developing interdisciplinary and joint initiatives for responsible DI&AI between universities, developers, industries and concerned partners.

## ZOOM IN

### ACCELERATING DI&AI KNOWLEDGE TRANSMISSION

**Imperial College London** publishes lists of [AI and digital experts](#) that can act as consultants for public and private organizations. Moreover, the university creates [podcasts](#) to communicate scientific information to the public .

In the UK, organizations that are members of the **What Works** network can access tools that help identify evidence-based practices. See, for example, the [Education Endowment Foundation](#).

**Paris-Saclay University** launched [Scikit-learn](#) to provide simple and efficient tools for predictive data analysis (machine learning with Python). Tools are accessible to all and can be used in various contexts.

## ZOOM IN

### KNOWLEDGE CO-CREATION AND INNOVATION CO-DEVELOPMENT

The **University of Bordeaux** launched the Spine application that allows the public to annotate MRI brain images as a contribution to research in neuroscience. By mobilizing hundreds and thousands of Internet users, large collections of medical images can be analyzed very quickly to answer pressing questions about Alzheimer's disease, multiple sclerosis and other neurodegenerative disorders. The University of Bordeaux is working with Brigham and Women's Hospital (affiliated with Harvard Medical School, Boston) on this project.

**Osaka University** established the [Institute for Datability Science](#) (IDS) to promote productive collaboration between STEM and SHS scholars (including legal scholars, lawyers, ethicists and economists). One of its objectives is to connect data science researchers with researchers from different backgrounds (medicine, arts, legal studies, history) who want to work on DI&AI projects, and help them obtain external funding for their project. The Institute supports researchers in putting together the responsible research component of their grant proposal in order to ensure that the project respects responsible research practices and meets the Institute's standards.

**Côte d'Azur University** has developed [dedicated structures](#) to spur collaboration between academic research, industry and markets around DI&AI developments. Reference Centres set up public-private partnerships for the development of innovation through experimentation, testing of products and services, and co-financing. The Center of Modeling, Simulation, and Interactions offers specific training, advanced expertise and cutting-edge technology to entrepreneurs and project leaders.

Growing public distrust of systems and companies that collect and use personal data<sup>23</sup> suggests the need for a more vibrant civic leadership within the DI&AI knowledge system. This idea rests on the fact that citizens can contribute significantly to shaping policies around complex issues. Given that universities and scholars are still considered credible sources of information by citizens and political representatives<sup>24</sup>, they are well positioned to play the role of third-party trust brokers in supporting the development of civic leadership for responsible DI&AI.<sup>25</sup> They can rely on this reputational capital to engage broadly with stakeholders in the ecosystem.

To play this role, universities need to incorporate within their core mission an agenda of public participation and deliberative democracy, incentivize faculty members to take part in civic activities, and recognize researchers who participate in these transformative practices. The principles and methodologies needed to support universities and other institutions in this regard are well developed.<sup>26</sup> The Montreal Declaration for Responsible AI is a good example of the integrative leadership universities can provide, as its architects used co-construction methods involving researchers and civil society participants to develop guidelines and policy recommendations for AI production and use (see Zoom In on next page).

## ZOOM IN

### THE MONTREAL DECLARATION FOR RESPONSIBLE AI

The [Montreal Declaration](#) is the culmination of more than a year of work, research and discussion with close to 500 citizens, experts, public policymakers, industry stakeholders, civil society organizations, and professional associations. This democratic co-construction process, organized by the **University of Montreal** and the Fonds de Recherche du Québec, aimed to produce guidelines for the development and deployment of AI in society. In December 2018, the final version of the Declaration was made public, presenting 10 ethical principles and a set of recommendations.

### DEMOCRATIC SPACES FOR DI&AI DISCUSSION

The [Bordeaux Artificial Intelligence Alliance \(BAIA\)](#), a project carried out by **University of Bordeaux**, comprises more than 2,000 individuals from industries, public agencies, non-profit and academic institutions. Information regarding DI&AI developments is shared through newsletters and social media with all members of the network.

**Côte d'Azur University** is setting up a "[Maison de l'intelligence artificielle](#)" (AI House) in partnership with local and national authorities. It will invite citizens to participate with developers and innovators in discussions about DI&AI, as well as the co-creation of knowledge and innovation.

**Aix-Marseille University** is participating in the creation of the "[City of Innovation and Knowledge](#)", with support from the French government. Designed as a crossroads between research, innovation, training and culture, it will host research laboratories and offer training by academic and industrial actors. The City's ambition is to create an economic and cultural hub that is oriented towards France's Mediterranean partners.

**Imperial College London** is a main participant in the [GovTech Lab](#) that aims to facilitate the discussion, adoption and exploration of new digital technologies – AI, Internet of Things, Big Data, Blockchain – with a view to supporting the adoption of these technologies in the public sector. The GovTech Lab platform has three functions. The first is the Knowledge Transfer Consortium, a discussion forum that brings together stakeholders from government, academia, business and industry. The second is Education and Training, where the GovTech Lab provides a central hub for educating and enhancing knowledge for people interacting with emerging technologies. The third is the Research and Development platform, which showcases activities of the GovTech network. Network participants include leading UK academic research groups and professional experts from government and industry.

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## ZOOM IN

## SECTION 2: Transforming the Research Agenda

The recent evolution of technology has resulted in an exponential increase in the production of digital data and the capacity to harvest and process data. The rise of “Big Data” presents great opportunities, but also poses challenges for the responsible conduct of research in academia.<sup>27</sup> Historically, universities have been promoters of sound policies and practices around data governance and knowledge production and dissemination that apply to research performed within and outside their traditional boundaries.<sup>28</sup> In the research space of the digital era, the relevance and legitimacy of universities as drafters of standards and good practices for responsible research is increasingly questioned.<sup>29</sup>

Higher education institutions around the world need to take urgent action to be a key player for leadership in the promotion of practices for the responsible conduct of research in the age of DI&AI. The question is not whether universities need to adapt, but how they can actively contribute to advancing the science of responsible DI&AI development and governance. That means, among other things, striving in situations of shared leadership to define requirements for ensuring the robustness of AI algorithms, regulating the commercial use of DI&AI and minimizing its environmental impact.

This next section focuses on three key research challenges DI&AI presents for universities.

### **1) Designing and implementing high ethical standards for the governance and stewardship of academic research in DI&AI**

SHS researchers are making increasing use of Internet data as these offer new opportunities to observe and analyze human behaviours.<sup>30</sup> The sources of information are multiplying and becoming increasingly varied (e.g. user-generated videos, social media posts, e-health data) as the Internet becomes the backbone of communications and a main tool for conducting direct observation of activities and behaviours in society.<sup>31</sup> Research use of this data entails various risks and opportunities.

First, it is often difficult or impossible for researchers to collect informed consent at scale to analyze and manage the data they collect.<sup>32</sup> Moreover, for some research purposes, requiring individual authorization for data reuse becomes counterproductive given the societal benefits to be had from the study of large-scale and pooled individual information.<sup>33</sup> For example, current consent-based models used in biomedical research tend to limit research access to data collected through clinical trials, since individual approval is required for each specific research endeavor.<sup>34</sup>

We are currently seeing innovative attempts to ensure that, when necessary, researchers can access, analyze and manage these data without individual consent, while maintaining high standards for transparency, privacy and accountability. For instance, “data trusts” and “data commons” are new collective data governance mechanisms that represent a promising way to achieve the large-scale collection of individual data *and* their responsible use in research.<sup>35</sup>

**ZOOM  
IN**

#### **RESPONSIBLE DATA MANAGEMENT**

**HEC Paris** is part of the [Centre d'accès sécurisé aux données \(CASD Consortium\)](#). Research data collected by HEC Paris and partner institutions in France are aggregated into a common platform that researchers from these institutions can access securely. This initiative facilitates inter-university research cooperation and decreases costs related to data storage, management and security.

**Osaka University** has contributed to the [Initiative for Life Design Innovation \(iLDi\)](#) funded by the Japanese Ministry of Education, Culture, Sports, Science and Technology. The iLDi aims to set up a personal Life record platform that will store and manage individual data to ensure responsible reuse by researchers and companies. Secondary use purposes and practices are revised and assessed by a data ethics board. In this project, efforts are made to obtain explicit consent whenever data subjects receive a request for secondary use with specified purposes, with each request assessed by a data ethics board.

Second, despite their best efforts, researchers cannot always prevent privacy breaches when Big Data is collected, managed and analyzed (e.g. there is always a risk that de-identified data could be re-identified by matching the dataset with other identified sources of information).<sup>36, 37</sup> To minimize risks, precautionary measures need to be taken by researchers and universities throughout the research process. This is especially important when data leakages could cause harm to individuals.

Third, addressing the rising challenge of security will be central to the future of Big Data use and management. The 2017 WannaCry cyber-attack is a vivid example of the risks we face: hundreds of organizations were affected across the world, including many hospitals, public agencies, companies and non-profit organizations.<sup>38</sup> Researchers and universities need to better understand and estimate the impact of cyber-attacks and IT failures, and better anticipate and mitigate risks.

## ZOOM IN

### ENHANCING DATA SECURITY

**Paris-Saclay University** developed a project around personal cloud management to enhance the local storage and treatment of data, and improve security. This project is part of the [Center for Data Science \(CDS\)](#), a multidisciplinary initiative that unites more than 300 researchers and 50 laboratories around developments in data science applied to specific fields: physics, biology, medicine, chemistry, human and social sciences.

The **Government of Canada** is structuring a [Digital Research Infrastructure](#) to better equip researchers and academic institutions with the tools and services needed to conduct Big Data research that adheres to strict standards of data management and cyber security.

[SERENE-RISC](#) is a network of security experts created by researchers from the **University of Montreal** and others to break down silos and put people from academia, industry and government in contact with one another. Network leaders describe themselves as brokers who make sure information circulates in all directions. SERENE-RISC organizes two small annual conferences (about 150 people attend). They also disseminate research results. The strategy involves, “translating” scientific articles into a one-page, one-paragraph, and one-sentence summaries. To date, 200 articles have been treated in this way to publicize evidence-based results. Partners publicize the summaries in their own networks.

Fourth, traditional research oversight systems will need to be revised or upgraded to enable universities to face the challenges raised by DI&AI research. These systems include the Ethics Committees and Institutional Review Boards (IRB) that universities have put in place to monitor research involving human subjects. The relevance and usefulness of IRBs are increasingly questioned in the Big Data era.<sup>39</sup> Critics mention that IRB members are rarely experts in Big Data and struggle to evaluate the safety, validity and ethical dimensions of DI&AI research projects, which may involve uncommon questions and research methods.<sup>40, 41</sup> Moreover, IRBs do not always have the resources required for post-approval assessment of research projects.<sup>42</sup> There is therefore a need to adjust, and perhaps extend human research protection systems beyond current IRB practices to enable researchers and universities to better safeguard the rights of human subjects involved in DI&AI research.<sup>43</sup>

Last, but not least, academic researchers and universities must remain both critical and innovative in the DI&AI age. Universities should play a pedagogical role and entice other players to tackle issues related to the responsible production and use of DI&AI. The academic research community should emphasize critical thinking to push back against techno-solution promises of DI&AI when that appears necessary, and remind politicians and policymakers that while DI&AI holds significant promise, it cannot solve all the problems societies are facing.<sup>44, 45</sup> More specifically, universities could, and arguably should, come together to develop specific guidelines regarding the production and use of DI&AI by universities, researchers and developers. They could rely on existing guidelines (e.g. tools included in the Montreal Declaration for Responsible AI) or work together (see Part 2) to develop shared guidelines to orient digital transformations.

## ZOOM IN

### CREATING A DI&AI IMPACT OBSERVATORY

In 2018, the **University of Montreal** collaborated with eight other universities to create the [International Observatory on the Societal Impacts of AI and Digital Technology](#) (OBVIA). OBVIA brings together researchers, businesses, non-profit organizations and public institutions to conduct cross-sectoral and interdisciplinary work aimed at enhancing society's ability to maximize the positive impacts and mitigate the negative effects of AI and digital technology on people, organizations and communities.

In 2019, **Côte d'Azur University**, along with public partners, launched the first [Observatory on AI in France and in Europe](#) called OTESIA. It will partner with companies, local governments and non-profit organizations in the analysis of AI's impact on society, the economy and the elaboration of public policies.

### 2) Articulating responsible academic-industry partnerships for Big Data and AI use

Universities are evolving within a research environment that is increasingly complex and dense. First, they collaborate with private laboratories, large firms, think tanks and public agencies, while also developing knowledge in parallel with these multiple stakeholders.<sup>46</sup> Second, the resources of commercial research centres funded by tech giants (with large salaries, advanced technological infrastructure and computing power, and especially access to Big Data) have made them increasingly attractive to top DI&AI graduates and academics. Constrained by current academic rules and structures (such as limits on the data they can collect and how they can commercialize innovation),<sup>47</sup> some academics are completely or partially leaving universities.<sup>48, 49</sup> Third, academic researchers' increasing ability to use privately owned data and commercial computing resources creates fresh opportunities for academic research, but challenges their academic independence and capacity to disseminate knowledge (e.g. traditional industry-academic partnerships include limitations in key areas like data security, data control, privacy protection, avoidance of conflicts of interest, and accountability).<sup>50</sup>

## ZOOM IN

### AI RESEARCHERS WITH PUBLIC AND PRIVATE AFFILIATIONS

Joelle Pineau, AI Professor and researcher at **McGill University**, is also heading the Facebook Artificial Intelligence Research Lab in Montreal (FAIR Lab). The agreement was concluded between the tech giant and **McGill University** as a way to retain leading AI academics such as Professor Pineau.

At **Mila**, several university professors are conducting academic research and supervising and teaching students, while leading research projects in DI&AI companies and start-ups. Conversely, experts from the industry are welcome at MILA to supervise doctoral and postdoctoral student research.

**HEC Paris** hosts multiple chairs sponsored by private firms such as AXA, Joly Family, L'Oréal, Natixis and GS1 related to data analytics and digital transformation. These chairs provide researchers with key data to conduct their projects. The chair system is organized in a way that preserves academic freedom and benefits both researchers and students of the school. For instance, the Joly Family Chair held by Prof. Rodolphe Durand has led to the creation of a compulsory course on purposeful leadership for all bachelor students in the school. Similarly, the SMART Law Team at HEC Paris is working with Atos and students of multiple programmes (MSc Data Science for Business, LL.M. and CEMS) to create AI-driven and Smart contract solutions to ensure compliance in data flows. The ultimate goal of the project is to ensure people's personal data is protected across the supply chain of the global digital economy.

That said, universities are very well positioned to conduct important DI&AI research and exert a significant impact in the field. They have the capacity to harness the human and technological resources needed to pioneer "blue-sky research" exploring high-risk domains. Moreover, universities house a large number of impactful publicly funded research institutes and researchers that have their own networks across universities and within

the broader DI&AI ecosystem. Universities are therefore well positioned to access and analyze the vast amounts of still unexplored public or government-held data (health data, socio-environmental data, security data, transportation etc.) necessary for interdisciplinary and socially driven research activities that are complementary to the business-driven R&D conducted by for-profit companies.<sup>51</sup> Partnerships with governments and public agencies are key to ensuring that universities can play this role.

## ZOOM IN

### UNIVERSITY PARIS-SACLAY CENTER FOR DATA SCIENCE

**Paris-Saclay University** has constituted a [Center for Data Science \(CDS\)](#) that aims to develop methods and tools to analyze and extract useful information from large amounts of data for research use in physics, biology, medicine, chemistry, the environment and the human sciences. This project is multidisciplinary and involves research on analytical methodologies (statistics, processes of machine learning, extracting knowledge, viewing data), as well as on software design. More than 300 permanent researchers in 50 laboratories participate in the CDS supporting data science projects and events.

Data production outside the academic world is not new, but the fact that it has become predominant is unprecedented. The significant asymmetry between universities and industries in terms of resources and governance structures<sup>52</sup> explains the lucrative industry-academic partnerships involving researchers from both worlds that have emerged to train and validate DI&AI models.<sup>53</sup> Such partnerships can be challenging for academic researchers who have to adapt to imperatives and rules that may be incongruent with their usual research practices. Researchers may have to revisit how they conduct data analysis and publish results when interacting with partners who have different incentives and priorities (e.g. corporate/industrial secrecy). Researchers may find such relationships arduous and have difficulty anticipating consequences without guidance from their institution and exchanges with other researchers about their experience.

This exchange of information and best practices on industry-academic partnerships could lead to the development and implementation of models to ensure the quality of data used for research purposes, and the protection of researchers' academic freedom when collaborating with DI&AI industries (e.g. researchers should be able to present their research results and comments on research in different forums). Universities will also need to think about governance guidelines to help their researchers navigate efficiently through these new partnerships opportunities.

## ZOOM IN

### INNOVATIVE UNIVERSITY-INDUSTRY PARTNERSHIP

**Harvard University** has created an [organizational model of university-industry partnership](#) managed by an organization of academics named Social Science One, supported by the Institute for Quantitative Social Science at Harvard and the Social Science Research Council. The model enables researchers to access privately-owned data that would otherwise never be shared with the academic community. It proved effective at forging a productive partnership between Harvard researchers and Facebook.

### ***3) Creating productive interdisciplinary and multi-stakeholder research partnerships to support responsible AI development***

DI&AI present society with numerous opportunities, but also major challenges. For example, researchers emphasize that workers and citizens are right to be concerned about use of biased automated decision-making systems by courts, social services, hospitals, etc. that pose important risks of discrimination.<sup>54</sup> Legal scholars, in particular, have underlined that the deployment of AI systems to support, and sometimes replace, professionals in the execution of administrative and analytical tasks raises liability and accountability issues.<sup>55</sup>

These examples illustrate that DI&AI is as much a social issue as it is an engineering challenge. Interdisciplinary approaches are therefore essential to understanding and navigating the socio-technical conundrum of DI&AI development and deployment. Universities will need to transform their current approach to DI&AI research, by expanding the capabilities of STEM researchers beyond big data analytics, machine learning and software engineering. Academic institutions can capitalize on their extensive networks of researchers to develop a better understanding of the ethical, legal, managerial and societal implications of DI&AI. Some universities are already investing in this area through the development of interdisciplinary DI&AI research centres that promote interaction between SHS, STEM and other researchers.

## ZOOM IN

### INTERDISCIPLINARY DI&AI RESEARCH CENTERS

Founded in 2010, the **University College London Centre for Digital Humanities (UCLDH)** is a cross-faculty research centre that brings together a vibrant network of people who teach and research a wide range of disciplines. UCLDH cultivates close working relationships between the university and international institutions, culture and heritage sectors and industry partners.

**Osaka University** has set up an interdisciplinary integrated research centre to explore ethical, legal and social issues (ELSI) arising with emerging technologies, including AI and ICT systems. The centre is focused on the following activities: (1) implementing and facilitating interdisciplinary integrated research on ELSI; (2) providing a hub for formulating research networks on ELSI between scholars in the humanities/social sciences (e.g., philosophy, ethics, law including jurisprudence, STS, science communications), scholars in natural science/engineering fields (e.g., computer science, informatics, robotics), the business sector, and research networks involving universities and other institutions; (3) developing collaborations among stakeholders (e.g., civil society, the academic sector, business sector, national/local government sector) to facilitate consensus-building and policy-making on ELSI; (4) developing human resources, including those familiar with ELSI as well as scholars and expert ELSI practitioners.

Interdisciplinary approaches are also key to defining the conditions under which DI&AI innovations can be efficiently and responsibly integrated into fields of practice. A main challenge today is bridging the gap between the development of DI&AI and its application in sectors such as logistics, agriculture, health care or transportation.<sup>56</sup> The time lapse between scientific breakthrough and widespread implementation creates a “transition period” that can put public trust at risk.<sup>57</sup> “Are the huge investments made in AI research really worth it?” In health care, experts speak of an “AI chasm” between the moment algorithms are developed in research labs and their implementation in real-life clinical settings.<sup>58</sup> This might be the main “inconvenient truth about AI.”<sup>59</sup>

Universities can play a role in governing the efficient transition from design to diffusion of AI. They can lead or co-lead the development of research and innovation that integrate disciplines and communities within and beyond their walls. By connecting with policymakers, communities and firms, researchers can foster DI&AI developments that respond to socially relevant questions. The idea is not to stop conducting blue-sky research in DI&AI, but rather to pay greater attention to the issues raised by DI&AI innovation<sup>60</sup>, the social context of technology use, and practical contingencies in the design and development of technologies. Such pursuits would facilitate DI&AI implementation in real-life environments and maximize its positive impact on societies and populations.

Finally, to contribute to the equalization of DI&AI research and development across countries, universities will need to invest in effective, inclusive and equitable international collaborations that span the whole research pipeline, from data collection and analysis, to algorithm development and testing, to the diffusion of research results in scientific journals. This is crucial, as the lack of diversity in DI&AI research can have highly negative impacts on AI applications on the ground.<sup>61, 62</sup> For instance, most of the open genomic datasets that can be used to develop and train algorithms in biomedical research overly represent white male populations.<sup>63, 64</sup> This

considerably limits the usefulness of AI applications in most regions and countries. Universities can play their part in addressing the AI inequity conundrum by structuring transcontinental research partnerships that will increase the probability of producing DI&AI solutions that are safe in diverse sociocultural environments.

## ZOOM IN

### UNIVERSITY OF MONTREAL

At the **University of Montreal**, the Centre for techno-social innovation [InvenT](#) encourages researchers and students with different expertise to work with practitioners and decision-makers in organizations on identifying and addressing problems related to AI and Big Data, while adhering to key ethical principles from the Montreal Declaration.

## ZOOM IN

### AI COMMONS

The [AI COMMONS](#) network unites researchers, practitioners, private and public organizations across several countries to accelerate the dissemination of expertise and resources connected to AI. In particular, the network aims to connect experts in AI and related fields with individuals and organizations that are facing a problem that this technology would be helpful in solving.

**RECOMMENDATION 4:** Universities should play a co-leading role in exploring and developing innovative data governance models within the DI&AI ecosystem.

**RECOMMENDATION 5:** Universities and, more broadly, public research centres should develop an explicit strategy to harness the potential of public and open data for DI&AI research.

**RECOMMENDATION 6:** Universities and the private sector should explore innovative partnerships that value responsible research practices and guide researchers in their application.

**RECOMMENDATION 7:** Universities should promote the development and implementation of research standards and guidelines that support independent and responsible research within the DI&AI ecosystem.

**RECOMMENDATION 8:** Universities should go global in their partnerships with other institutions and partners to promote the development and implementation of inclusive research within the DI&AI ecosystem.

## SECTION 3: DI&AI and New Responsibilities in Education

It has become apparent during the Covid-19 pandemic that creating highly advanced digital tools is only one part of the DI&AI equation societies will have to solve. For example, mobile applications to track contacts of known cases will not be useful unless they respect a country's legislation, meet citizens' expectations with regard to privacy, and accommodate vulnerable groups, such as people without smart phones. For new products to be adopted, their integration and use in the real world needs to be planned before they launch. For example, algorithms will become useful to detect eye disease or fast-growing tumors in real-life settings only once new workflows are designed to integrate the innovation, training is provided for health professionals (e.g. to judge borderline cases) and models are adjusted (e.g. to handle often imperfect images).<sup>65</sup> Finally, tough questions will have to be considered regarding the transformative potential of DI&AI on societies and the economy. As seen in recent months, "we're great at devising shiny, mainly software-driven bling that makes our lives more convenient in many ways. But we're less accomplished at reinventing health care, rethinking education, making food production and distribution more efficient, and, in general, turning our technical know-how loose on the largest sectors of the economy."<sup>66</sup>

In this section, we argue that universities can catalyze the production of an ecosystem of responsible and socially mindful DI&AI students and workers. Universities are at the crossroads of multiple sectors and types of expertise, and can provide students, practitioners and decision makers with comprehensive interdisciplinary training that will help them navigate the fast-changing market of the digital era and contribute to the development and deployment of safer, more useful and more effective technologies. We focus here on three main educational roles universities can play in the DI&AI ecosystem.

### *1) Helping students and workers gain resilience, agility and autonomy to face digital transformations*

While DI&AI is not exactly new, researchers and experts concur that recent advances in the field are intensifying the transformation of workplaces and the nature of work.<sup>67</sup> Recent studies show that AI will accelerate the shift in work skills that has been underway over the past 15 years<sup>68</sup> and has increased demand for advanced technological skills (e.g. in programming, data analysis, data protection). Today, a broader range of social, emotional and cognitive skills, such as creativity, critical thinking and complex information processing, are becoming essential for students seeking to integrate the labour market.<sup>69</sup>

As producers and disseminators of interdisciplinary knowledge, universities can play a role in helping students and workers acquire digital competencies, and develop the soft skills they need to navigate the changing requirements of the job market. With their STEM and SHS expertise, universities can produce cutting-edge knowledge on the multiple types of change induced by DI&AI to work and social relations. Universities' pluralistic approach to knowledge is highly valuable in developing comprehensive curricula that will enable students and established workers to gain resilience, agility and autonomy in the face of digital transformations.

## ZOOM IN

### DEVELOPING DIGITAL COMPETENCE

**Côte d'Azur University** has developed training programmes and modules to enhance digital and AI literacy among students from multiple backgrounds. It offers a program for bachelor's and master's students, a program for students already specialized in mathematics and computational science (including doctoral students), a program for high school students, a professional training program for non-specialists in AI (schoolteachers, managers, engineers, medical teams, doctoral students, etc.), and a program for medical professionals.

**HEC Paris** recently created the [Centres of Expertise in Entrepreneurship & Digital](#) (IDEA Center) and SNO (social business). The Centres focus on three axes: research and applied research, training, and implementation and outreach. Several programs in digital innovation, data science, as well as commercial and social entrepreneurship studies are proposed to students on and off campus.

Over the past few decades, universities have reshaped programs and courses to respond to evolving labour market demands and anticipate changes produced through automation and the digitization of work. Training in library science and information management is a good example of this transformation. Current and future librarians have been offered formal and continuing education courses in database searching and information classification to adapt to the rapid digitization of content and material. They have also acquired the skills needed to manage digital information according to international standards.<sup>70</sup>

Several institutions have started to change university curricula to match the skills required in many of the areas that DI&AI will impact.<sup>71</sup> In academic medicine, for instance, universities in the US and Canada have begun to offer machine-learning courses to medical students to equip them to apply AI techniques to the analysis of medical images.<sup>72</sup> While these adaptations cannot anticipate all the changes that will affect work and professions, they are essential to developing more adaptive individuals with a broader range of competences.

## ZOOM IN

### TRAINING A NEW GENERATION OF DI&AI LEADERS

**University College London** launched [two new Centres](#) in 2019 for Doctoral Training focused on “Foundational AI” and “AI-enabled Healthcare Systems”. The centres are collaborating with public health organizations, research institutes and companies to train a new generation of researchers, business leaders and entrepreneurs with knowledge and competence in management, data science and innovation ethics.

The **University of Montreal** recently launched a new [master’s programme in Digital Health](#) to enable healthcare professionals to acquire complementary skills in data science and information management, while gaining an appreciation for issues related to digital health developments.

The **University of Bordeaux** has launched a new [graduate programme](#) (master’s and doctoral training) in Digital Public Health, combining lectures in epidemiology, biostatistics, computing and social sciences to explore the impact of digital public health on society.

Universities need to multiply these efforts, as organizations are increasingly looking for professionals who can combine various competencies to bridge the communication gap between DI&AI developers (e.g. programmers and data scientists) and specialists in a given field (e.g. medicine, law, management).<sup>73</sup> To meet these demands, universities must work harder to open up the frontiers between departments and develop programs and courses that increase the resilience, agility and empowerment of workers.

### **2) Cultivating social responsibility and ethical mindfulness in tech students to spur safer, more useful and effective digital innovations**

The Cambridge Analytica scandal provided striking evidence of how Big Data from social media could jeopardize the very foundations of democracy and make it difficult to ensure fair election campaigns.<sup>74</sup> The rapid diffusion of AI-based innovations has raised serious issues (e.g. safety, discrimination, inequality) that are intrinsically related to the way technologies are designed and developed.<sup>75</sup> Despite these risks, the ethical and social aspects of technologies are often assessed only *after* negative impacts become apparent.

To evaluate the potential harms and benefits of DI&AI during the first phases of technology development and testing, the data scientists who develop algorithms and the multiple experts in charge of their validation would ideally operate in a transdisciplinary setting and possess appropriate skills.<sup>76</sup> Admittedly, universities already offer a wide range of courses on topics such as computer ethics, privacy and security, the social impact of technology, etc. However, very few universities go beyond such stand-alone courses to comprehensively embed SHS and ethics training across the curricula for data scientists and algorithm developers.<sup>77</sup> Academic institutions face the challenge of adapting teaching methods and curricula to available resources and learning environments, in order to engage large numbers of tech students within and beyond their walls. Massive Open Online Courses

Training in responsible DI&AI should target user populations, but also the companies with business models based on the development and spread of these innovations.

(MOOCs) and other distance-learning methods (see next subsection) could be employed to disseminate SHS training and help students and faculty members explore the critical issues raised by DI&AI.

## ZOOM IN

### EMBEDDING SHS IN TECH DEVELOPMENT TRAINING

At **Harvard University**, the [computer science curriculum](#) has been revised to embed ethics training provided by professors from the philosophy department. Computer scientists are trained to reflect on the societal impacts of technologies and develop solutions to minimize their potential risks and adverse effects.

At the Canadian Robotics and Artificial Intelligence Ethical Design Lab (CRAiEDL) at **Ottawa University**, Professor Jason Millar organizes [workshops](#) to train engineers in ethics capacity building using innovative methodologies. Building a “value-map”, for instance, engineers are led to reflect on potential conflicts of interest and values between stakeholders during the design of a technology.

## ZOOM IN

### SCALING SHS TRAINING AROUND DI&AI ISSUES AND SOLUTIONS

The **University of Bordeaux** has developed a [MOOC on research integrity](#) in scientific professions (French and English) and will soon launch a course on Software Law (under development).

The French **National Institute for Research in Digital Science and Technology** (INRIA) has developed an online course on [privacy protection in the digital age](#) (French).

The **Institute for Data Valorization** (IVADO) has just launched a MOOC on [bias and discrimination in AI](#), in partnership with the **University of Montreal**.

Only a small percentage of DI&AI is currently integrated into real-life settings, and an even smaller portion has been proven to generate positive outcomes for individuals and organizations.<sup>78</sup> To improve adaptation, uptake and evaluation, universities will need to equip students with the skills to develop responsible DI&AI that considers the needs and expectations of end users, and is suited to the environments in which it will be implemented. For example, pedagogical models exist to develop communities of practice where students engage with actors from government organizations, business and civil society to experiment collaborative methods of responsible innovation development and testing (e.g. Design Thinking and co-design methodologies).<sup>79</sup> Changing the training of tech students, and leading them to envision innovation development and diffusion differently, will have a considerable impact on the tech industry as a whole.

### **3) Leading the movement towards diversity and inclusion in DI&AI industries**

In the 1940s, 50s and 60s, the vast majority of computer programmers and systems analysts in the US were women; today women comprise a minority of the labour force in these sectors.<sup>80</sup> For workers from visible minority groups, the picture is even more worrying. In major digital tech industries (GAFAM) less than 5% of all workers are nonwhite.

Recently, New York University’s AI Now Institute evoked the “diversity disaster” that now affects the entire AI sector.<sup>81</sup> And there is increasing evidence of the impact of this lack of diversity: facial recognition applications failing to identify darker skinned users, chatbots adopting hate speeches, etc. According to AI Now, the biases built into the AI industry are attributable to the lack of diversity in perspectives, values and concerns in AI design and development.

There is no question that industry must play its part to increase the participation of underrepresented populations in the AI field (e.g. by hiring a more diverse group of candidates, by being more transparent about pay and more attentive to reports of discrimination and harassment, by creating a more welcoming atmosphere). But universities must also make changes to increase diversity.<sup>82</sup> At Carnegie Mellon University, for instance, the admissions system has favored women in tech by no longer rewarding teenage coders.<sup>83</sup> And the apprenticeship programs in computer science developed by universities in conjunction with companies can encourage intake of a more diverse group of tech developers—including students from lower socio-economic backgrounds who cannot afford to enrol in full-time university programs.

## ZOOM IN

### APPRENTICESHIP PROGRAMMES IN COMPUTER SCIENCE

**HEC Paris** became involved some years ago in a partnership with [École 42](#), a computer programming school with a peer-to-peer learning environment. The objective is to bring diversity and skills complementarity in student teams projects involved in HEC Digital & Entrepreneurship programs.

Moreover, at **HEC Paris**, a student association, [HEC Data Minds](#), was created with the goal to empower HEC students to become fluent in coding and analytical problem solving. It organizes coding seminars, conferences and events with professionals from the tech and traditional industry on digital and data issues.

The **University of Bordeaux** is an active member of [Robocup](#), which is the largest international competition in autonomous robotics. Within this context, several junior competitions are organized during the year, addressing high school students under the mentorship of academics. The first Women's Robocup will be organized in Bordeaux in June 2021 during the international Robocup.

Universities should also address the “leaky pipeline” issue: the drop in the proportion of women and underrepresented groups at each successive level in academia (e.g. only 18% of authors at leading AI conferences are women, and more than 80% of AI professors are men<sup>84</sup>). Promoting a more diverse and representative faculty could have a major impact on the composition of the AI industry. Indeed, studies show that environmental factors (faculty composition, presence of advisors, institutional support, etc.) are key to the success of women and underrepresented minorities in programs that are dominated by white men.<sup>85</sup>

## ZOOM IN

### CREATING A MORE INCLUSIVE COMMUNITY OF DI&AI DEVELOPERS AND RESEARCHERS

[Spoken Tutorial](#) is a publicly funded project developed by the **Indian Institute of Technology in Bombay** to promote IT literacy in students and workers across India and in neighboring countries. Ten-minute long spoken tutorials (ST) are created for self-directed learning. They are dubbed into all Indian languages and can be used offline. Both ST and the software trained by the tutorials are publicly available at no cost. Anyone can create a ST, learn independently using ST (with no Internet connection), and conduct ST-based training programmes. A total of 4.5 million students have been trained, of whom 1.5 million are studying arts/science/commerce.

Part of the [AI for Social Good initiative](#), the internship programme set up by the **Mila** is currently enrolling students from multiple countries in Africa, Asia and South America. Under the supervision of top AI academics, students are paid to conduct four to six months' work on an AI project of their choice. They are encouraged to tackle a research question or practical concern arising in their own cultural and social environment and field of practice.

The support of professors and advisors who are familiar with the realities of students' lives can help overcome psychological barriers that limit student confidence and undermine academic achievement. To promote inclusion and diversity within and beyond their walls, universities need to encourage diverse faculty members to engage in mentoring, outreach and recruitment activities, and reward these activities. Female and minority professors and researchers can act as powerful role models for students who are hesitant about pursuing their career aspirations.

**RECOMMENDATION 9:** Universities should collaborate to develop innovative online and on-campus courses and programs to increase digital literacy, adaptability and resilience in students and workers.

**RECOMMENDATION 10:** Universities should embed ethics and SHS literacy across the curricula for tech students, notably by using transdisciplinary learning experiences, to support responsible DI&AI research and innovation.

**RECOMMENDATION 11:** Universities should develop innovative and vigorous strategies to promote equity and diversity in STEM courses and programs, and more specifically in DI&AI domains.

## SECTION 4: Universities as users of DI&AI

Universities have long used digital technologies to increase the effectiveness and efficiency of *existing* business processes. For example, universities started using Enterprise Resource Planning systems 30 years ago to better connect offices and departments and ensure that financial information, registration data and faculty course loads would be accessible at lower cost and in real time.<sup>86</sup> Universities have also using the Web to provide 24/7 information for more than a quarter-century. But digital technologies can do more than offer universities faster and cheaper ways to basically do more of the same. They increasingly offer the potential to rethink current processes (that is to conduct certain key activities in a different way) and the power to build new business models and adopt groundbreaking long-term strategies.<sup>87</sup>

For example, MOOCs enhance the scalability and affordability of university courses by enabling more diverse populations (e.g. people from lower socio-economic backgrounds or emerging countries, non-traditional students such as single parents and people changing careers) to conveniently access higher education at various stages in their lives. Universities can also rely on a wide range of digital tools (e.g. mobile devices, cloud systems, video games) to tailor educational content to a student's abilities, preferred mode of learning, and experience. In some universities, AI systems are used to augment tutoring with autonomous conversational agents that can answer student questions and provide assistance with learning and assignments.<sup>88</sup>

These transformations are leading universities to reflect on the nature of teaching and learning, as well as to reconsider the interactions between faculty members, lecturers, administrators and students.<sup>89</sup> For example, pedagogy is progressively moving beyond traditional lectures to allow remote collaboration and co-creation in complement to face-to-face interactions between professors and students.<sup>90</sup>

Universities can also use DI&AI to reinvent key processes. For example, AI-driven chatbots can immediately answer tough questions applicants might have about their eligibility or tuition fees (and, in the end, attract more students), or help students navigate their university and determine when their classes will be or who will be teaching them.<sup>91</sup> Some universities have begun adopting machine learning techniques to identify opportunities to save in procurement activities, generate metadata for library content<sup>92</sup> or better determine which donors fundraising specialists should prioritize.<sup>93</sup> Creating an AI that could automatically analyze the applications and social media posting of students could also "make the task of choosing which applicants should receive offers faster, cheaper, and more accurate"<sup>94</sup> and, ultimately, enable universities to "significantly modify the dynamics of competition for top [...] candidates."<sup>95</sup>

The rise of DI&AI could fundamentally disrupt the higher education sector by enabling new organizations to gain market share at the expense of universities in some important segments. For example, the development and adoption of new, powerful algorithms could increase the capacity of online course or program providers to automatically evaluate the quality of written essays or vocal answers to questions, to personalize lessons and exercises according to the needs of individual learners, and to tutor students and increase their engagement.<sup>96</sup> Powerful innovations such as AI-powered MOOCs are what led Clayton Christensen to state that traditional universities should seriously rethink the way they will do things in the future. As Christensen, who developed the theory of "disruptive innovation" in the 1990s, said: technologies enable "new business model[s] to coalesce, and that's what is happening in higher ed now."<sup>97</sup>

We see four actions as especially important for universities in facing the impact of DI&AI.

First, universities should carefully plan their digital offensive and assess the potential of digital technologies and the positive and negative impacts these may have on their business model, business strategies and business processes. Planning may include establishing a formal DI&AI governance structure, hiring a Chief DI&AI Officer or equivalent (as more than 200 universities and colleges have already done, according to a 2018 study<sup>99</sup>),

### UNIVERSITIES SEE DI&AI AS AN OPPORTUNITY

Times Higher Education and Microsoft recently conducted a survey of more than 100 AI experts and university leaders and found that 94% of respondents believe that AI will increase the future demand for university graduates. Moreover, 86% of respondents disagree (most often, strongly) with the idea that AI will lead to the closure of universities. In fact, 95% of them see AI as an opportunity rather than as a threat.<sup>98</sup>

adopting a deliberate and coordinated DI&AI strategy to support all aspects of change, conducting ongoing scanning activities (in order, among other things, to identify promising technologies and best practices) and creating R&D departments and 'sandboxes' to design and safely carry out experiments.<sup>100</sup>

## ZOOM IN

### MOOCS IN DI&AI

**HEC Paris** began experimenting with MOOCs in 2013. Thanks to the courses and programs it offers through the [Coursera platform](#), the business school estimates it has been able to attract students it would not have reached in the past.

Spoken Tutorial and "[Train 10,000 Teachers](#)" (or T10KT) are two very large-scale asynchronous and synchronous teaching methodologies developed by the **Indian Institute of Technology Bombay**. Using these approaches, the Institute is able to teach tools or languages like Koha, Moodle, Scilab and Python to 5,000 teachers and librarians at the same time. A financial model to make this approach affordable for students, and self-sustaining in the long run, has been successfully tested.

Second, universities should take measures to improve their capacity to maximize the positive impacts of AI. These measures are not exclusively technical, as we saw in the first section of this paper. Indeed, exploiting the full potential of DI&AI will depend, *to a very large extent*, on bringing about social, cultural and organizational changes. For example, universities will need to change rules and accountabilities to empower and motivate employees to redesign processes around DI&AI and use the new tools put at their disposal. They will also have to train staff to productively process the information provided by algorithms. To paraphrase information technology governance expert Ross, recruiters will know what to do when the machine tells them an applicant has a 95% chance of becoming a successful student, "but what's the next step when the machine says there's a 50% likelihood that this happens?"<sup>101</sup>

Third, universities should start to identify the positive and negative impacts DI&AI could have on students, researchers, employees and other stakeholders, and define strategies for reducing or eliminating potential risks. For example, allowing AI tools like chatbots to gather and analyze very large quantities of sensitive data, such as student or staff records, raises major ethical and privacy concerns that should be addressed by universities *before* they start using the tools. Moreover, management should be ready to face some of the questions that introducing AI to automate key processes raises, *even when the algorithms put in place are unbiased and function basically as planned*. Oswald reminds us, for example, that we "cannot always assume that the forecast or classification represents the only or main factor on which the 'rightness' or 'wrongness' of the overall decision is to be judged. Doing so risks changing the question that the [...] decision maker has to answer. 'Young Jones was admitted to dental school despite the algorithmic prediction that he would do poorly, and look he has done poorly; therefore, the human decision was wrong.' But perhaps the university's policy of admitting candidates from deprived backgrounds outweighed the prediction at the time."<sup>102</sup>

Fourth, universities should collaborate more closely with one another on internal use of DI&AI. For example, a lack of preparation could make universities especially vulnerable to cyber attacks. These could impair their legitimacy and, hence, their capacity to conduct research in the future, and even expose them to lawsuits. Cyber security is an ideal area for inter-university collaboration, to share best practices and research on DI&AI security, and increase their common preparedness.

To conclude, "the ongoing coronavirus pandemic has forced a global experiment that could highlight the differences between, and cost-benefit trade off of, the suite of services offered by [universities] and the ultra-low-cost education of [online education providers]<sup>103</sup>." Whatever happens in the coming months and years, universities should develop a deep understanding of what DI&AI can and cannot do for their mission, processes and clientele.

**RECOMMENDATION 12:** Universities should study how DI&AI will impact their business models and implement strategies and processes to enhance the positive effects of DI&AI on their organization.

**RECOMMENDATION 13:** Universities should produce a practical guide on steps universities can take to become responsible and efficient users of DI&AI and better carry out their missions. This guide would emphasize DI&AI practices that have been successfully experimented or adopted by universities across and outside the U7+ network, the challenges they faced and the solutions they implemented. It should also help universities identify the expertise they will need to use DI&AI as a lever for change.

**RECOMMENDATION 14:** Universities should create knowledge exchange forums and online courses on the topic of DI&AI. These should be tailored for different university players (e.g. forum for researchers, for CIOs or Chief DI&AI Officers, forum for employees).

# ■ PART II: A MACHINE FOR STRATEGIZING: PARAMETERS OF A DI&AI INTERNATIONAL ACADEMIC+ NETWORK

## SECTION 1: Rationale

Networks provide a promising way to face great societal challenges and technological transitions, and deal with “wicked problems.” The intensity and velocity of developments in DI&AI call for an increase in the capacity of universities to respond to and influence such a socio-technological push. In this section, we propose the implementation of a multilateral and multi-stakeholder network to support the development and transformation of universities in response to the multiple challenges raised by DI&AI. The DI&AI Academic+ Network will be involved in an ambitious program of activities based on the exploration, experimentation, execution and evaluation of core DI&AI developments within and beyond universities.

Network formation is not a goal in itself, but rather a means to assemble the conditions for collaborative governance across autonomous yet interdependent organizations and groups. *Collaborative governance* is defined as “... processes and structures of **public policy decision-making and management** that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished.”<sup>104</sup> An extension of this stream of scholarship is found in the notion of *collaborative platform*, defined as “an organization or program with dedicated competences, institutions and resources for facilitating the creation, adaptation and success of multiple or ongoing collaborative projects or networks.”<sup>105</sup> The collaborative platform aims to increase the operational capacities of the network.

Organizing in networks requires defining and implementing specific parameters. A network will develop if time and resources are devoted to the development of shared motivation (a common definition of problems and domains of intervention, mutual trust and understanding, legitimacy and commitment), shared principles and rules for effective joint action (governance, decision-making, allocation of resources and priority setting, evaluative criteria, rules to arbitrate conflicts or differences) and clear and agreed principles of engagement, including the question of resource commitment.<sup>106</sup> It is expected that the network and collaborative governance co-evolve in order to respond to new challenges that are identified through joint thinking and action.

## SECTION 2: Operational parameters

### *Mission of the network*

The DI&AI Academic+ Network aims to promote cooperation between universities, public agencies, firms and civil society organizations to develop and propose collective responses to the major issues and opportunities raised by DI&AI in societies.

While the collective voice of universities constitutes the network’s core, the “+” highlights its multi-stakeholder nature. The network is based on the idea that universities are part of a vibrant multi-stakeholder DI&AI ecosystem, with which they need to engage in order to remain relevant and innovative. Where appropriate, the network builds on existing regional, national or continental networks.

The DI&AI Academic+ Network will be involved in an ambitious program of activities based on the exploration, experimentation, execution and evaluation of core DI&AI developments within and beyond universities.

## GOALS OF THE NETWORK:

The network will maximize its value through pursuit of the following four goals:

- 1 - Promoting high-impact international, interdisciplinary and intersectoral dialogue and research on responsible DI&AI.
- 2 - Developing, sharing and promoting best practices, tools and solutions that contribute to embedding responsible DI&AI innovation principles and mechanisms within the university's core mandates of research and education and within society.
- 3 - Developing innovative evidence-informed solutions through collaborative research on responsible DI&AI.
- 4 - Speaking publicly as a single voice on core issues related to responsible DI&AI.

### *Functions of the network:*

The network will perform four functions related to the roles of universities within the DI&AI ecosystem: 1) **the network as an engine for university diplomacy** to nurture greater collaboration and cooperation among universities and key partners and stakeholders (NGOs, firms, citizen forums, etc.) within the DI&AI ecosystem—this network function relates mostly to challenges and opportunities discussed in this paper on the positioning of universities within the broader DI&AI ecosystem; 2) **the network as a collective to create and share best practices** for the institutional renewal of universities within this ecosystem—this network function is related to challenges and opportunities arising from the digital transformation's impact on the fundamental missions of universities, 3) **the network as a force of advocacy to influence and shape DI&AI developments and impacts according to norms of responsible innovation**—this network function sees universities using their specificities and assets to achieve an impact within the broader global DI&AI ecosystem by promoting evidence-informed practices and solutions, and 4) **a network dedicated to experimentation and the search for evidence-informed innovative solutions**, in the spirit, for example, of the [UN GlobalPulse](#) initiative for the development and deployment of responsible DI&AI. Through these different functions, the network aims to support the development of capacities, to influence the approaches used to develop and deploy DI&AI and to act as a set of labs to identify and experiment innovative solutions with key partners across the ecosystem.

The network aims to support the development of capacities, to influence the approaches used to develop and deploy DI&AI and to act as a set of labs to identify and experiment innovative solutions with key partners across the ecosystem.

### *Membership and resources*

Universities adhere to the network on a voluntary basis. Membership is for an initial period of three years.

An adaptive fee scale is established according to the income level (high, middle or low) of the university's country of origin.

Adherence to the core values, mission and goals of the network is reflected in a Memorandum of Understanding signed by each university member of the network.

### *Governance*

An *Elected Steering Committee* is composed of eight members, with an initial three-year mandate. The steering committee includes members from the following institutions: one designated representative from each of four universities that are members of the network, one representative of private sector developers, one representative of an NGO, one representative from government and one student representative.

The mandate of the steering committee consists mainly in developing, with network members, a plan and program of activities aligned with the mission and goals defined for the initial three years, and in managing the financial resources provided by membership fees and other sources of funding.

In term of resources, the DI&AI Academic+ Network benefits in its initial phase of development from the support of an administrative coordinator and a person in charge of strategic development, partnership and communication.

Membership fees should cover the cost of these two resources plus additional recurrent operating costs. In addition, member universities provide in-kind resources to support core program activities.

The *steering committee* sets up committees to oversee and develop various components of the network's program of activities. These committees mobilize network members in order to ensure broad participation and a plurality of views and perspectives. They may focus their work on specific themes and/or regions.

An annual assembly of all network members, with external members as observers, and an annual network colloquium are organized to share developments in the network and its main achievements. Revisions and updates of the network's program are accomplished through these two forums.

The Elected Steering Committee, with the support of network members, is responsible for gaining support and formal endorsement from relevant high level regional and government bodies.

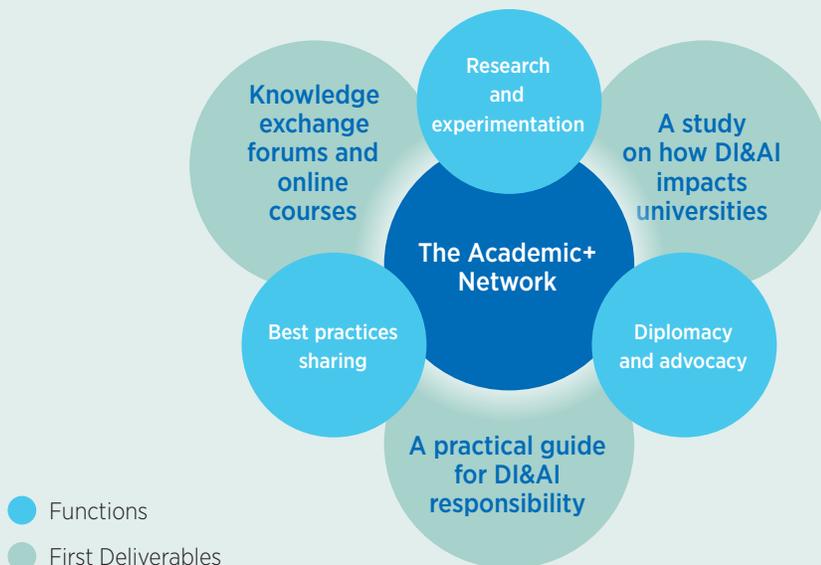
### Deliverables

The network's program of activities will address its four main goals. Clearly defined deliverables are a condition for obtaining resources from the DI&AI Academic+ Network. University members are expected to work closely with the DI&AI Academic+ Network office to identify sources of funding and help secure resources required to perform core program activities. Depending on their total value, membership fees may contribute to core program activities.

### THREE KEY PROJECTS

Universities that participated in this position paper expressed an interest in undertaking further work through the network on the paper's recommendations, starting with the following three: 1) Universities should conduct a study on how digital technologies will impact the business models, strategies and processes of universities; 2) Universities should produce a practical guide on steps universities could take to become responsible and efficient users of digital technologies and better accomplish their missions; 3) Universities should create knowledge exchange forums and online courses on the topic of DI&AI for different university players (e.g. forum for researchers, for CIOs or Chief DI&AI Officers, forum for employees).

### THE NETWORK'S FUNCTIONS & DELIVERABLES



### ***Tools to evaluate effectiveness***

An evaluation framework will be developed and implemented by the steering committee, based on the DI&AI Academic+ Network's goals and mission.

### ***Steps in developing the network***

Following the meeting to present the position paper to the U7+ universities (<https://www.u7alliance.org>), a steering committee will be formed within three months to recruit and formalize membership and prepare a proposed program of activities and business plan to launch the network within six months. A broad consultation of university members will take place before formal adoption of a plan for the first three years of activity. Resources and support will be needed for this initial stage of development, as described above.

**RECOMMENDATION 15:** The U7+ universities will formally decide at their next meeting whether to host a network of universities dedicated to responsible DI&AI. Universities that collaborated on this position paper have already expressed their interest in participating in such a network.

**RECOMMENDATION 16:** A steering committee will be formed at the next U7+ meeting with the mandate to develop a business and activity plan for the network within six months. This steering committee will make concrete proposals on financial, governance and operational matters, as well as identify program priorities for the network. Right from the start, the DI&AI Academic+ Network will benefit from administrative and strategic support to ensure its viability and success in the initial phase of development.

# CONCLUSION

This paper focuses on the specificities of universities and what these imply for the roles they play within the broader DI&AI ecosystem. It is deliberately university-centric, exploring how the digital world impacts universities from within and examining their actual and potential contributions to responsible DI&AI development.

This perspective recognizes the importance of fostering cross-fertilization between universities, researchers from the various disciplines involved in DI&AI research and other organizations that populate the DI&AI ecosystem. Multilateralism is seen as a way to advance the responsible DI&AI agenda. Within this extremely dynamic ecosystem, all players have to think explicitly about their particular contributions, constraints and opportunities, and consider the benefits of collaboration and cooperation.

In the first part, we underlined that universities need to change in order to sustain their legitimacy and relevance within this booming ecosystem. We also pointed to assets that are specific to universities, notably knowledge and reputational capital (based on scientific credibility), in order to identify roles they can play to greatest effect. In all cases, the roles assumed by universities must be defined with consideration for the contributions of other core players in the DI&AI ecosystem. Universities do not have a monopoly on assets; neither are they immune to distortions introduced by narrow individual or organizational interests. We seek in this paper to move beyond a naïve regard for the Ivory Tower to provide a grounded perspective on the legitimate roles of universities in the pursuit of responsible DI&AI.

The agenda we propose for universities is based on deliberation about how to renew their orientations and practices to add value to the DI&AI ecosystem. We are confident—and this confidence is supported by the many innovative practices highlighted throughout the paper—that universities are prepared and equipped to meet expectations as they pursue the responsible DI&AI agenda.

Specific recommendations address the teaching and research missions of universities and the way these operate in the evolving higher education market. One key element of our analysis relates to the importance of creating resilient and well-informed agents for the DI&AI ecosystem—of increasing socio-technical literacy to fertilize the ecosystem with a plurality of views and types of knowledge. Another key element is the governance of data and more broadly the governance of research within the digital world. Recommendations regarding the research and teaching missions of universities emphasize the value of transdisciplinary knowledge in spurring innovative thinking and action. By joining forces, SHS and STEM players will contribute to developing cutting-edge knowledge, competencies and practices in responsible DI&AI. A key lesson from the analysis of university business processes is that management and operations will need to be revisited if universities are to maintain capacity to fulfill these ambitions.

Universities are stand-alone institutions that operate in distinct jurisdictions, but face common challenges and opportunities. In the second part of this paper, we propose the creation of a university network to support the joint development of an agenda for responsible DI&AI. This proposition recognizes both the unique value universities bring to the DI&AI ecosystem and the need to accelerate their internal transformation and strengthen their position as credible actors within the ecosystem. In order to launch, organize and develop high-impact initiatives, the university network for responsible DI&AI will need support and resources.

We hope this paper provides fertile ground for further thinking and collaborative partnerships in this period when universities face unprecedented challenges and opportunities. The potential for win-win partnerships with others key players in the ecosystem has never been greater. The proposed network would create a solid frame on which to construct these partnerships.

We are confident—and this confidence is supported by the many innovative practices highlighted throughout the paper—that universities are prepared and equipped to meet expectations as they pursue the responsible DI&AI agenda.

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